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The Effects of an Integrative Universally Designed Motor Skill Intervention across General, Inclusion, and Self-Contained Early Childhood Center Classrooms

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by

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DEDICATION

To parents for their constant love and support over the last three years. Also, to the all the very special children and students I have worked with over the years who without my research would not be possible. Thank you, for providing me inspiration, passion, and drive to LOVE going to work every day.

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ABSTRACT

This dissertation consists of two studies that examine the effects of a school-based universally designed integrative intervention on the gross motor, fine motor, and health-related fitness skills of preschool and kindergarten with and without disabilities. Both studies focused on the effects of a school-based universally designed integrative intervention across general, inclusion and self-contained early childhood classroom settings. Study 1 examined the effects of the universally designed integrative intervention in general and inclusion classrooms in children without disabilities, and children with mild to moderate disabilities. Study 2 examined the effects of the universally designed integrative intervention in self-contained classrooms for children with moderate to severe disabilities. Study 1 used a pre/post/control experimental design, while Study 2 featured a descriptive analytic design.

The purpose of Study 1 was to examine the effects of an integrative intervention on gross motor, fine motor, and health-related fitness skills for young children with and without disabilities. I randomly selected children (general = 30; inclusion = 28) to participate in a universally-designed integrative motor intervention and children (general = 25; inclusion = 28) to participate in the control condition. I conducted two separate 2 group (intervention and control) x 2 time (pretest and posttest) repeated measures ANCOVAs controlling for sex for raw TGMD-2 scores to determine the effectiveness of the intervention on children's gross motor skills. To account for within-group differential effects of the intervention between children with and without disabilities, I conducted a

subsequent 2 group (disability and no disability) x 2 time (pretest and posttest) repeated measures ANCOVA controlling for sex. Next, to determine the effects of the intervention on children's gross motor, fine motor and health-related fitness skills I conducted two separate 2 group (intervention and control) x 2 time (pretest and posttest) repeated measures ANOVA using BOT2-BF raw point scores. Our main findings suggest young children both with and without disabilities demonstrated low competencies in motor skills regardless of disability according to multiple assessments. Findings from this study suggest young children both with and without disabilities can benefit from an integrative intervention targeting multiple facets of basic motor skills when using an appropriate curriculum framework such as universal design for learning.

The purpose of Study 2 was to examine the effects of an integrative universally designed intervention on gross motor, fine motor, and health-related fitness skills of young children with moderate to severe disabilities. Furthermore, I measured both process and product characteristics of children's gross motor, fine motor, and health-related fitness skills to critically examine the programmatic effectiveness of the intervention. I randomly selected children (*n* = 11) to participate in a universally-designed integrative motor intervention and children (*n* = 9) to participate in the control condition. I measured all children prior to the study on the Test of Gross Motor Development (TGMD-2) and the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition Brief Form (BOT2-BF). I examined group (e.g., intervention and control) mean differences through paired sampled t-tests for BOT2-BF and TGMD-2 scores. I also examined the individual change in BOT-2 and TGMD-2 scores on all children from pretest to posttest. Findings from this study suggest young children with moderate to severe disabilities can improve gross motor, fine motor, and health-related fitness skills through a universally designed motor skill curriculum, however children must be provided the appropriate support (e.g., paraprofessionals) and be placed in their "least restrictive" environment.

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Chapter 1

Introduction

This dissertation includes two studies that examined the effects of an integrative universally designed motor skill intervention on children's gross motor, fine motor, and health-related fitness skills enrolled in general, inclusion, and self-contained early childhood centers (e.g., preschool and kindergarten classrooms). The focus of the first study was to examine the impact of an integrative universally designed motor skill intervention on the gross motor, fine motor, and health-related fitness skills of young children with and without disabilities in both general and inclusion early childhood classrooms (e.g., preschool and kindergarten). The focus of the second study was to examine the effects of an integrative universally designed motor skill intervention on the gross motor, fine motor, and health-related fitness skills of young children in a self-contained classroom receiving the same integrative intervention as the general and inclusion classrooms in study one. Specifically, I examined if an ecologically valid integrative universally designed intervention led by an expert in adapted physical education and early childhood motor development was a) feasible in a typical physical education environment and b) elicits significant gains in gross motor, fine motor, and health-related fitness skills from pre to posttest under ideal circumstances. This chapter provides a general introduction and overall purpose of the dissertation, a brief description of the integrative universally designed intervention implemented in both dissertation studies, and the specific purpose and hypotheses/ research questions for each study.

Background

The development of gross motor, fine motor, and health-related fitness skills in the early years (ages 3-6 years) is critical for individuals to overcome "barriers" towards participation in physical activity (Seefeldt, 1980; Stodden, et. al, 2008; Stodden, True, Langendorfer, & Gao, 2013). Children who demonstrate lower levels of motor skills in childhood are more likely to have increased amounts of sedentary behaviors throughout adolescence and adulthood (Barnett, van Beurden, Morgan, Brooks, & Beard, 2008; Stodden et. al, 2008) which may have negative effects on health-related physical fitness and obesity (Robinson et al., 2015).

Children throughout the United States are consistently presenting progressively lower performance levels of gross motor, fine motor, and health-related fitness skills with increasing levels of sedentary behaviors (Robinson et al., 2015). Lower levels of motor skills and high levels of sedentary behavior are often exacerbated for children with disabilities (Must et. al, 2013; Ryan, Hensey, McLoughlin, Lyons, & Gormley, 2014; Schedlin, Lieberman, Houston-Wilson, & Cruz, 2012). Federal legislation and policy such as the Individuals with Disabilities Education Improvement Act (IDEA, 2004) mandate that children with disabilities be placed in their least restrictive environment (e.g., general classrooms, including physical education). An increasing number of children with disabilities are now being included in general classrooms and physical education every year (Kitmitto, 2011; MacLeskey, Lander, Williamson, & Hoppey, 2012). Some general physical education teachers feel as though they are not prepared or qualified to teach students with disabilities (Martin, Kwon, & Healy, 2016). The increasing number of students with disabilities being placed into general physical education each year affects the extent to which children with disabilities experience practice with motor skills in general physical education (Capio, Sit, Eugia, Abernathy, & Masters, 2015). Therefore, examinations of interventions to promote the developmentally appropriate practice and instruction towards developing gross motor, fine motor, and health-related fitness skills of children with and without disabilities in both general and inclusion education classrooms are needed.

In inclusive physical education settings, many children with disabilities receive less physical activity (Pan, 2008) and exhibit decreased class participation than their peers (Ng, Rintala, Villberg, & Kannas, 2014). Teachers often struggle with actively engaging students with disabilities in physical education in a safe, positive, and active learning environment (Ellis, Wright, & Cronis, 1996; Klavina & Block, 2008). Interventions to increase certain components of motor skills in children with disabilities are well documented (Bishop & Panelinan, 2018; Baranek, 2002; Sterba, Rogers, France, & Vokes, 2002). However, little research has been conducted on school-based integrative intervention programming to increase gross motor, fine motor, and health-related fitness skills for individuals with and without disabilities within designated motor skill time (e.g., recess or physical education. (Houston-Wilson, Dunn, van de Mars, McCubbin, 1997; Taunton, Brian, & True, 2017; Valentini & Rudisill, 2004a; Valentini & Rudisill, 2004b).

Moreover, many children with moderate to severe disabilities demonstrate difficulties performing gross motor, fine motor, and health-related fitness skills (Bishop & Pangelinan, 2018; Beckung & Hagburg, 2002; Cole & Meyer, 1991; Kakooza-Mwesige, Forssberg, Eliasson, & Tumwine, 2015; Kuhtz-Buschbeck et al., 2003; Pitetti, Baynard, & Agiovlasitis, 2013; Hanna et al. 2009). Many of the aforementioned motor skills are required to for children with moderate to severe disabilities to perform activities of daily living and demonstrate a basic quality of life (Browder & Spooner, 2011; Favazza & Siperstein, 2016). The difficulties demonstrated by children with moderate to severe disabilities in vital areas of basic motor development (e.g., gross motor, fine motor, and health-related fitness skills) may be attributed to the confounding fact that many children do not receive the mandated related services in regard to motor development (e.g. adapted physical education) (GAO, 2010). In fact, due to a national shortage of adapted physical education teachers, many children are not being offered appropriate services (Zhang, 2011). Moreover, very few preschool or early childhood centers have a certified physical education teacher, much less an adapted physical education teacher (McWilliams, 2009; Brian, Pennell, Schenkelberg, & Sacko, in press; Zhang, 2011). These deleterious statistics are concerning given federal mandates are in place to help develop and improve vital motor skills through appropriately provided services (e.g., adapted physical education). Lack of access to appropriate services may exacerbate motor difficulties for children with moderate to severe disabilities (WHO, 2011). Therefore, early identification and intervention is crucial for proper development of children with moderate to severe disabilities (WHO, 2011).

Integrative Motor Skill Intervention

Integrative Successful Kinesthetic Instruction for Preschoolers (ISKIP)

I designed the ISKIP intervention by modifying and expanding the existing SKIP program developed by Goodway and colleagues (Altunsöz, & Goodway, 2016; Brian et al. 2017a; Brian et al. 2017b; Goodway & Branta, 2003). The original SKIP curriculum is rooted in evidence-based practices across fields such as motor development (Gallahue, Ozmun & Goodway, 2012; Haywood & Getchell, 2014); and physical education (Rink, 2014; Siedentop & Tannehill, 2000). The original SKIP curriculum includes three foundational principles: (1) teaching fundamental motor skills to improve children's overall motor competence (2) reinforcement through providing structured opportunities to practice fundamental motor skills (3) providing developmental appropriate opportunities for a wide variety of learners to create positive movement experiences for children during the early years (Altunsöz, & Goodway, 2016; Brian et al., 2017a; Brian et al., 2017b).

The universal design for learning principles include (a) multiple means of representation (b) multiple means of action and expression and (c) multiple means of engagement (CAST, 2011). I first accounted for the needs of all children within each class based on the present level of performance, diagnosed disability, sex, learning style (i.e., auditory, kinesthetic, visual). I then designed each lesson with activities that included multiple within-skill variations. I created each lesson to be child-centered, rather than teacher-centered meaning many options within stations were available to all children but each child chose which skill variation to participate. Within each skill station I then provided: (a) multiple means of instruction (e.g. visual task cards, picture schedules, short video clips, physical demonstrations, and verbal cues) (b) multiple within task variations at each skill station in which children could pick from a variety of equipment, distances, size targets, or between single or partnered activities (c) providing a least-to-most prompting hierarchy within-task at each skill station featuring visual, verbal, partial physical, and full physical prompts as needed to serve as both an informal assessment to but also ensure the success of all children in skill performance at each station. Every component of the prompting hierarchy was offered at all times; children could choose which level of prompting they needed. (d) determining within-station task completion by a set-time (2-minutes) rather than set-number (e.g., ten trials).

To develop ISKIP, I expanded the scope of SKIP-universal design for learning (SKIP-UDL) to include gross and fine motor skills along with health-related fitness as outcome measures. Fine motor skills included manual dexterity, fine motor precision, fine motor integration, and health-related fitness strength and agility, balance, and stability. Components of fine motor skills and health-related fitness skills were all featured in ISKIP and were additive to the traditional locomotor and object control skill focus of SKIP. However, in designing the lessons for ISKIP, we also employed the same principles and curriculum design from SKIP-UDL.

Study purposes and hypotheses/research questions

Study 1. The purpose of this study was to examine the effects of an integrative intervention on gross motor, fine motor, and health-related fitness skills for young children with and without disabilities. Furthermore, measuring the effectiveness of an integrative intervention on gross motor, fine motor, and health-related fitness skills was utilized through multiple assessments to measure the multi-faceted programmatic effectiveness of an integrative intervention appropriately. I hypothesized that the integrative intervention would increase gross motor, fine motor, and health-related fitness skills of both children with and without disabilities as measured by two separate motor assessments, the Test of Gross Motor Development-Second Edition (TGMD-2) (Ulrich, 2000) and the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition Brief Form

(BOT2-BF) (Bruininks, & Bruininks, 2010) as compared to children in the control condition. Furthermore, I hypothesized that within the integrative intervention condition, there will be no significant group differences in gross motor, fine motor, or health-related fitness skills for a) children enrolled in either general or inclusion intervention classrooms b) children with either a documented disability or no documented disability.

Study 2. The purpose of this study was to examine the effectiveness of a universally designed integrative motor skill intervention on individual gross motor, fine motor, and health-related fitness skills of children with moderate to severe disabilities enrolled in a self-contained early childhood classroom. I hypothesized the integrative intervention would increase gross motor, fine motor, and health-related fitness skills of children with moderate and severe disabilities as measured by two separate motor assessments, the TGMD-2 and the BOT2-BF as compared to children in the control condition. I also hypothesized that children in the integrative intervention condition would demonstrate significant individual gains in gross motor, fine motor, and health-related fitness skills at the posttest as compared to their pretest scores.

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter is to provide a comprehensive literature review informing both studies. The chapter is organized into the following sections: (a) universal design for learning (b) theoretical frameworks (d) motor skill interventions (e) motor assessments and (e) an overall summary of the literature.

Universal Design for Learning

The concept of universal design emerged in the early 1990's from the field of architecture after federal legislation passed the Americans with Disabilities Act or ADA (ADA, 1990). ADA requires all buildings be handicap accessible to meet the needs of individuals with physical disabilities (ADA, 1990). Architects were then required to consider features such as wheelchair ramps, wider door frames, elevators, railings, etc. to accommodate individuals' with disabilities (Rose, 2000). While some of these modifications could be made to already existing buildings, in future building designs architects began to consider these modifications within the design phase. Therefore, emerged the architectural principle of universal design (Rose, 2000).

The principle of universal design emerged into the field of education in the early 1990's shortly after the field of architecture (Rose, 2000). The federal law of IDEA in check date here for IDEA reauthorization, also required children with disabilities to have larger access to the general education programs. IDEA created momentum in education to provide as much access for children with disabilities in school settings. In 2004, federal legislation reauthorized IDEA to now require all children with disabilities in schools be placed into their least restrictive environment. Placing children in the least restrictive environment grants children access to the general education curriculum and higher expectations of learning (Jimenez, Graf, & Rose, 2007). Children can be placed in the least restrictive environment on a continuum ranging from least to most in the amount of access to general education curriculum, resources, support services, and educational programming instead of placing them in separate environments (Friend, 2005; Meyer & Rose, 2000).

Using principles from universal design to accommodate children in the least restrictive environment, educators conceptualized the term universal design for learning. While universal design for learning employs the same principles of universal design, the outcome of universal design for learning is different (Rose, 2000). Universal design is rooted in providing the maximal access to individuals with disabilities at all times, while universal design for learning provides individuals with disabilities appropriate access, goals, and supports to maximize the individuals learning to their fullest potential (Rose, 2000). Universal design for learning contrasts a "one size fits all" approach to learning by providing an approach to inclusion in general education through various and alternative mediums (e.g., assessments, strategies, goals) to meet the needs of all learners' styles, needs, strength, limitations, and preferences (Rose, 2000). This approach is based upon the foundational principle of universal design, in that universal design for learning in education meets the needs of the learner in the design phase of curriculum, planning, and implementation (Meyer, & O'Neill, 2000). Utilizing universal design for learning in education has provided a method of full inclusion in the least restrictive environment for children with disabilities so that all children can learn and find success in education (Rose, 2000).

Specifically, universal design for learning principles provide a curricular framework from which to design inclusive school-based motor skill interventions, that deliver content through multiple avenues to meet the needs, preferences, and learning styles of a wide range of students without specifically modifying the curriculum and teaching methods to meet each individual need (Meyer & O'Neill, 2000). Creating an intervention using universal design for learning curricular framework can support increased intrinsic motivation to engage all types of learners (Evans & Boucher, 2015). The universal design for learning framework guides teachers towards designing lessons that fully include children into the original activity and meet the individual needs of all students with disabilities. The universal design for learning framework often increases children's motivation to learn new skills and promotes participation with peers in physical education (Lieberman, & Houston-Wilson, 2018).

Theoretical Framework

Dynamic Systems Theory

The development of a universal design for learning based integrative motor intervention is positioned under the theoretical framework of Dynamical Systems Theory (DST) (Kelso, Holt, Kugler, & Turvey, 1980; Kugler, Kelso, & Turvey, 1980; Kugler, Kelso, & Turvey, 1982; Thelen, 1985). DST suggests that development is age related but not age dependent (Kelso, Holt, Kugler, & Turvey, 1980; Kugler, Kelso, & Turvey, 1980; Kugler, Kelso, & Turvey, 1982; Thelen, 1985). Rather, DST suggests that development occurs through the interaction of a single or multiple motor subsystems causing perturbation within the entire motor system. The product of the perturbation of the current motor system in turn produces a new motor pattern or movement (Kelso, Holt, Kelso & Tuller, 1984, Kugler, & Turvey, 1980; Kugler, Kelso, & Turvey, 1980; Kugler, Kelso, & Turvey, 1982; Thelen, 1985). DST is rooted in Chaos Theory (Thelen, 1991) which is derived from the mathematical field. From a developmental perspective, chaos theory suggests that development of motor processes throughout the lifespan is organizing "chaos" (e.g., multiple interactions: biological subsystems, variables in the environment, processes involved in a motor task) to produce and develop specific motor processes (Newell, 1986; Thelen & Ulrich, 1991). The organization of the multiple interactions (individual, environment, and task) in relation to the development of motor processes rely on four constant factors: degrees of freedom, order parameters, control parameters and attractor states (Gallahue et al., 2012, Ozmun, & Goodway, 2012). A further explanation of these four constant factors are listed below:

Degrees of freedom refers to the freezing and releasing of certain muscles from central nervous that determine potential movement patterns within the motor system (Bernstein, 1967). Degrees of freedom determine a) the number of components in the motor system and b) the number of interaction within in component within the motor system to develop a motor pattern (Turvey, Fitch, & Tuller, 1982). The principles of degrees of freedom purports that the central nervous system select which muscles within the motor system to freeze or release when performing a movement pattern or motor skill (Clark & Whitall, 1989). This foundational question is known as the degrees of freedom problem in motor development (Bernstein, 1967).

Order parameters refer to the entire behavior of the motor system. Order parameters are often specific components that initiate the various coordination patterns that define the overall movement pattern within a skill (Kelso, 2000). Order parameters of movement are often referred to as movement frequency or relative phase of movement (Kelso, 2000). Control parameters movement are components within the motor system that affect the stability or characteristics of each movement pattern (Gallahue, et al., 2012).

Control parameters elicit a change in movement pattern based upon the interaction of variables within the individual motor system or the environment surrounding the individual (Gallahue et al. 2012). Control parameters initiate self-organization of the degrees of freedom within a movement to produce control and coordination of a movement pattern (Gallahue et al., 2012). Control parameters are categorized as positive or negative factors that influence movement patterns. Affordances are considered positive control parameters, while rate limiters are considered negative control parameters (Gallahue et al., 2012)

Attractor States are referred to the stability of the motor system when producing a self-organizing movement behavior (Lewis, 2005). Attractors states are repeatable patterns based upon fixed-action movements. These fixed-action movement patterns are often known as developmental sequences or stages of movement skills (Langendorfer & Roberton, 2002). Affordances and rate limiters within the control parameters elicit changes in attractor states of movement skills from not proficient or rudimentary motor patterns to proficient or complex motor patterns (Gallahue, et al., 2012). A period of highly variable performance of a movement pattern until the next attractor state is achieved with stability often indicate changes in attractors states (Gallahue, et al., 2012). Motor skill acquisition is achieved when stability occurs in the current developmental sequence, stage or attractor state in the particular movement skill (Southard, 1998, 2002). The evolution between stability and variability in attractor states demonstrates the non-linear trajectory of development of movement patterns. Development occurs in a non-linear trajectory defined by stages or sequences of proficient movement patterns (Langendorfer & Roberton, 2002).

Newell's Constraints

The two studies are grounded in a practical translation of DST via Newell's Model of Constraints (Newell, 1986). Newell's model suggests that development occurs from the independent association of three constraints: the individual person, the task that the individual is performing, and the environment that surrounds the individual (Newell, 1986). Each one of the three constraints either affords or restricts certain movement patterns and behaviors (Newell, 1986).

Using both DST and Newell's constraints as a framework, the universal design for learning motor intervention would be grounded on the basis of (a) manipulating both functional (e.g. providing lower-impact activities for children who are obese or have cerebral palsy) and structural (e.g. providing tactile, verbal and visual instructions of tasks for children with Autism Spectrum Disorders or have a hearing or VI) constraints of the individual, and (b) controlling environmental (e.g., manipulating group sizes, noise levels, lighting, etc.) constraints c) addressing task (e.g., modifying equipment, distances of tasks) (Hamilton, Pankey, & Kinnuen, 2002; Newell, 1986; Pope, Breslin, Getchell, & Liu, 2012) constraints. Providing opportunities to manipulate the individual, environment and the task for each class while maintaining a unified structure in physical education could have a significant impact on the individual's motor skills.

Vygotsky's Zone of Proximal Development

The ISKIP intervention utilized the specifically, targeting Vygotsky's three prerequisites levels of learning: "(a) acknowledgment of skills or information that need to be learned, (b) identification of appropriate strategies to learn the skills/information and (c) engagement" (Vygotsky, 1978). Vygotsky's Zone of Proximal Development suggests that in creating the ISKIP intervention, I believe children's abilities to learn and perform various motor skills (e.g., gross motor, fine motor, and health-related fitness skills can be influenced by interactions by the interaction of the child peers and teachers (Vygotsky, 1978). More specifically, within the ISKIP intervention, I used a "scaffolding model" rooted in the Zone of Proximal Development in which children complete various motor tasks as children chose with support from teachers, peers, or type of instruction (Vygotsky, 1978). Each station within the ISKIP intervention featured a scaffolding hierarchy presented to all children. After repetitive practice children, the ultimate goal was children would begin to decrease in levels of scaffolding and begin to develop independent skill competency. Practical examples of "scaffolds" within ISKIP include: child hold hand with a partner to balance on one foot, placing a spot on the floor reminding a child to step with opposition, performing a tracing activity using hand-over-hand.

Motor Interventions

Motor skill interventions rooted in DST and Newell's Constraints are highly effective demonstrating powerful effect sizes [(η^2 = .61 (Brian et al. 2017a) to η^2 = .73

(Robinson & Goodway, 2009)]. Major findings from these interventions include: 1) children from low socioeconomic status are at risk for developmental delays (Brian et. al, 2017a; Robinson, 2011), 2) girls are delayed in object control skills more than boys of the same age (Robinson, & Goodway, 2009; Goodway, Robinson, & Crowe, 2010), and 3) motor skill interventions can significantly remediate gross motor skill delays in as little as 6 weeks (Brian et al., 2017a). However, in examining multiple reviews and meta-analysis (38 motor skill intervention studies) (Lai et. al, 2014; Logan, Robinson, Wilson, & Lucas, 2011; Morgan et al., 2013; Riethmueller, Jones, & Okley, 2009), two intervention populations were exclusively children with disabilities (Rimmer & Kelly, 1989; Rintala, Pienimäki, Ahonen, Cantell, & Kooistra, 1998) and three of the studies included both children with and without disabilities (Taunton et al., 2017; Valentini & Rudisill, 2004a; Valentini & Rudisill, 2004b).

In the three studies that included children with and without disabilities, significant results with powerful effect sizes ($\eta^2 = .32$; Valentini & Rudisill, 2004a; Valentini & Rudisill, 2004b to $\eta^2 = .67$; Taunton et al., 2017) were reported. However, these studies only examined gross motor skills, excluding health-related fitness and physical activity directly and do not provide sufficient evidence of the effect of the intervention on children with and without a disability.

Unfortunately, school-based health-related fitness interventions targeting physical activity and health-related physical fitness are mainly focused on typically developing children (Kriemler et al., 2011; Lai et al., 2014). In a review of 19 studies, nine studies effectively impacted physical activity, and in four of those studies, the intervention directly affected physical activity levels (Kriemeler, 2011; Lai et al., 2014). Three of four studies that included a 6 to 12-week follow-up of physical activity showed a significant retention effect (Kriemeler, 2011). Authors reviewed 14 intervention studies with outcomes that included physical activity and/or fitness and motor skill and found that the effectiveness of the interventions varied. Eight studies reported to significantly increasing fitness, while six studies significantly increased motor skills (Kriemeler, 2011; Lai et al., 2014). Studies that examined fitness variables only yielded significant positive effects when intervention length was equal to or greater than 12 weeks (Kriemler, 2011). As stated above, none of the school-based interventions included children with disabilities (Kriemeler, 2011; Lai et al., 2014). In the previously mentioned studies (Kriemeler, 2011; Lai et al., 2014), the extent of effectiveness of these interventions is undetermined, as effect sizes were not reported. An examination of school-based interventions encompassing gross motor, fine motor, and health-related fitness skills that includes both children with and without disabilities is needed to determine intervention effectiveness within the context of inclusive physical education settings.

Many school-based interventions have aimed to increase motor competence, physical activity, and health-related fitness (Lai et al., 2014). However, few interventions have targeted fine motor skill development (Ibana & Caçola, 2016). Children with disabilities often present significant impairments with fine motor skills (Arnould, Bleyenheuft, & Thonnard, 2015; Provost, Lopez, & Heimerl, 2007; Summers, Larkin, & Dewey, 2008). Certain components of gross motor movements (e.g., accuracy, control, coordination, dexterity, visual motor skills, and eye-hand coordination) are influenced by the development of fine motor skills (e.g., connecting dots, drawing circles) (Henderson & Pehoski, 2006). The development of fine motor skills in all individuals can have implications on more complex motor skills such as ball skills (e.g., catching or striking), manual dexterity, (e.g., transferring items across the midline) and bimanual coordination (e.g., jumping jacks). Children's competencies in ball skills and manual dexterity have also been shown to significantly associate with health-related fitness performance (Haga, 2008).

While fine motor interventions are prevalent for children with and without disabilities (Baranek, 2002; Case-Smith, 2000; Dawson, & Watling, 2000; Parette, & Hourcade, 1984), the context of these interventions are often therapy, home-based or academic, and not in the context of fitness, physical education and/or movement settings. School-based interventions intended upon improving gross motor, fine motor, and health-related fitness skills for all students need to consider universal design for learning as a part of their curriculum as well as multiple motor assessments to examine multi-faceted programmatic effectiveness.

Motor Assessments

Test of Gross Motor Development-Second Edition (TGMD-2)

To measure children's gross motor skills, I used the TGMD-2 (Ulrich, 2000). The TGMD-2 is a valid and reliable assessment of gross motor development for children ages 3 years to 10 years 11 months. The TGMD-2 measures children's gross motor skill development through both process and product measures. The assessment battery is comprised of 12 skills divided into two subscales: locomotor skills and object control skills. Locomotor skills are movements that allow a child to move from one point to another (Haywood & Getchell, 2014). Locomotor skills assessed in the TGMD-2 include: running, galloping, hopping, jumping, sliding and leaping. Object control skills are any movements that require the body to manipulate an object to perform a designated motor task (Haywood & Getchell, 2014). Object control skills assessed in the TGMD-2 include striking, dribbling, catching, kicking, throwing and rolling. Each child receives a demonstration of each of the 12 skills on the TGMD-2, after the demonstration the child gets a non-scored practice trial. After the non-scored practice trial, if the child still performs the skill incorrectly, they receive another demonstration of the skill. The child performs two additional scored trials of each skill.

The TGMD-2 is both a normative and criterion-referenced assessment. Each skill within the TGMD-2 has between three and five criteria for each skill trial. A rater records a "1" if the participant performs the criterion of the skill. A rater records a "0" if the participant does not perform the criterion of the skill. A raw skill score between 0 and 10, depending on the individual skill, is determined by summing the criterion total for each trial. Each raw skill score is summed with the other five skills within the subscale to determine a raw subscale score between 0 and 48. Each locomotor and object control subscale score can be summed to determine the total gross motor raw score. One converts each raw subscale score into a percentile rank, standard score, gross motor quotient, and age equivalent using normative referencing accounting for each child's age and gender.

Bruininks-Oseretsky Test of Motor Proficiency-Second Edition Brief Form (BOT2-BF)

The BOT-2 Brief Form (BOT2-BF) is an identification assessment of gross and fine delays using normative reference screening for individual's ages 4 – 21 years. The BOT2-BF is a valid and reliable assessment to measure individuals with and without most disabilities level of motor proficiency (Bruininks & Bruininks, 2010). The BOT-BF measures motor proficiency via 12 items representing eight subscales: fine motor precision (e.g., filling a star; drawing a line through a path), fine motor integration (copying an overlapping circle; copying a diamond), manual dexterity (e.g., stringing blocks), bilateral coordination (touching nose with index finger-eyes closed), balance (e.g., walking forward heel-to-toe on a line), speed and agility (e.g., one-legged side hop), upper-limb coordination (e.g., catching a tossed ball-one hand; dribbling a ball-alternating hands) , strength (knee or full push up) (Bruininks & Bruininks, 2010). For each of the 12 items, the child is read the directions using an optional teaching text in the administration manual and shown a demonstration by an administrator of the assessment, and also provided a picture of a child completing each skill as provided in the BOT2-BF administration manual. For the four-fine motor precision and fine motor integration skills, each child completes the fine motor packet, with one scored trial for each of the four skills. Each child completes two scored trials of manual dexterity, bilateral coordination, balance, and speed and agility. In the skills of upper limb coordination, children complete one scored trial of catching a tossed ball. Within the trial children's score is comprised of how many times they catch the ball out of five tossed balls. For the dribbling a ball skill, children complete two scored trials. Within each trial, children attempt to dribble the ball while alternating hands for ten consecutive dribbles. Children complete one scored trial of the push-up skill within the strength subscale. During the trial, children attempt to complete as many knee push-ups as possible for 30 seconds.

One converts each of the raw scores of each of the 12 BOT2-BF skills into a skill point score ranging from 0-10 depending on the specific skill. Each of the 12 BOT2-BF skill point scores is summed to determine a total BOT2-BF point score ranging from a minimum score of 0 to a maximum score of 72. Next, one converts each of the eight BOT2-BF subscales point scores into six composite scores: fine manual control, manual coordination, body coordination, strength and agility, total motor composite, gross motor composite, fine motor composite using normative referencing based upon age and sex. A conversion of the six composite scores reports a child's total score of motor proficiency (Bruininks & Bruininks, 2010).

Summary

Unfortunately, there is a limited evidence base on the effectiveness of integrative motor skills interventions. However, interventions to improve children's overall motor competence should consider gross motor, fine motor, and health-related fitness skills within a single intervention. While interventions that specifically target gross motor skills have shown to be effective (Logan et. al, 2011; Riethmueller, 2009) interventions with outcomes of fine motor, and health-related fitness skills have inconsistent findings (Baranek, 2002; Case-Smith, 2000; Dawson, & Watling, 2000; Kriemler, 2011; Lai, 2014; Parette, & Hourcade, 1984). Thus, more research is needed to determine effective instructional programming to not only improve gross motor but the fine motor and health-related fitness skills within school-based interventions. Before integrative interventions can occur, the proper assessment tools are needed to examine the effects of gross motor, fine motor, and health-related fitness skills targeted within the intervention. Currently, motor assessments exist to assess the motor skills of individuals with and without disabilities (e.g., fine motor skills, manual dexterity, and bilateral coordination, gross motor skills) (Henderson et al., 2007; Folio & Fewell, 2000). However, only one assessment, the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition Brief

Form (BOT2-BF) encompasses multiple components of gross motor, fine motor, and health-related fitness skills (e.g. gross motor skills, fine motor skills, manual dexterity, bilateral coordination and aspects of health-related fitness) for individuals with and without general disabilities (Bruininks, & Bruininks, 2010). Moreover, pairing the BOT2-BF with an assessment that provides a more in-depth analysis of children's gross motor skills (e.g. object control and locomotor skills) serves two distinct purposes for the two studies a) an in-depth analysis of children's gross motor, fine motor, and health-related fitness skills and b) to measure the multi-faceted programmatic effectiveness of an integrative intervention to improve gross motor, fine motor, and health-related fitness skills appropriately. The two studies address the gap in multifaceted, integrative motor skill intervention literature by providing integrative interventions with outcomes of increasing gross motor, fine motor, and health-related fitness skills of individuals with and without disabilities. The current studies attempt to further examine the effectiveness of a school-based interventions with aims of gross motor, fine motor, and health-related fitness skills in young children with and without disabilities, ranging from mild to severe.

The two dissertation studies fill the gaps in motor development, physical education, and adapted physical education literature by (a) examining children in preschool and kindergarten's gross motor, fine motor, and health-related fitness skills through both product and process oriented motor assessments measures (b) examining the effects an inclusive universally designed integrative motor skill intervention for children without disabilities, and with mild, moderate, and severe disabilities (c) examining the effects of a multi-faceted integrative motor skill intervention through both product and process motor assessment measures.

CHAPTER 3: STUDY 1

THE EFFECTS OF AN INTEGRATIVE, UNIVERSALLY-DESIGNED MOTOR SKILL INTERVENTION ON YOUNG CHILDREN WITH AND WITHOUT DISABILITIES[1]

[1]Taunton, S., Brian, A., Pennell, A., Lieberman, L., True, L., Webster, C.A., & Stodden, D.F., (in review). The effects of an integrative, universally-designed motor skill intervention on young children with and without disabilities. *Research in Developmental Disabilities.*

Abstract

Many interventions do not offer an integrative approach to developing multiple aspects of motor skills within school-based settings for both children with and without disabilities. Moreover, many singular motor assessments do not provide a holistic representation of children's motor skills. Therefore, the purpose of this study was to examine the effects of an integrative intervention on gross motor, fine motor, and health-related fitness skills for young children with and without disabilities. We randomly selected children (general = 30; inclusion = 28) to participate in a universally-designed integrative motor intervention and children (general = 25; inclusion = 28) to participate in the control condition. We conducted two separate 2 group (ISKIP and control) x 2 time (pretest and posttest) repeated measures ANCOVAs controlling for sex for raw TGMD-2 scores to determine the effectiveness of the intervention on children's gross motor skills. We conducted a subsequent 2 group (disability and no disability) x 2 time (pretest and posttest) repeated measures ANCOVA controlling for sex. We conducted two separate 2 group (intervention and control) x 2 time (pretest and posttest) repeated measures ANOVA using BOT2-BF raw point scores to determine the effects of the intervention on children's gross motor, fine motor, and health-related fitness skills. Our main findings suggest young children both with and without disabilities demonstrated low competencies in motor skills regardless of disability according to multiple assessments. Findings from this study suggest young children both with and without disabilities can benefit from an inclusive integrative intervention targeting multiple facets of basic motor skills when using an appropriate curriculum framework such as universal design for learning.

Keywords: adapted physical education, motor skills, inclusion

Highlights

- Young children both with and without disabilities are demonstrating low competencies in gross motor, fine motor, and health-related fitness skills.
- Providing structured opportunities (e.g., integrative interventions) within early childhood centers targeting the development of gross motor, fine motor, and health-related skills can effectively improve children's competencies in as little as 6-weeks.
- Universal design for learning is an effective curricular framework to improve gross motor, fine motor, and health-related fitness skills for children in general or inclusion early childhood classroom.
- The integrative intervention, ISKIP, is deemed effective for improving motor competencies in both gross motor, fine motor, and health-related fitness skills using multiple motor assessments.

Gross motor skills are defined as skills that require an individual to coordinate large parts of the body to perform specific motor tasks needed for daily function (e.g., walking, running, throwing) (Gallahue et al., 2012). Fine motor skills are defined as skills that require an individual to complete small motor tasks with their fingers, hands, wrist, feet or toes needed for daily function (e.g., buttoning a shirt, tracing on a line, touching your finger to an object) (Gallahue et al., 2012). Health-related fitness is defined as components of physical fitness that targets cardiovascular function, strength and flexibility associated with good health or disease prevention (McArdle, Katch, & Katch, 2015; Powers, 2014). While the relationship of gross motor skills and health-related fitness in child development, particularly health and physical activity is well documented, fine motor skills are often seen as a separate facet of motor development and not often paired with gross motor or health-related fitness outcomes. The development of fine motor skills (e.g., connecting dots, drawing circles) influence components of gross motor movements (e.g., accuracy, control, coordination, dexterity, visual motor skills, and eye-hand coordination) (Henderson & Pehoski, 2006).

The development of gross and fine motor skills, in addition to health-related fitness skills such as balance, stability, and strength is vital for children's healthy development during the early years of life (Brian, Getchell, De Meester, True, & Stodden, in review; Haga, 2008; Lubans, Morgan, Cliff, & Barnett, 2010). Proficiency in the motor domains (e.g., gross motor, fine motor, and health-related fitness skills) has implications for children throughout adolescence and into adulthood (Brian et al., in review; Haga, 2008; Robinson et al., 2015; Stodden et al., 2008; Stodden et al., 2014). Moreover, fine motor skills can have implications on more complex motor skills such as ball skills (e.g., catching or striking), manual dexterity, (e.g., transferring items across the midline) and bimanual coordination (e.g., jumping jacks) (Haga, 2008). Children's competencies in ball skills and manual dexterity have also been shown to significantly correlate with health-related fitness performance (Haga, 2008; Haga, 2009; Stodden et al., 2014).

Children who demonstrate lower levels of both gross and fine motor skills during early childhood are more likely to have decreased levels of health-related fitness and physical activity (Bürgi et al., 2011; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Young children specifically children with disabilities, often present significant impairments with fine motor skills. Most consequently, young children with lower levels of gross motor, fine motor, and health-related fitness skills are at a higher risk for the development of hypokinetic diseases (e.g., type II diabetes, obesity) and decreased levels of participation in physical activity later in adolescents (Robinson et al., 2015; Stodden et al., 2008).

Young children throughout the United States are consistently presenting progressively lower performance levels of gross motor, fine motor, and health-related fitness skills (Arnould, Bleyenheuft, & Thonnard, 2015; Provost, Lopez, & Heimerl, 2007; Robinson et al., 2015; Summers, Larkin, & Dewey, 2008). More recently, the consequential effects of delays in gross motor, fine motor, and health-related fitness skills on children's overall health (e.g., obesity and type II diabetes levels) and development (e.g., academic achievement, executive function, self-regulation, social-cognitive skills) have been exceedingly present (D'Hondt et al., 2013; Hansen, Hermann, Lambourne, Lee & Donnelly, 2014; Liang, Matheson, Kaye, & Boutelle, 2015). Moreover, delays in gross motor, fine motor, and health-related fitness skills have been shown in most children regardless of disability (Schott, Alof, Hultsch, & Meermann, 2007; Wrontniak et al., 2016). However, motor delays and poor health-related fitness delays is often exacerbated for children with disabilities (Bishop & Pangilinan, 2018;Livesey, Keen, Rouse, & White, 2006; Must et al., 2013; Provost, Lopez, & Hemerl, 2007; Ryan, Hensey, McLoughlin, Lyons, & Gormley, 2014; Schedlin, Lieberman, Houston-Wilson, & Cruz, 2012; Taunton, et al., 2017; Valentini & Rudisill 2004b; Williams, Whiten, & Singh, 2004; Wrotniak et al., 2006). Therefore, identifying programs to increase gross motor, fine motor, and health-related fitness skills is needed to remediate delays of in these vital areas of children's health and development. One potential solution is delivering a motor skill and health-related fitness intervention to young children (ages 3 - 6) during existing recess time in early childhood centers.

Motor skill interventions targeting the development of gross motor skills (e.g., locomotor and object control skills) have been deemed highly effective with large effect sizes [$\eta^2 = .61$ (Brian et al. 2017a; 2017b) to $\eta^2 = .73$ (Robinson & Goodway, 2009)]. Many intervention studies have targeted gross motor skills of young children either specifically without disabilities or only on children with disabilities (Bishop & Pangilinan, 2018; Ketcheson, Hauck, & Ulrich, 2017; Logan, Robinson, Wilson, & Lucas, 2011; Veldman, Jones, & Okely, 2016) . However, few studies have examined the effects of gross motor skill interventions in children with and without disabilities in school-based settings (Taunton et al., 2017; Valentini & Rudisill, 2004a; Valentini & Rudisill, 2004b).These inclusive school-based intervention studies report significant results with powerful effect sizes ($\eta^2 = .32 - .67$) (Taunton et al., 2017; Valentini & Rudisill, 2004a; Valentini & Rudisill, 2004b) in both children with and without disabilities. However, these studies only examined gross motor skills, and in most cases specifically fundamental motor skills.

School-based interventions targeting other areas of children's motor development (e.g., fine motor and health-related fitness skills) for both children with and without disabilities in inclusive settings is less prevalent (Feder & Majnemer, 2007; Lai et al., 2014; Pless & Carlsson, 2000). Fine motor interventions are prevalent and effective for both children with and without disabilities in therapy, home-based or academic settings (Baranek, 2002; Case-Smith, 2000; Dawson & Watling, 2000; Parette, & Hourcade, 1984). However, few to no studies are in the context of fitness, physical education, and movement settings. Many interventions studies have targeted both gross motor skills and health-related fitness in school-based settings (Kriemeler, 2011; Lai et al., 2014). However, the effectiveness of these interventions is often inconsistent. In fact, most interventions only yielded significance in after twelve or more weeks and, the extent of the effectiveness of these interventions (e.g., effect sizes) are unreported or determined (Lai et al., 2014; Pan, Chang, Tsai, Chu, Ceng, & Sung, 2017; Sallis et al., 1997). To our knowledge, few intervention studies have targeted both gross motor skills and components of health-related fitness in children ages 3 to 6 years old and even fewer studies have examined the effects of intervention on health-related fitness and fine motor skills (Bürgi et al., 2011). Therefore, developing an integrative school-based intervention for both children with and without disabilities is needed in addition to identifying an effective curricular framework to deliver the integrative intervention to children both with and without disabilities in inclusive movement settings (e.g., recess, physical education).

One particular approach is to develop an integrative school-based intervention, targeting multiple components (e.g., gross and fine motor skills; health-related fitness skills) of motor development that can be additive during existing gross motor time (e.g. recess or free play) (Domitrovich, Bradshaw, Greenberg, & Ialongo, 2010; Gooze, Hughes, Finkelstein, & Whitaker, 2010). Moreover, given the number of children both with and without disabilities placed in general and inclusive classrooms in early childhood centers, the integrative intervention should use appropriate pedagogical frameworks to include all children. Within school-based settings, federal legislation and policy, such as the Individuals with Disabilities Education Improvement Act (IDEA,

2004) mandate that school's place children with disabilities in the least restrictive learning environment (e.g., general classrooms including physical education and recess) within their school. As a result, every year, placing children with disabilities in general and inclusion classrooms with typically developing peers is becoming more prevalent (Kitmitto, 2011; MacLeskey, Lander, Williamson, & Hoppey, 2012). Therefore, implementing an integrative motor skill intervention using an appropriate curricular framework in school-based settings such as an early childhood center can provide opportunities to intervene with children both with and without disabilities in inclusive and supportive environments. Furthermore, identifying an effective curricular framework to deliver the integrative intervention in inclusive school-based settings is needed.

Universal design for learning has a strong history in areas such as special education and is emergent in fields such as adapted physical education (Lieberman & Houston –Wilson, 2018; Rose, 2000). The foundation of universal design for learning is rooted in a conceptual framework in which teacher's account for all children' abilities, preferences, learning styles, languages, and individual needs for in the design phase of curriculum and lesson planning. The universal design for learning framework implemented in motor skill interventions is in contrast to other pedagogical strategies implemented in previous motor skill interventions. Teachers provide multiple means of representation (e.g., visual task cards, physical demonstration), action and expression (e.g., communication cards, inter-task choices), and engagement (e.g., equipment selection, selection of task difficulty, individual or partner choice) to all children within each lesson throughout the intervention. The reconceptualization of the universal design for learning framework implemented in motor skill intervention is in contrast too traditional “one size fits all” curriculum featured in many physical education and motor skill interventions (Hitchcock, Meyer, Rose, & Jackson, 2002). Many inclusion strategies include making separate modifications for specific disabilities, learning styles, or preferences, separate from the main lesson designed for the “average” learner within the class environment. Moreover, in many curricula frameworks, modifications are made to accommodate the needs of "other" learners after the design of the lesson plan. Universal design for learning accounts for the diversity of all learners in the beginning, by creating genuinely inclusive physical education experiences through unified activities and games to maximize learning (Lieberman, Clarq, & Lytle, 2008).

One gross motor intervention that has shown to increase young children’s gross motor skills in school-based settings is the Successful Kinesthetic Instruction for Preschoolers (SKIP) program (Altunsöz, & Goodway, 2016; Brian et al., 2017a, Brian et al., 2017b; Goodway & Branta, 2003). In 2017, Taunton and colleagues applied the principles universal design for learning with the existing SKIP intervention to create a universally designed motor skill intervention (SKIP-UDL) for both children with and without mild disabilities. The SKIP-UDL intervention proved highly effective ($\eta^2 = .67$) in increasing gross motor skills of both children with and without disabilities in an inclusive recess setting (Taunton et al., 2017). Although the SKIP and SKIP-UDL programs are deemed effective, they are only designed to target gross motor skill development. Currently, there is a significant knowledge gap on the additive effects of an integrative intervention addressing multiple aspects of young children’s health and well-being during early childhood. Therefore, the purpose of this study was to examine the effects of an integrative intervention on gross motor, fine motor, and health-related fitness for young children with and without disabilities. Furthermore, measuring the effectiveness of an integrative intervention on gross motor, fine motor, and health-related fitness skills is needed through multiple assessments to measure the multi-faceted programmatic effectiveness of an integrative intervention appropriately.

Materials and Methods

Participants

We recruited preschool and kindergarten children (*N* = 111) ages 3 to 6 years (*Mage* = 5.15 years, *SD* = 9.83 months) from a local public early childhood center. The sample represented a diverse population across age (3-year-olds = 10; four-year-olds = 38; five-year-olds =37; six year olds = 26), sex (girls = 58; boys = 53), ethnicity (African American = 24; Hispanic = 15; Caucasian = 70; Other = 2). Five children in the study sample also spoke English as a second language. Overall the sample included children both with disabilities (*n* = 24) and without disabilities (*n* = 86). For this study, we only reported children with a documented disability as provided by a formalized diagnosis from school district records. Disabilities present included Autism Spectrum Disorders (*n* = 2), developmental delay (*n* = 4), speech and language disorder (*n* = 17), and deaf/hard of hearing (*n* = 1). Four children presented multiple mild to moderate disabilities (deaf/hard of hearing and speech/language disorder = 1; speech/language disorder and developmental delay = 3).

Setting

The current study took place at a public early childhood center within a rural school district in the southeastern United States. The early childhood center contained 29 classrooms that included preschool (children ages 3 and 4 years-old) and kindergarten (children ages 5 and 6 years-old). We randomly selected six of the 29 classrooms to participate in this study. In accordance with the school district policy, all children received 30 minutes of free play daily. Classroom teachers led and supervised all activities during recess. The center had two identical playground spaces including but not limited to stationary playground equipment (e.g., climbing equipment, slides, poles, etc.), stationary balance beams, modified basketball hoops, tricycles, hula hoops, and playground balls. Each playground also included a giant sandbox with many pieces of equipment (e.g., shovels, bucket, utensils for drawing) to promote fine motor development. A sidewalk track surrounded the outside of the playground for children to play with gross motor equipment and ride tricycles. Teachers and children also had access to vast field space and often played various teacher-led games (e.g., relay races, cooperative games, etc.). During inclement weather, the early childhood center has a large multipurpose room for children to have recess.

Design and Variables

This study featured a pre/post/control experimental design. The primary independent variables were participating in the (n = 53) integrative intervention or the control condition (n = 59). In addition to intervention condition, the other independent variables were participants being placed in (a) general (n = 55) or inclusion (n = 56) classrooms and (b) either having a documented disability (n = 24) or not (n = 87).

Children with disabilities were in both the general and inclusion classes. The school determined child's placement in either the general or inclusion classroom by the level of Response To Intervention (RTI) support. The general class was Tier 1 (core instruction through differentiated instruction) and 2 (targeted group ins through conceptually-oriented instruction) support classroom, while the inclusion classroom included children that required Tier 1 through Tier 3 (individualized intervention through tailored support) supports within the classroom. We designed the ISKIP intervention without individual RTI tiers, however for children enrolled in the study we divided from general, and inclusion classes based upon provided RTI tier supports. Instead, we developed each lesson to meet a wide range of within-task variations (e.g., instructional support, instruction, goals, and equipment) (Rose & Meyer, 2002). The ISKIP intervention provided universally designed, flexible and adaptable options for all children in both the general and inclusive physical education classes (Pisha & Coyne, 2001). The structured support of universal designed for learning targeted whole group station and activities rather than individual modifications for each station/activity. We promoted children's' decision making by allowing child choice in the supports, types of instruction, goals, and equipment they needed to learn and participate in each station and activity.

Instrumentation

Test of Gross Motor Development-Second Edition (TGMD-2)

To measure children's gross motor skills, we used the TGMD-2 (Ulrich, 2000). The TGMD-2 is a valid and reliable assessment of gross motor development for children ages 3 years to 10 years 11 months. The TGMD-2 measures children's gross motor skill development through both process and product measures. The assessment battery is comprised of 12 skills divided into two subscales: locomotor skills and object control skills. Locomotor skills are movements that allow a child to move from one point to another (Haywood & Getchell, 2014). Locomotor skills assessed in the TGMD-2 include: running, galloping, hopping, jumping, sliding and leaping. Object control skills are any movement that requires the body to manipulate an object to perform a designated motor task. Object control skills assessed in the TGMD-2 include striking, dribbling, catching, kicking, throwing, and rolling. Each child receives a demonstration of each of the 12 skills on the TGMD-2, after the demonstration the child gets a non-scored practice trial. After the non-scored practice trial, if the child still performs the skill incorrectly, they receive another demonstration of the skill. The child performs two additional scored trials of each skill.

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BOT2-BF subscales point scores into six composite scores: fine manual control, manual coordination, body coordination, strength and agility, total motor composite, gross motor composite, fine motor composite using normative referencing based upon age and sex. A conversion of the six composite scores reports a child's total score of motor proficiency (Bruininks & Bruininks, 2010).

Integrative Successful Kinesthetic Instruction for Preschoolers (ISKIP)

We designed the ISKIP intervention by modifying and expanding the existing SKIP program developed by Goodway and colleagues (Altunsöz, & Goodway, 2016; Brian et al., 2017a, Brian et al., 2017b; Goodway & Branta, 2003). The original SKIP curriculum is rooted in evidence-based practices across fields such as motor development (Gallahue et al., 2012; Haywood & Getchell, 2014) and physical education (Rink, 2014; Siedentop & Tannehill, 2000). The original SKIP curriculum includes three foundational principles: (1) teaching fundamental motor skills to improve children's overall motor competence (2) reinforcement through providing structured opportunities to practice fundamental motor skills (3) providing developmental appropriate opportunities for a wide variety of learners to create positive movement experiences for children during the early years (Altunsöz, & Goodway, 2016; Brian et al., 2017a; Brian et al., 2017b).

The universal design for learning principles includes (a) multiple means of representation (b) multiple means of action and expression and (c) multiple means of engagement. We first accounted for the needs of all children within each class based on the present level of performance, diagnosed disability, sex, and learning style (i.e., auditory, kinesthetic, visual). We then designed each lesson with activities that included multiple within-skill variations. We created each lesson to be child-centered, rather than teacher-centered meaning many options within stations were available to all children but each child chose which skill variation they preferred. Within each skill station we then provided: (a) multiple means of instruction (e.g. visual task cards, picture schedules, short video clips, physical demonstrations, and verbal cues) (b) multiple within task variations at each skill station in which children could pick from a variety of equipment, distances, size targets, or between single or partnered activities (c) providing a least-to-most prompting hierarchy within-task at each skill station featuring visual, verbal, partial physical, and full physical prompts as needed to serve as both an informal assessment to but also ensure the success of all children in skill performance at each station. We offered every component of the prompting hierarchy at all times; children could choose which level of prompting they needed (d) determining within-station task completion by a set time (2-minutes) rather than set-number (e.g., ten trials).

To develop ISKIP, we expanded the scope of SKIP-UDL to include gross and fine motor skills along with health-related fitness as outcome measures. Fine motor skills included manual dexterity, fine motor precision, fine motor integration, and health-related fitness strength and agility, balance, and stability. Components of fine motor skills and health-related fitness skills were all featured in ISKIP and were additive to the traditional locomotor and object control skill focus of SKIP. However, in designing the lessons for ISKIP, we also employed the same principles and curriculum design from SKIP-UDL (Figure 3.1).

Each ISKIP lesson featured a station-style structure. Stations included a locomotor activity station, an object control activity station, and then a balance/stability/health-related fitness station (Figure 3.1). A certified physical education teacher holding a bachelor's and master's degree in physical education with six years' experience leading motor skill interventions in early childhood centers led the ISKIP motor skill intervention. The teacher also had extensive experience in teaching children both with and without disabilities in general and inclusive settings. Each class also had two assistant teachers co-leading the intervention to maintain the school’s teacher-to-student ratio of 1:9 - 1:11 during physical education and recess. The assistant teachers were currently obtaining degrees in physical education and had previous experience delivering motor skill interventions and working with children with disabilities.

We then divided children within each ISKIP class into three groups (e.g., red, blue and green). Upon arrival, children went to their designated group line. At each group line a picture schedule of the groups ISKIP rotation directed children through the lesson activities. After the introduction and rules/procedures for each station's activities in group lines, children went to one of the three designated stations their group was assigned too. Each group of children went to each station for seven minutes, then rotated to the next station on the group's picture schedule. After each group completed each of the three skill stations, all groups went to a fine motor station for seven minutes. An overall group review and wrap-up concluded the ISKIP intervention. Each intervention day included implementing the ISKIP intervention across two general physical education intervention classes and one inclusion intervention class. During non-intervention days (i.e., three days per week) children in the ISKIP participated in the control condition during scheduled recess time. Please refer to Figure 3.1 for more details of daily ISKIP activities.

Control Condition

Children randomly assigned to the control condition participated in the early childhood center's "business as usual" recess/gross motor time. Recess occurred five days per week for 30 minutes (360 total minutes) over the course of the six-week ISKIP intervention which included playing activities in the center's playground and multi-purpose room (refer above to the setting section for further detail).

Procedures

We obtained approval for all methods in the current study from an Institutional Board at a local university in the southeastern United States. After receiving institutional board approval, all parents provided consent and children provided verbal and written assent to participate in the study. We randomly assigned children to either the ISKIP or control conditions across the six participating classrooms. Although we randomized children to intervention condition at the child level, we still randomized children from within either the general or inclusion classroom classification. We assessed the gross motor, fine motor, and health-related fitness levels of all children regardless of the condition before the start of the ISKIP using the TGMD-2 (Ulrich, 2000) and the BOT2-BF (Bruininks & Bruininks, 2010). We implemented both assessments by the standardized procedures in both the TGMD-2 (Ulrich, 2000) and BOT2-BF (Bruininks & Bruininks, 2010) manual. After the pretest assessment, children in the ISKIP condition participated in a six-week (360 total minutes) integrative intervention twice weekly during their 30-minute recess/gross motor time. At the conclusion of the six-week ISKIP intervention, we assessed gross motor, fine motor, and health-related fitness skills with the TGMD-2 (Ulrich, 2000) and BOT2-BF (Bruininks & Bruininks, 2010) of all children regardless of condition using the same standardized procedures at the pretest.

We digitally recorded all TGMD-2 (Ulrich, 2000) and BOT2-BF (Bruininks & Bruininks, 2010) assessments, as well as all intervention sessions to ensure coding and intervention integrity throughout the study. After the posttest, we trained two independent raters to code the TGMD-2 assessment for all participants. One lead rater coded the entire sample, while the second rater coded 30% of randomly selected videos. Each coder established 92.6% reliability with a "gold-standard" rater before the start of data coding. We trained four separate coders for the BOT2-Bf assessment, four independent coders established an interrater reliability of 88.3% across the randomly selected 30% sample.

Intervention Integrity

To ensure the integrity of the ISKIP intervention, we established intervention integrity through a verification procedure to determine the internal validity of the ISKIP intervention. To establish intervention integrity, we created an ISKIP fidelity check sheet. We created the ISKIP fidelity check sheet by modifying and combining two existing fidelity measures in motor skill intervention and universal design for learning. The first fidelity check sheet used in the development of the ISKIP fidelity check sheet is the Teacher- Successful Kinesthetic Instruction for Preschoolers (T-SKIP) fidelity check sheet created by Brian and colleagues' in 2017. The initial use of this fidelity instrument was to establish intervention fidelity in a T-SKIP intervention (Brian et al., 2017b). In tandem with the T-SKIP fidelity check sheet we also used the universal design for learning checklist developed by Lieberman and colleagues' in 2008. The purpose of the universal design for learning checklist is to provide teachers with a guide to determine if the basic principles of universal design for learning are present within their physical education class. Specifically, to ensure all children are provided multiple means to participate in all activities within the class (Lieberman et al., 2008).

We created an initial draft of the ISKIP fidelity check sheet from the fidelity as mentioned above measures to inform our check sheet. We then sent the initial ISKIP fidelity check to a panel of five experts representing fields such as special education, adapted physical education, curriculum and instruction, and motor development. After each expert provided feedback, we then combined all edits and feedback to create a final version of the ISKIP fidelity check sheet. Upon completion of the finalized ISKIP check sheet, we sent the measure back to the experts for final approval of the ISKIP check sheet.

We used the ISKIP fidelity check sheet to determine intervention fidelity across all three intervention classes. The fidelity measure includes a 60- item check sheet divided into seven distinct sections to represent all aspects of an ISKIP lesson. Sections of lesson fidelity included: prior to lesson (3 items), introduction (3-items), task sections with demonstration, within-task and closure sub-categories (15-items each), and task transitions (4 items). The overall universal design in physical education section divided into five sections: inclusiveness, delivery mode representation, multiple means of engagement, and multiple means of assessment (22-items total). We trained two independent raters to code 100% of intervention sessions. One rater coded 100% of the total sample, while the second rater coded a random sample of 30% of overall intervention sessions. Each rater scored the lesson using a 1, 0 or N/A scoring system. Upon watching the video recording of each lesson, raters circled a 1 if the fidelity item was present, a 0 if the fidelity item was no present, and a (-) if the fidelity item was not applicable. Some fidelity items required judgment by the rater. Raters responded with a score of 1 if the fidelity item was correct at-least 75% of the task, 0 if it was incorrect or incorrect for more than 25% of the task, (-), needed but did not occur or * correct but not needed. We summed each rater's scores for each section and divided by the total number of applicable fidelity items within the instrument then multiplied by 100 to determine the percentage of each ISKIP lessons intervention fidelity. Overall ISKIP fidelity was 95.7% across all lessons and classes. We established an inter-observer agreement of 93.1% between the two independent coders across the random 30% sample. In addition to establishing ISKIP intervention fidelity, we also completed a weekly observation of the free play control condition. Since we randomized children at the child-level, we wanted to ensure site contamination or a bleed over intervention effect did not occur within participating classrooms. Upon nine random observations, six on intervention days and three on non-intervention days we established no contamination occurred between ISKIP and control children.

Data Analyses

We first conducted descriptive analyses (e.g., raw and point total scores, standard scores, and percentile ranks) for both TGMD-2 and BOT2-BF assessments. We then conducted three separate independent samples *t*-tests to determine differences between-group (i.e., ISKIP and control) (b) classes (general and inclusion) and (e) sex at the pretest for raw BOT2-BF total point and raw TGMD-2 total gross motor scores at the pretest. If there were sex differences present, we controlled for sex in the analyses. Next, we conducted two separate 2 group (ISKIP and control) x 2 time (pretest and posttest) repeated measures ANCOVAs controlling for sex for raw TGMD-2 scores to determine the effectiveness of ISKIP on children's gross motor skills. To account for within-group differential effects of ISKIP between children with and without disability, we conducted a subsequent 2 group (disability and no disability) x 2 time (pretest and posttest) repeated measures ANCOVA controlling for sex. Next, to determine the effects of the ISKIP intervention on children's gross motor, fine motor and health-related fitness skills we conducted two separate 2 group (ISKIP and control) x 2 time (pretest and posttest) repeated measures ANOVA using BOT2-BF raw point scores. To confirm results of the repeated measures ANOVA and ANCOVA's we conducted an independent samples t-test at the posttest will TGMD-2 and BOT2-BF scores.

Theory

Newell's Constraints

The ISKIP intervention is grounded in a translational interpretation of Dynamical Systems Theory via Newell's Model of Constraints (Newell, 1986). Newell's model suggests that development occurs from the interdependent association of three constraints: the individual person, the task that the individual is performing, and the environment that surrounds the individual and the task (Newell, 1986). Through a practical translation, we used Newell's Model of Constraints as the theoretical basis for the designing and implementation of ISKIP. Practical translations of Newell's Constraints include the following to increase children's overall motor repertoire: (a) manipulating both functional (e.g., providing lower-impact activity choices within each station) and structural (e.g., providing tactile, verbal, and visual prompts within each station activity) constraints of the individual (b) Controlling environmental constraints (e.g., manipulating group sizing, noise levels) during lessons (c) manipulating the task to provide affordances and rate limiters within the task (e.g., modifying equipment, distances within station activities) constraints (Newell, 1986; Pope, Breslin, Getchell, & Liu, 2012). The goal of ISKIP is to provide opportunities to increase children's gross motor, fine motor, and health-related fitness skills by manipulating the individual, environment for each lesson while maintaining a unified structure for all within the ISKIP class.

Vygotsky's Zone of Proximal Development

The ISKIP intervention utilized the specifically, targeting Vygotsky's three prerequisites levels of learning: (a) acknowledgment of skills or information that need to be learned, (b) identification of appropriate strategies to learn the skills/information and (c) engagement (Vygotsky, 1978). Vygotsky's Zone of Proximal Development suggests that in creating the ISKIP intervention, we believe children's abilities to learn and perform various motor skills (e.g., gross motor, fine motor, and health-related fitness skills) can be influenced by the interactions of the child peers and teachers (Vygotsky, 1978). More specifically, within the ISKIP intervention, we used a "scaffolding model" rooted in the Zone of Proximal Development in which children complete various motor tasks as they chose with support from teachers, peers, or type of instruction (Vygotsky, 1978). Each station within the ISKIP intervention featured a scaffolding hierarchy presented to all children. After repetitive practice, the ultimate goal was children would begin to decrease in levels of scaffolding and begin to develop independent skill mastery. Practical examples of "scaffolds" within ISKIP include: child hold hand with a partner to balance on one foot, placing a spot on the floor reminding a child to step with opposition, performing a tracing activity using hand-over-hand.

Results

Descriptive results of raw mean scores for both the BOT2-BF and TGMD-2 are located in Table 4.2. An independent samples *t*-test revealed no significant differences between group for BOT2-BF $t(109) = -.66$, $p = .50$, $d = .38$ or TGMD-2 $t(109) = 1.29$, $p = .54$, $d = .28$ pretest scores. A separate independent samples *t*-test showed no significant difference between classes (general and inclusion for BOT2-BF ($t(109) = -.476$, $p = .63$, $d = .00$) and TGMD-2 ($t(109) = 1.29$, $p = .199$, $d = .32$) pretest scores. However, an independent samples t-test revealed a significant difference for sex for TGMD-2 ($t(109) = 3.642$, $p < .001$, $d = .70$) but not BOT-BF ($t(109) = -.262$, $p = .79$, $d = .24$) pretest scores.

TGMD-2 Locomotor

Results of the 2 group (ISKIP control) x 2 time (pretest and posttest) ANOVA in TGMD-2 scores revealed a significant main effect for time $F(1, 103) = 77.15$, $p < .001$, $\eta^2 = .42$ and group (ISKIP and control) $F(1, 103) = 12.87$, $p < .001$, $\eta^2 = .11$. Results also showed a group x time interaction $F(1, 103) = 36.26$, $p < .001$, $\eta^2 = .26$. However, there were no significant interactions reported for ISKIP group x class (general and inclusion) $F(1, 103) = .02$, $p = .882$, $\eta^2 = .00$; ISKIP group x disability $F(1, 103) = .02$, $p = .896$, $\eta^2 = .00$; or ISKIP x class x disability $F(1, 103) = .13$ $p = .720$, $\eta^2 = .00$.

TGMD-2-Object Control

Results of the 2 group (ISKIP control) x 2 time (pretest and posttest) ANCOVA controlling for sex in TGMD-2 scores revealed a significant main effect for time $F(1, 103) = 45.16$, $p < .001$, $\eta^2 = .30$ and group (ISKIP and control) $F(1, 102) = 11.77$, $p < .001$, $\eta^2 = .10$. Results also showed a group x time interaction $F(1, 103) = 21.78$, $p < .001$, $\eta^2 = .17$. However, there were no significant interactions reported for ISKIP group x class (general and inclusion) $F(1, 102) = .03$, $p = .861$, $\eta^2 = .00$; ISKIP group x disability $F(1, 102) = .036$, $p = .850$, $\eta^2 = .00$; or ISKIP x class x disability $F(1, 102) = 1.02$, $p = .314$, $\eta^2 = .01$.

BOT2-BF

Results of the 2 group (ISKIP control) x 2 time (pretest and posttest) ANOVA of BOT2-BF scores revealed a significant main effect for time $F(1, 109) = 13.984$, $p < .001$, $\eta^2 = .12$ and group (ISKIP and control) $F(1, 109) = 8.28$, $p < .005$, $\eta^2 = .07$. Results also showed a group x time interaction $F(1, 109) = 6.48$, $p < .012$, $\eta^2 = .05$. However, there were no significant interactions reported for ISKIP group x class (general and inclusion) $F(1, 52) = .037$, $p = .82$, $\eta^2 = .00$ and ISKIP group x disability $F(1, 52) = .978$, $p = .325$, $\eta^2 = .00$. However, results revealed a significant ISKIP x class x disability interaction $F(1, 52) = 4.85$, $p = .030$, $\eta^2 = .04$.

To confirm ANCOVA results, independent samples *t*-test revealed a significant difference between group (ISKIP and control) for BOT2-BF ($t(109)$ 2.331, $p = .022$, $d = .14$) and TGMD-2 ($t(109) = 6.270$, $p < .001$, $d = .22$) for posttest scores.

Discussion

To our knowledge, few studies have examined multiple facets of young children's gross motor, fine motor, and health-related fitness skills in school-based interventions that include children with and without disabilities (Taunton et al., 2017). The findings in this study directly addressed these significant gaps through two primary aims. The purpose of this study was to examine the effects of an integrative intervention (e.g., ISKIP) on the gross motor, fine motor, and health-related fitness skills of young children with and without disabilities. The secondary purpose of this study was to measure ISKIP program effectiveness on gross motor, fine motor, and health-related fitness skills through multiple assessments.

Effects of ISKIP on Targeted Outcomes

The primary purpose of this study was to examine the effects of an integrative intervention (e.g., ISKIP) on the gross motor skills, fine motor skills, and health-related fitness of young children with and without disabilities. In the present study, children in ISKIP demonstrated significantly greater gains in all three target outcomes (i.e., gross motor, fine motor, and health-related fitness skills) as compared with the control group. The overall effect sizes of ISKIP for gross motor skills as reported by the TGMD-2 (η^2 = .33), is not as robust as previous SKIP studies (η^2 = .61 - .73) (Altunsöz, & Goodway, 2016; Brian et al., 2017a; Brian et al., 2017a; Goodway & Branta, 2003). However, when considering only 180 minutes of the reported 360-minute ISKIP intervention were allotted for gross motor skill development, our effect sizes are comparable to many of many six-week, 360-minute SKIP studies (Brian et al., 2017a; Brian et al., 2017b; Taunton et al., 2017). Additionally, children within ISKIP included those with and without disabilities. Thus, our sample may be one of the most diverse samples studied within the literature. Thus, differentiating instruction has been more challenging than the samples within.

Despite lower gains in TGMD scores than the previous literature, ISKIP resulted with not only significant but similar or better effect sizes for fine motor (η^2 = -.24 - .05) (Barton, Reichow, Schnitz, Smith, & Sherlock, 2015; Pless & Carlsson, 2000). While our effect sizes for BOT2-BF do not show as robust effect sizes (η^2 = .03 - .50) as some school-based health-related fitness skill interventions, these interventions included dosages of 12+ weeks with a larger focus on physical activity and health-related fitness skills (Pan et al., 2017; Sallis et al., 1997.) Overall, the significant increases in fine motor skills and health-related fitness ($p < .012$) within the ISKIP intervention are similar to many other studies. However, many of these studies did not include children with disabilities (Kriemler et al., 2011; Lai et al., 2014).

Within-Group Differences of ISKIP

A secondary research question within the primary purpose of this study was to determine if there were differential effects of SKIP based upon children enrolled in general or inclusion classes. Overall, there were no significant differences between general and inclusion classes for TGMD scores ($F(1, 52) = .487$, $p = .487$, $\eta^2 = .00$); and BOT2-BF ($F(1, 52) = .037$, $p = .82$, $\eta^2 = .00$) scores at the posttest. This is not surprising given the curriculum framework used in the ISKIP intervention. Universal design for learning has often been cited as an effective curricular framework to create equal learning opportunities to increase competencies in both children with and without disabilities (CAST, 2011; Spencer, 2011). However, in inclusive movement settings, universal design for learning has only been used in practical settings (Lieberman & Houston-Wilson, 2018). Universal design for learning lacks a substantial evidence-base to deem universal design for learning an evidence-based strategy to increase learning and competencies for inclusive movement settings (Taunton et al., 2017). The current study is one of only two studies to provide evidence to speak to the anecdotal effectiveness of universal design for learning in inclusive movement settings (Taunton et al., 2017). Using the principles of universal design for learning in tandem with evidence-based physical education and motor development practices could explain no significant differences between general and inclusion classes' gross, fine, and health-related fitness scores at the posttest. Moreover, ISKIP included many within-task variations and a variety of instructional strategies to accommodate for the wide range of needs, abilities, and preferences of children to ensure children both with and without disabilities learn and increase skill competency within the integrative intervention.

Effectiveness of ISKIP using Multiple Assessments

Another purpose of this study was to examine the effectiveness of ISKIP on both children with and without disabilities' motor and health-related fitness skills based upon multiple measures. Findings of the current study reported no significant differences between children with and without disabilities for TGMD-2 scores ($F(1, 52) = .487$, $p = .487$, $\eta^2 = .00$). However, there were significant differences between children with and without disabilities for BOT2-BF scores ($F(1, 52) = 4.85$, $p = .030$, $\eta^2 = .04$). Previous studies examining young children's motor skills, particularly in school-based settings typically utilized only one assessment to measure children's motor skills (e.g., gross motor, fine motor, and health-related fitness skills). A major underlying issue is using a singular motor assessment, is there is no "gold standard" motor assessment to capture a holistic picture of children's motor skills (Piek, Hands, & Licari, 2012). Moreover, many motor assessments have a ceiling or floor effect, meaning there is a limitation in the assessment in capturing extremely low or extremely high ranges of motor abilities (Staples & Reid, 2010; Wuang, Su, & Huang, 2012). Many motor assessments also target a specific area of motor ability or are more sensitive and specific to certain populations (Cools, De Martelaer, Samaey, & Andries, 2009). The current study addresses a major gap in the motor development literature calling for the use of multiple assessments of both product and process oriented assessment to assess many facets of children's motor skills (e.g., gross motor, fine motor, and health-related fitness skills). Using multiple assessments may more accurately identify children's specific deficits in overall motor competence and its' associations to other areas of child development (Cattuzzo et al., 2016; Logan, Barnett, Goodway, & Stodden, 2017; Robinson et al., 2015). Moreover, children's motor skill performance across various motor assessments are often associated, but are often structurally different (Valentini et al., 2015). Therefore, utilizing multiple assessments for a holistic measure of children motor skills is needed. Additionally, utilizing specific assessments for certain components of motor skills (e.g., fine motor, balance and stability, fundamental motor skills) within a specific context (e.g., clinical settings or school-based settings) is warranted. Assessing children's motor skills (e.g., gross motor, fine motor, and health-related fitness skills) using multiple assessments (i.e., more than two) can also serve not only to identify motor deficits but provide appropriate documentation for appropriate placement for services (e.g., physical education, occupational therapy, and physical therapy) for children with developmental delays and disabilities (IDEA, 2004).

We chose to implement the TGMD-2 (Ulrich, 2000), a process and process-oriented assessment, and the BOT2-BF (Bruininks & Bruninks, 2010), a product-oriented assessment to assess children's gross motor, fine motor, and health-related fitness skills. The TGMD-2 is a practitioner-friendly motor assessment with strong validity, reliability, and internal consistency in measuring young children's (ages 3 – 6) fundamental motor skills, a foundational component of gross motor skill development (Ulrich, 2000). The TGMD-2 also serves to meet multiple needs such as an identification and screening tool for motor deficits, tracking individual's progress, measuring program effectiveness and informing instructional programming (Ulrich, 2000). Therefore, the TGMD-2 is an appropriate assessment to measure individual children's gross motor skills while examining program effectiveness and informing the curriculum programming of ISKIP. The BOT2-BF provides a more holistic measure of young children's motor skills (e.g., fine motor skills, manual dexterity, balance, stability, and strength) (Cools et al., 2009). The BOT2-BF is also more sensitive and specific to young children with mild to moderate disabilities and is widely used by adapted physical education teachers as well as physical and occupational therapists for diagnosing motor impairments and determining placement for services (Cools et al., 2009). Using both the TGMD-2 and BOT-2 assessments provided a more in-depth analysis of children's motor skills both prior to and after the ISKIP intervention. Moreover, using multiple assessments aided in determining program effectiveness for the multiple facets of the integrative ISKIP intervention.

Recess and Free Play in Early Childhood Centers

In the present study, children in ISKIP demonstrated significantly greater gains in all three target outcomes of motor skills (i.e., gross motor, fine motor, and health-related fitness skills) as compared with the control group. Many studies demonstrated that children who are only receiving free play or recess are often at-risk for developmental delay demonstrating low level of motor skill performance, particularly for children with disabilities (Brian et al., 2017a, Brian et al., 2017b; Goodway & Branta, 2003; Taunton et al., 2017). Furthermore, children both with and without disabilities who receive as little as 30 minutes of structured motor time per week twice per week in addition to free play score as high as 50 percentile points higher on motor assessments than peers who only receive free play (Taunton et al., 2017). Results from this study support the notion that simply "recess" and "free play" during designated gross motor time within preschools and early childhood centers may not yield to significant development of critical motor skills (e.g., gross motor, fine motor, and health-related fitness skills) necessary for healthy growth and development.

Importance of an Integrative Intervention

Implementing various interventions targeting vital areas of children's development is needed but often poses many challenges for implementation in school-based settings. Many challenges include lack of resources, training of staff, and time to deliver programming during the school day have been reported as potential causes for young children's delay in aspects of the physical domains of learning (Gooze et al., 2010). Initial findings at the pretest of the current study demonstrated a significant need for a more integrative approach to developing gross motor, fine motor, and health-related fitness skills during the early years (Diamond, 2010). Results of our study provide support for the approach of taking existing designated time (e.g., free play or recess) and implementing a structured integrative intervention, with an appropriate curricular framework, targeting multiple outcomes of children's development (e.g., gross motor, fine motor, and health-related fitness skills) can be additive in increasing children's overall motor repertoire regardless of current ability or disability. School districts should consider creating structured intervention times throughout the school week, in addition to free play. Moreover, in designing an integrative intervention school districts should consult with multiple specialists within the school (e.g., occupational therapists, physical therapists, classroom teachers, physical education teachers, and special education teachers). Collaboration across multiple disciplines can aide in effective curriculum development and provide optimal training for classroom teachers, special education teachers or physical education teachers administering an integrative intervention (Sato & Haegele, 2017).

Limitations and Future Research

While this study has many strengths, it is not without limitation. While the study included children with and without disabilities across both general and inclusion classes the sample size within these groups were small. Therefore, the generalizability of the ISKIP curriculum should be taken with caution until further examinations implement the ISKIP intervention with larger sample size. However, results of the current ISKIP intervention showed significant increases in children's gross motor, fine motor, and health-related fitness skills with moderate effect sizes. Results demonstrate that even with a short intervention dosage during children's existing gross motor time (e.g., 360 minutes) both children with and without disabilities can improve many aspects of motor development (e.g., gross motor, fine motor, and health-related fitness skills). Future research should examine the effects of a longer ISKIP intervention dosage (e.g., greater than 12 weeks) and also the retention effects (e.g., 6 months to a year) of both a short-term (e.g., 6-weeks) and long-term (e.g., 12-weeks) ISKIP intervention on children's gross motor, fine motor, and health-related fitness skills.

This study was an efficacy trial to determine if an integrative school-based intervention delivered during existing gross motor time could improve young children's gross motor, fine motor, and health-related fitness skills. The ISKIP intervention the intervention was delivered by a trained expert in motor development and physical education and was implemented under ideal circumstances. Future research should examine the effects of the ISKIP intervention when delivered by classroom and physical education teachers. Moreover, future research should include a larger sample size of children with and without disabilities in both early childhood (preschool and kindergarten) and K-12 physical education settings.

Conclusion

Presently, young children both with and without disabilities are demonstrating significant delays in many facets of overall motor development (e.g., gross motor skills, fine motor skills, and health-related fitness skills). Children both with and without disabilities demonstrated significant delays in gross motor skills, fine motor skills, and health-related fitness skills. However, children both with and without disabilities who participated in an integrative intervention (e.g., ISKIP) twice per week during regularly scheduled gross motor time at an early childhood center for 6-weeks demonstrated significant gains in gross motor, fine motor, and health-related fitness skills compared to children who only received recess. Most notably, there were no significant differences in gross motor, fine motor or health-related fitness skills for children enrolled in both general and inclusion classes at the conclusion of the ISKIP intervention. Findings from this study suggest young children both with and without disabilities can benefit from an integrative intervention targeting multiple facets of motor development when using an appropriate curriculum framework such as universal design for learning. Future research should examine the effects of longer intervention dosages and retention effects of integrative interventions such as ISKIP on gross motor, fine motor, and health-related fitness skills for both children with and without disabilities.

Table 3.1

Pretest and Posttest TGMD-2 Means by Condition and Disability

Condition	**BOT2-BF Total Point Pretest**	**BOT-BF Total Point Posttest**	**TGMD-2 Total Raw Score Pretest**	**TGMD-2 Total Raw Score Posttest**
General ISKIP	20.90 (13.36)	28.60 (20.52)	40.89 (11.17)	61.34 (13.40)
General Control	16.00 (12.75)	18.32 (14.06)	37.53 (12.54)	45.73 (11.79)
Inclusion ISKIP	20.46 (14.13)	34.89 (25.14)	37.33 (11.30)	56.54 (15.03)
Inclusion Control	21.21 (19.96)	26.50 (18.73)	35.53 (11.55)	41.21 (12.92)
Disability				
ISKIP (disability)	20.43 (15.81)	30.73 (22.03)	38.15 (12.34)	56.61(16.68)
Control (disability)	19.97 (19.28)	25.00 (18.49)	35.08 (11.17)	41.62 (12.48)
ISKIP (no disability)	20.96 (11.09)	32.61 (24.13)	40.37 (10.24)	61.62 (11.17)
Control (no disability)	16.90 (13.16)	19.05 (17.24)	38.47 (13.01)	45.69 (12.48)

Object Control Station (1)	Balance/Stability/Health- Related Fitness Station (2)
Station Activity: **Score the Goal** Kicking a chosen ball to a chosen target from 3, 5, or 10 feet away to either a low, medium or high target on the wall as many times as possible for 1-minute (5 rounds) **Equipment Choices**: 8.5” playground ball, Large Beach ball, 8.5”foam ball, large lightweight volleyball "trainer ball," slo-mo soccer ball, 20” playground ball **Instructional Choices:** physical demonstration, cue cards, a video demonstration, visual task analysis card, various visual, verbal and physical prompts **Within-Task Choice:** Approach ball standing in place, walking or running	**Station Activity: Treasure Chest Transfer** Transfer your treasure of a scarf or bean bag in a to walk tandem, semi-tandem or feet apart on a chosen pattern line (straight, zig-zag-or box) to a chosen hula hoop) to collect as much treasure as possible for 1-minute (5 rounds) **Equipment Choices:** scarf or bean bag **Instructional Choices:** physical demonstration, cue cards, a video demonstration, visual task analysis card, various visual, verbal and physical prompts **Within-Task Choices:** carry the "treasure" while holding it in one or two hands, balancing it on top of your hand, balancing on top of your head
Fine Motor Station (4)	**Locomotor Station (3)**
Station Activity: Maze for Daze Choose from a variety of sheets with different mazes. Complete each maze with wither a crayon, thick marker, thin marker, or colored pencil. Once you have complete one maze, you may move to a different table and pick another maze. **Equipment Choices:** Writing implement-large expo marker, tiny expo marker, crayon or color pencil. Maze- variety of different levels of difficulties. **Instructional Choices:** physical demonstration, verbal and visual prompts, partial physical prompts or full hand-over-hand **Within-Task Choices:** prompt fading cards (maze to trace with full line, thick dotted line, small dotted),	**Station Activity: Over the Puddle** Make it over the rainy day puddle by jumping or leaping over the puddle, or you may hop through the puddle to the other side without getting your feet wet. You can start with cones 1, 2, 3, or 5 ft away. You can choose to make it over a large puddle, medium puddle or small puddle. See how many puddles you can jump over in thirty seconds (10 rounds) **Equipment Choices:** Make it over a tall cone, medium cone, low cone or line over the floor **Instructional Choices:** physical demonstration, cue cards, video demonstration, visual task analysis card, various visual, verbal and physical prompts **Within-Task Choices:** make it over the puddle by yourself, with a friend, or with a teacher’s help
Group Rotation Red Group = 1, 2, 3, 4 Green Group = 2, 3, 1, 4 Blue Group = 3, 1, 2, 4	

Figure 3.1 Example of ISKIP lesson divided by stations and group rotation.

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CHAPTER 4: STUDY 2

THE EFFECTS OF AN INTEGRATIVE, UNIVERSALLY-DESIGNED MOTOR SKILL INTERVENTION ON YOUNG CHILDREN WITH MODERATE TO SEVERE DISABILITIES[1]

[1]Taunton, S., Brian, A., Pennell, A., Lieberman, L., Webster, C.A., & Stodden, D.F., (in review). The effects of an integrative, universally-designed motor skill intervention on gross motor skills of children with moderate to severe disabilities. *Adapted Physical Activity Quarterly*.

Abstract

Currently, many young children with moderate to severe disabilities do not receive appropriate instruction or support within existing motor time (e.g., recess or targeted fine motor skill development). Moreover, many singular motor assessments do not capture both the process and the product of children with moderate to severe disabilities gross motor, fine motor, and health-related fitness skills. Therefore, the purpose of this study was to examine the effects of an integrative universally designed intervention on gross motor, fine motor, and health-related fitness skills of young children with moderate to severe disabilities. Furthermore, we measured both process and product characteristics of children's gross motor, fine motor, and health-related fitness skills to critically examine the programmatic effectiveness of the intervention. We randomly selected children (n = 11) to participate in a universally-designed integrative motor intervention and children (n = 9) to participate in the control condition. We assessed all children prior to and after the intervention on the Test of Gross Motor Development (TGMD-2) and the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition Brief Form (BOT2-BF). We examined group (e.g., intervention and control) mean differences through paired sampled t-tests and individual change scores in BOT2-BF and TGMD-2 scores on all children from pretest to posttest. Findings from this study suggest young children with moderate to severe disabilities can improve gross motor, fine motor, and health-related fitness skills through a universally designed motor skill curriculum, however, children must be provided the appropriate support (e.g., paraprofessionals) and be placed in their "least restrictive" environment.

Keywords: adapted physical education, self-contained classroom, motor skills

Many children with moderate to severe disabilities demonstrate difficulties performing gross motor, fine motor, and health-related fitness skills. Many of the aforementioned motor skills are required to for children with moderate to severe disabilities to perform activities of daily living and demonstrate a basic quality of life (Browder & Spooner, 2011; Favazza & Siperstein, 2016). Federal legislation requiring individuals with disabilities ages 4 – 21 years receive appropriate related services to develop and improve basic skills competencies (IDEA, 2004). Despite federal mandates, many children with moderate to severe disabilities are still demonstrating lower levels of basic gross motor, fine motor, and health-related fitness skills than peers (Bult, Verschuren, Jongmans, Lindeman, & Ketelar, 2011; Palisano et al., 1997a).

The motor development difficulties of children with moderate to severe disabilities (e.g., gross motor, fine motor, and health-related fitness skills) may be attributed to a national shortage of adapted physical education teachers (Zhang, 2011). Thus, many children are not being offered appropriate adapted physical education services (Zhang, 2011). Moreover, less than 1% of preschool or early childhood centers have a certified physical education teacher (McWilliams, 2009; Brian, Pennell, Schenkelberg, & Sacko, in press). These deleterious statistics are concerning given that federal mandates are in place due to the vital nature of services, such as adapted physical education, to help develop and improve motor skills through appropriately provided services (e.g., adapted physical education). Lack of access to appropriate services may exacerbate motor difficulties for children with moderate to severe disabilities (WHO, 2012). Therefore, early identification and intervention is crucial for proper development of children with moderate to severe disabilities (WHO, 2012)

Despite a good faith effort by many school districts to provide appropriate related services and opportunities, many young children with moderate to severe disabilities are not receiving appropriate services (e.g., adapted physical education) in either specially designed or general physical education classroom environments (Block & Obrusnikova, 2007; GAO, 2010). Lack of appropriate services (e.g., instruction from an adapted physical education specialist) provides little opportunity for young children to develop and increase gross motor, fine motor, and health-related fitness skills (Qi & Ha, 2012). Despite federal mandates, many contextual barriers in school-based settings can hinder the delivery of structured movement opportunities for young children with moderate to severe disabilities (Block & Obrusnikova, 2007; GAO, 2010). Many early childhood centers lack physical access, equipment and facilities for students with moderate to severe disabilities to learn and develop basic gross motor, fine motor, or health-related fitness skills in an optimal and nurturing environment (Pivik, Mccomas, Laflamme, 2002; Rimmer, Riley, Wang, Rauworth, & Jurkowski, 2004). Many early childhood centers employ general physical education or classroom teachers to instruct children with moderate to severe disabilities in the development of basic gross motor, fine motor, and health-related fitness skills (e.g., general classrooms or general physical education) (Brian et al., in review; Downing & Peckham-Hardin, 2007; McWilliams et al., 2009). However, many general physical education teachers and special education teachers do not receive the extensive coursework and training regarding teaching children's motor development, particularly for children with moderate to severe disabilities (Brian et al., in review; McWilliams, 2009; Wilhelmsen & Sørensen, 2017).

Many children with moderate to severe disabilities require specialists to teach basic gross motor, fine motor, and health-related fitness skills (e.g., adapted physical education teacher, occupational therapist or physical therapist) (Horn & Khang, 2012; Hunt, Soto, Maier, & Doering, 2003). However, few early childhood centers provide specialists (e.g., physical education and adapted physical education teachers, occupational therapists, physical therapists) with the proper content knowledge and training to provide formalized motor programming to increase gross motor, fine motor, and health-related fitness skills of children with moderate to severe disabilities (Qi & Ha, 2015). Additionally, many children require an additional paraprofessional to complete basic physical tasks required during recess or physical education (Downing, Rydack, & Clark, 2000). However, due to lack of resources, many young children may not have access to individual paraprofessionals during times allotted for the development of motor skills throughout the school day (Davis, Kotecki, Harvey, & Oliver, 2007). Furthermore, most paraeducators are not trained to work with their child in the physical activity and physical education settings (Lieberman, & Conroy, 2013).

Some preschools or early childhood centers do employ adapted physical education or physical education teachers to provide appropriate related services for young children with moderate to severe disabilities (GAO,2010). Providing related services (e.g., adapted physical education) through either specially designed physical education or within general physical education is optimal for young children with moderate to severe disabilities (Grenier & Lieberman, 2018; Winnick, & Porretta, 2017). Although, in many cases, it is not realistic, particularly in rural or Title-1 school districts, as there is a shortage of adapted physical education teachers (Zhang, 2011). Children with moderate to severe disabilities are often provided services in large class opportunities (e.g., grade level recess or general physical education) (Block & Obrusnikova, 2007; Downing & Peckham-Hardin, 2007). While providing physical education through whole class opportunities (e.g., physical education) is not ideal without support from an instructional aide or adapted physical education specialist, it is often the reality for children with moderate to severe disabilities (GAO, 2010). Recess and physical education spaces within early childhood centers often lack appropriate indoor and outdoor space, in addition to modified equipment to accommodate the needs of young children with moderate to severe disabilities to practice and increase competencies in gross motor, fine motor, and health-related fitness skills (Rimmer, Riley, Wang, Rauworth, & Jurkowiski, 2004). Therefore, in large class environments (e.g., general physical education) to develop gross motor, fine motor and health-related fitness skills such as recess and/or physical education many children with moderate to severe disabilities often exhibit sedentary behavior, and have decreased motor skills and class participation (Bloeman et al., 2015; Qi & Ha, 2015)

Recently, many leading organizations have called for the inclusion of children with disabilities into general and inclusive settings, particularly within a school-based context (WHO, 2012). Given ideal circumstances, children with moderate to severe disabilities in self-contained classrooms would receive individualized or supportive adapted physical education services within general physical education to increase competencies in basic gross motor, fine motor, and health-related fitness skills. However, given the aforementioned contextual barriers, it is not ecological or realistic that most children with moderate to severe disabilities will receive appropriate related services (e.g., adapted physical education) within general physical education during the early years' of childhood (Davis, Kotecki, Harvey, & Oliver, 2007). Therefore, an examination of potential ecologically valid instructional strategies and curricula to develop and improve competency in gross motor, fine motor, and health fitness skills for children with moderate and severe disabilities during designated gross motor time is needed. One potential solution is to provide an integrative motor skill intervention targeting gross motor, fine motor, and health-related fitness skills within existing group gross motor time (e.g., recess or physical education) for children with moderate to severe disabilities enrolled in a self-contained classroom. While the need for interventions for children with moderate to severe disabilities is known, often they are not implemented due to many conceptual and methodology problems surrounding this diverse population (Campbell, 2000). However, any potential intervention strategy or curriculum needs to consider both the environmental and contextual constraints within individual school-based environments such as Title 1 early childhood centers. Thus, ecologically valid strategies would need to take into account current employees to deliver the intervention (e.g., special education classroom teachers, general or adapted physical education teachers and paraprofessionals), class schedules, available space and equipment, center teacher-to-student ratios. Moreover, group interventions for children with moderate to severe disabilities must include individualized components to meet the wide range of ability and needs of children with moderate to severe disabilities enrolled in self-contained classrooms (Horn, 2012).

Large-scale inclusive motor skill interventions have been deemed effect for young children between the ages of 3 and 6 years with and without mild to moderate disabilities to increase overall motor (e.g., gross motor, fine motor, health-related fitness skill) competencies (Valentini & Rudisill, 2004b; Taunton et al., 2017; Taunton et al., in review). These interventions, however, are often conducted in segregation only targeting a singular facet of motor competence (e.g., either just gross motor, fine motor, or health-related fitness skills) or a specific disability population (e.g., cerebral palsy or Down's Syndrome) (Dewar, Love, & Johnston, 2015 ; González-Agüero, Vicente-Rodríguez, Moreno, Guerra-Balic, Ara, & Casajus, 2010; Silkwood-Sherer, Killian, Long, & Martin, 2012; Roostaei, Baharlouei, Azadi, & Fragala- Pinkham, 2017; Wuang, Chiang, Su, & Wang, 2011). However, the multiple facets of motor competencies are associated an influence children's overall development of motor skills (Hand et al., 2009). Thus, an integrative intervention during existing gross motor time (e.g., recess or physical education) may prove additive as it accounts for the transactional associations of multiple facets of motor competency (e.g., gross motor, fine motor, and health-related fitness skills) on child development (Hands, Larkin, Parker, Straker, & Perry, 2015).

One instructional strategy and curricula framework that meets a wide variety of children is universal design for learning (CAST, 2011; Rose & Meyer, 2000). Through universal design for learning, all children can be included in instruction or activities because each activity is designed to address individualized needs, preferences, learning styles, and abilities without excluding any child from the whole group or class activity (CAST, 2011; Lieberman & Houston-Wilson, 2018; Rose, Gravel, & Gordon, 2014). Universal design for learning is considered an evidence-based practice in the field of special education (CAST, 2011). Unfortunately, universal design for learning has a limited evidence-base on the effectiveness of implementation in settings such as physical education and adapted physical education (Taunton et al., 2017; Taunton et al., in review). Universal design for learning has been deemed an effective instructional and curriculum strategy for children with and without mild to moderate disabilities in group-based gross motor and integrative intervention settings (Taunton et al., 2017; Taunton et al., in review). However, further evidence on the effects of an integrative universally designed motor skill intervention on gross motor, fine motor, and health-related fitness skills of children with moderate to severe disabilities enrolled in self-contained early childhood classrooms is necessary. Therefore, the purpose of this study was to examine the effectiveness of a group-based universally designed integrative motor skill intervention on both group and individual gross motor, fine motor, and health-related fitness skill competency of children with moderate to severe disabilities enrolled in a self-contained early childhood classroom.

Methods

Participants and Setting

Preschool and kindergarten children (*N* = 19) with moderate to severe disabilities from a rural Title-1 early childhood center in the southeastern United States participated in the study. All children enrolled in the study presented one or more documented disabilities according to school district records. Across the 19 children enrolled in the study 36 disabilities were present (Autism = 4; Developmental Delay = 15; Speech and Language = 15; Orthopedic Impairment = 1; Other Health Impairments = 1). The overall sample represented both boys (*n* = 12) and girls (*n* = 7) ages 3 to 6 years old (*Mage* = 4.78 years; *SD* = 1.08 years) across multiple ethnicities (African American = 6; Hispanic = 4; Caucasian = 8). Each of the 19 participants for the current study was enrolled in one of three self-contained classrooms within a 26-classroom early childhood center for preschool and kindergarten children. Some children within the self-contained classrooms were placed in inclusion classrooms for short periods of time throughout the day, however never during scheduled gross motor time.

Design and Variables

This study featured a pretest/posttest/control descriptive-analytic design. The independent variable was intervention condition (e.g., integrative intervention or control). The dependent variable was the gross motor, fine motor, and health-related fitness skills.

Procedures

Prior to the start of the current study, we approved all study procedures through an Institutional Review Board at a local university within the southeastern United States. The local school district and school principal also approved all study procedures prior to the start of the study. Parents provided consent and children provided assent to participate in the study. After approval of all procedures, we randomly assigned children across the three self-contained classrooms to either the integrative intervention (n = 11) or control (n = 9) condition. Twenty children started the current study. However, before the study concluded one child in the control condition withdrew before the study. Before the integrative intervention began, we assessed all children on the Bruininks-Oseretsky Test of Motor Proficiency-Brief Form (BOT2-BF) according to the standardized procedures in the testing manual (Bruininks & Bruininks, 2010). After completion of the BOT2-BF at the pretest, children selected for the integrative intervention condition participated in a 30-minute twice-weekly integrative motor skill intervention over the course of six weeks (e.g., 360 minutes). Children in the integrative intervention condition also participated the early childhood centers' regularly scheduled gross motor time (e.g., recess) for the remaining three days per week. Children selected for the control condition participated in the early childhood centers' regularly scheduled gross motor time (e.g., recess) five days per week for the entirety of the 6-week integrative intervention. Upon completion of the intervention, we assessed all children again in both integrative intervention and control conditions on the BOT2-BF.

Bruininks-Oseretsky Test of Motor Proficiency-Brief Form (BOT2-BF)

We chose the BOT2-BF to assess children's overall motor proficiency in areas of gross motor, fine motor, and health-related fitness skills. The BOT2-BF is a product-oriented assessment for individual's 4 – 21 years. The BOT2-BF serves as an identification assessment for delays in gross and fine motor skills. The assessment is comprised of 12-items representing measures of children's motor proficiency across eight subscales (fine motor precision, fine motor integration, manual dexterity, bilateral coordination, balance, speed and agility, upper limb coordination, and strength). We assessed all children according to the procedures stated in the administration manual. For each item of the BOT2-BF assessment, we read the directions to complete each skill from the optional teaching text in the administration manual. During the reading of the directions, we also provided a physical demonstration of the skill. We completed the BOT2-BF with each child on either an individual or small group basis depending on the individual needs of each child.

To assess children's fine motor precision and fine motor integration skills, we had each child complete the fine motor packet with a member of the research team. Each of the 4-items included only one scored trial for each of the four skills. Scoring of the item varied based on skill; we determined scores by either, number of mistakes or by the characteristics of each skill drawing. The six-items of manual dexterity, bilateral coordination, balance, and speed and agility allowed for two scored trial of each skill. We determined each subscale score by the number of correct trials completed within the time allotted by the assessment. In the skills of upper limb coordination, children complete one scored trial of catching a tossed ball. We determine children's score by the number of catches out of five tossed balls. Children complete two scored trials of dribbling a ball with alternating hands. We determine the skill score by the number of consecutive alternating dribbles up to a maximum of 10 dribbles. The strength subscale is comprised of knee push-ups, children complete one scored trial for a maximum number of knee push-ups within the allotted 30 seconds according to the administration manual.

We converted each of the raw skill scores to a skill point score ranging from 0-10 depending on the skill item. We then summed each of the 12 BOT2-BF skill point scores to determine a total BOT2-BF point score, ranging from a score of 0 to 72 for a composite score of children's overall motor proficiency for gross motor, fine motor, and health-related fitness.

Test of Gross Motor Development – Second Edition (TGMD-2)

We implemented the TGMD-2 to provide a motor in-depth assessment of children's gross motor skills. The TGMD-2 both a process and product-oriented assessment of children's fundamental motor skills. The TGMD-2 is a valid and reliable motor assessment for children both with and without disabilities ages 3 to 10 years 11 months old (Ulrich, 2000). The TGMD-2 is comprised of 12 gross motor skills divided into two, 6-item subscales (e.g., locomotor and object control). Locomotor skills refer to gross motor movements that allow children to move from one fixed point to another (Haywood & Getchell, 2014). Object control skills refer to gross motor movements that allow children to perform a designated motor task by manipulating an object. The TGMD-2 locomotor subscale consists of running, galloping, hopping, sliding, leaping, and jumping. The TGMD-2 object control subscale includes skills of dribbling, striking, throwing, catching, kicking, and rolling. We administered the TGMD-2 on an individual or small group basis according to children's individual need. We conducted the TGMD-2 according to all procedures within the administration manual. We provided a demonstration of each skill to the child; the child then completed a practice trial of the skill. If the child did not perform the skill correctly, we provided an additional demonstration of the skill. After the practice trial, children then completed two scored practice trials of each skill.

The scoring of the TGMD-2 is both normative and criterion referenced. However, for this study, we only included criterion-referenced scores. Each of the 12 skills on the TGMD-2 is comprised of three to five critical elements. Scoring of each critical element is determined using a "1" or "0" scoring procedure. A trained rater provides a score of "1" for each critical element performed by the child during a scored trial. The rater provides a score of "0" for each critical element performed by the child during a scored trial. The rater then sums the scores of the two scored trials to determine a raw skill score. Raters then sum each of raw skill scores within each subscale to determine a raw subscale score. Children's total gross motor raw score is then determined from the summation of each raw subscale score.

Integrative Intervention

We developed the Integrative Successful Kinesthetic Instruction Preschoolers (ISKIP) through applying principles of universal design for learning to an existing evidence-based motor skill intervention to meet the wide-range of needs, preferences, and abilities of children with moderate to severe disabilities. The Successful Kinesthetic Instruction for Preschoolers (SKIP) intervention is an evidence-based gross motor skill intervention with a strong history of increasing motor skills for young children ages 3 to 5 years old from socioeconomic disadvantaged settings (Altunsöz, & Goodway, 2016; Brian et al., 2017a, Brian et al., 2017b; Goodway & Branta, 2003). Recently, Taunton and colleagues (2017; in review) established a universally designed version of the SKIP gross motor skill intervention, SKIP-Universal Design for Learning (SKIP-UDL) for children with and without mild to moderate disabilities. We developed the ISKIP intervention using basic principles from both the SKIP and SKIP-UDL intervention. We expanded the intervention to target multiple aspects of basic motor development (e.g., gross motor, fine motor, and health-related fitness skills) required for daily living and quality of life of children with moderate to severe disabilities. For a further description of the development of the ISKIP intervention, please refer to Taunton et al., in review.

ISKIP

A doctoral student holding a physical education teacher certification with over six years' experience delivering motor skill interventions to young children both with and without disabilities provided the ISKIP motor skill intervention. Two trained individuals obtaining degrees in physical education with an emphasis in adapted physical education served as teaching assistants throughout the entirety of the intervention to maintain the early childhood centers student-to-teacher ratio. Additionally, we trained a pre-service physical therapist to serve as a para-professional for a child in the study with an orthopedic impairment to satisfy the school district requirement of the child being provided a paraprofessional throughout the ISKIP intervention.

At the start of the ISKIP intervention, we divided children into three intact groups with three to four children within each group. Upon arrival, we placed children in designated groups, with each group receiving a picture schedule of the daily activities. Children rotated through three skill stations: object control activities (e.g., kicking, striking, throwing, etc.), locomotor activities (e.g., running, jumping, hopping, etc.), and balance, stability, and health-related fitness (e.g., push-ups, walking on lines, balancing on one foot). Children spent approximately 7-minutes at each skill station and rotated through each station within their intact groups. After each group completed the third station rotation, all children came together to complete a 7-minute fine motor skill station (e.g., stringing beads, tracing lines, coloring shapes, etc.).

We designed each skill station *a priori* to account for the individual needs, preferences, and abilities of each child within the ISKIP intervention. Each skill station included activities with multiple means of representation (e.g., skill task cards, brief skill videos etc.) action and expression (e.g., scaffolds within each skill station using a variety of visual, verbal, or physical prompts) and engagement (e.g., autonomy to select equipment, prompts, distances within each skill station). Children rotated through stations in small groups, once at the skill station the interventionist gave a brief group overview of the skill station task, formal instruction of the task, and multiple demonstrations of the task. Within each skill station, children would then choose any additional instructional aides, equipment, and distances, and prompting techniques to complete each skill task.

Control Condition

Children in the control condition, as well as children in the intervention condition on non-intervention days, participated in the early childhood center's regular scheduled gross motor time (e.g., recess) throughout the entirety of the study. During recess children in all three self-contained classrooms played on one of two playgrounds at the early childhood center. Children had access to play on stationary playground equipment (e.g., balance beams, sandboxes, large playground structures). A large bike path surrounded the playground for children to ride tricycles. Also, children had access to various physical education equipment (e.g., playground balls, modified basketball hoop, hula hoops, etc.). Each recess session was monitored by the classroom teacher, teaching assistants and paraprofessionals.

ISKIP Integrity

We created and verified a verification procedure (e.g., ISKIP fidelity check sheet) to establish the integrity and internal validity of the ISKIP intervention. We created the ISKIP fidelity check sheet from two existing measures, the Teacher-led Successful Kinesthetic Instruction for Preschoolers (T-SKIP) fidelity check sheet (Brian et al., 2017b) and the Universal Design for Learning checklist (Lieberman et al., 2008). We first drafted an initial check sheet for the ISKIP intervention modifying many of items from both the T-SKIP check sheet and Universal Design for Learning checklists, in addition to adding items tailored specifically for the context of the ISKIP intervention. We then sent the initial ISKIP fidelity check sheet to a panel of five-experts across various academic disciplines (e.g., adapted physical education, special education, motor development) for feedback. After receiving the feedback from the panel of experts, we created a final version of the ISKIP fidelity check sheet. We also sent the final ISKIP fidelity check sheet again to the panel of experts for approval. We provided an excerpt of the final ISKIP fidelity check sheet in Figure 4.1. For further description of the ISKIP fidelity check sheet, please refer to Taunton et al., in review.

We established the internal validity of the ISKIP intervention through scoring each intervention session with the 60-item ISKIP fidelity check sheet. We trained one rater to independently score all intervention sessions from the video recordings of all intervention sessions. We then trained a second rater to independently score 30 % of all intervention sessions. For a further description of the scoring of the ISKIP fidelity check sheet, please refer to Taunton et al., in review. Raters determined the ISKIP intervention to have an internal validity of 95.7% with an inter-rater agreement of 93.1% between independent raters. Furthermore, we video recorded all BOT2-BF (Bruininks & Bruininks, 2010) assessments for each child at the pretest and posttest to establish assessment coding and intervention integrity across multiple raters. All raters of the BOT2-BF form first established the initial reliability of 92.6% with a "gold standard" prior to coding the current study sample. All raters established inter-rater reliability of 88.3% amongst each other across both pretest and posttest BOT2-BF assessments (Bruininks & Bruininks, 2010).

Data Analysis

We first conducted descriptive analysis using pretest and posttest point scores of both BOT2-BF and TGMD-2 scores (Table 4.1).

BOT2-BF

We conducted two paired samples *t*-tests with pretest and posttest BOT2-BF point scores for both the ISKIP (n = 11) and control groups (n = 5). We removed three children in the control condition from analysis of BOT2-BF scores due to non-compliance with the assessment at either the pretest or the posttest. We then calculated mean differences in pretest and posttest BOT2-BF point scores for each child in both the ISKIP condition and control condition to determine individual motor gains of each child within the ISKIP intervention.

TGMD-2

We conducted four separate paired samples *t*-tests with pretest and posttest TGMD-2 scores of locomotor and object control subscales between the ISKIP (n = 10) and control condition (n = 6). The first independent samples *t*-test examined locomotor scores for both the ISKIP (n = 10) and control groups (n = 6). We removed one child in the ISKIP condition from analysis due to inability to complete the locomotor subscale due to an orthopedic impairment. We also removed another child in the control group from analysis due to non-compliance. The second independent samples *t*-tests examined object control scores pretest to posttest for both ISKIP (n = 11) and control groups (n = 6). We also removed the same child from the locomotor analysis from the object control analysis due to non-compliance. We then calculated change scores in pretest and posttest scores for each child in both the ISKIP and control condition to determine the individual motor gains of locomotor and object control skills.

Results

Paired Samples *t*-test

There were no significant differences in BOT2-BF scores from pretest to posttest for both the ISKIP ($t(10) = -2.21$ $p = .051$, $d = -1.39$) and control conditions ($t(4)$, p =

2.98, *d* = 2.98). Results for TGMD-2 scores demonstrated that there were significant differences from pretest to posttest in both locomotor ($t(9) = -6.03$, $p < .001$, $d = -4.02$) and object control skills ($t(10) = -3.80$, $p = .003$, $d = -2.40$) for children in the ISKIP condition. The control condition demonstrated no significant differences from the pretest to posttest for the BOT2-BF ($t(4) = .29$, $p = .298$, $d = -.29$), TGMD-2 locomotor skills ($t(6) = -.31$, $p = .762$, $d = -.25$) or TGMD-2 object control skills ($t(6)$ -.63, $p = .549$, $d = -.51$).

Individual Mean Differences

BOT2-BF

Children in the ISKIP condition showed change score scores from pretest to posttest ranging from -2 to +26. The overall change score mean for the ISKIP condition was 6.09 with a standard deviation of 9.09. Children in the control condition showed mean differences scores ranging from -1 to +3 from the pretest to the posttest. The overall change score mean for the control condition was 1.00 with a standard deviation of 1.87. We provided individual analyses of BOT2-BF mean differences for children in both the ISKIP and control condition in Figure 2.

TGMD-2

Children in the ISKIP condition showed mean difference scores from pretest to posttest ranging from +1 to +16 for the object control subscale. The overall change score mean of the ISKIP condition for object control subscale was 9.54 with a standard deviation of 4.45. Children in the control condition showed mean differences scores ranging from -4 to +7 from the pretest to the posttest for the object control subscale. Children in the control condition showed mean differences scores ranging from -7 to +4 from the pretest to the posttest for the object control subscale. The overall change score mean of the control condition for object control subscale was 1.83 with a standard deviation of 5.15. Individual analysis of TGMD-2 object control mean difference scores for children in both the ISKIP and control condition can be located in Figure 3. Children in the ISKIP condition showed mean difference scores from pretest to posttest ranging from +1 to +11 for the locomotor subscale. The overall change score mean of the ISKIP condition for the locomotor subscale was 6.90 with a standard deviation of 2.92. Children in the control condition showed mean differences scores ranging from -7 to +4 from the pretest to the posttest for the object control subscale. The overall change score mean of the control condition for the locomotor subscale was -1.16 with a standard deviation of 3.60. We provided individual analyses of TGMD-2 locomotor and object control subscale mean difference scores for children in both the ISKIP and control condition in Figure 3. Means and Standard Deviations of the BOT2-BF, TGMD-2 locomotor subscale, and TGMD-2 object control subscale.

Discussion

The purpose of this study was to examine the effectiveness of a group-based universally designed integrative motor skill intervention (e.g., ISKIP) on the individual gross motor, fine motor, and health-related fitness skills of children with moderate to severe disabilities enrolled in a self-contained early childhood classroom. More specifically, we aimed to create an ecologically valid intervention to see not only if improvements in gross motor, fine motor, health-related fitness skills could occur but also show the extent to which current early childhood centers standards for developing motor skills in the hypothesized least restrictive environment were actually “least restrictive” for the participants in our sample.

The current “least restrictive” environment at the early childhood center for motor skill activities was recess (e.g., free play). Recess included no specific skill instruction, but access to equipment such as playground balls, hula hoops, balance beams, basketball goals, sandboxes, tricycles, tracing worksheets, string and beads, etc. Children in all three self-contained classrooms (N = 30) attended recess at the same time on one playground. Three lead teachers supervised recess with the help of two teaching assistants and three paraprofessionals. The ISKIP condition mimicked the early childhood center’s teacher to student’s ratio, with much of the same equipment in the recess condition at the early childhood center. We only included formalized instruction using evidence-based practice to deliver an integrative universally designed curriculum for motor skills as opposed to teacher facilitation in recess.

Gross Motor, Fine Motor, and Health-Related Fitness Skills

Given the integrative structure of the ISKIP intervention, we examined children in both the ISKIP and control conditions gross motor, fine motor, and health-related fitness skills prior to and after the intervention using the BOT2-BF. While some children in the ISKIP condition demonstrated individual gains in BOT2-BF scores (+0 to +26), results revealed no significant group differences (p = .051) from the pretest to the posttest. Lack of group significance from pretest to posttest is somewhat surprising given that we provided a structured intervention led by an expert interventionist. However, the BOT2-BF is solely a product-oriented assessment (Bruininks & Bruininks, 2010). Changing the product of young children’s movement requires more time than changing the process of children's movement (True, Brian, Goodway & Stodden, 2017). Therefore, our short intervention dosage (e.g., 6 weeks for 360 minutes) may not have been enough to change the product of children's movement. Specifically, the issues of intervention dosage compounded by the multiple components targeted in an integrative intervention many have not allotted enough time to develop and improve each individual gross motor, fine motor, and health-related fitness variable within the ISKIP intervention. We hypothesize that a larger ISKIP intervention dosage with a larger sample of young children ages 3 – 6 with moderate to severe disabilities study results may yield significant differences between the pretest and posttest BOT2-BF scores.

Object Control and Locomotor Skills

Given the nature of the integrative intervention, we wanted to perform a more in-depth analysis of children's gross motor skills. Gross motor skills through the process measures of the TGMD-2 we found significant differences in both object control (+ 1 to +16 raw points) and locomotor skills (+1 to +11) between children in the ISKIP condition from pretest to posttest. However, no significant differences were reported for children's object control (-4 to +7) and locomotor skills (-7 to +4) for children in the control condition from pretest to posttest. These findings are not surprising giving process measures (e.g., step with opposition) change more quickly than product measures (e.g., number of pushups in 30 seconds) of children's movement. While we reported overall significant gains both locomotor and object control skills in the ISKIP condition, two children in the ISKIP condition still demonstrated only marginal gains (+1 to +5) in gross motor skills (either object control or locomotor skills). This is an indication that while group-based universally designed motor skill interventions may be a "least restrictive" environment for most children given the current support structure (e.g. teacher to student ratio, paraprofessionals), some children may need additional support or specially designed adapted physical education in order to develop and improve gross motor skills. Moreover, children in control condition demonstrated little to no gain in gross motor skills, or in some cases even regressed in gross motor skills from pretest to posttest. As a group, the control condition did not significantly increase locomotor (+1 to +3) or object control skills (+1 to +5) from the pretest to the posttest. Overall, three children in the control condition showed no gain (+0) in one subscale and even regressed slightly (-4) in another subscale. Only one child in the control condition increased in the both the locomotor subscale (+4) and the object control (+7) subscale from the pretest to the posttest. Findings from this study provide evidence that current recess conditions within early childhood centers may not be conducive for children with moderate to severe disabilities to develop locomotor (e.g., hopping and jumping) and object control skills (e.g., striking and kicking).

Importance of the Least Restrictive Environment

Our results demonstrate that while a universally designed intervention curriculum can increase the gross motor, fine motor, and health-related fitness skills of some children with moderate to severe disabilities in a group-based setting, it did not for all children. Specifically, children with lower function or more severe disabilities within the ISKIP condition did not significantly develop or increase gross motor, fine motor and health-related fitness skills. Our results provide evidence that the universally designed curriculum may be an effective instructional strategy for all students but only when children are provided with the appropriate supports (e.g., para-educators) and within their true least restrictive environment. Literature supports these results presenting evidence that providing children with moderate to severe disabilities appropriate supports is critical for their learning and development (Knight, Browder, Angello, & Lee, 2017). Thus, changes in the early assessment and evaluations of young children in regard to gross motor, fine motor and health-related fitness skills is warranted. Most notably, results of assessments and evaluations should be reflected in children's Individualized Education Plans and children need to be provided with the appropriate services and supports to meet goals in the development of gross motor, fine motor and health-related fitness skills.

Strengths and Limitations

The current study was an exploratory study to examine the effects of a group-based ISKIP intervention within a self-contained early childhood center on gross motor, fine motor, and health-related fitness skills of children with a wide range of moderate to severe disabilities. While this study poses many strengths, it is not without limitations. We utilized two separate validated motor assessments the BOT2-BF and TGMD-2 to measure the effects of the integrative intervention. We did not solely target one component of children's overall motor skills but rather multiple facets of gross motor, fine motor, and health-related fitness skills. Moreover, in using assessments that capture both the process and product of children's motor skills provides an in-depth examination of specific areas of delay and growth throughout the study on children's gross motor, fine motor, and health-related fitness skills. This exploratory study was innovative in that it was the first to our knowledge to implement a universally-designed integrative intervention within a group-based setting to children with moderate to severe disabilities. Results of this study have significant implications for teachers and administrators regarding assessment, placement, and curriculum strategies for young children with moderate to severe disabilities enrolled in self-contained classrooms. The current study provides evidence that a universally-designed integrative motor skill intervention can improve gross motor, fine motor, and health-related fitness skills of children with moderate to severe disabilities. However, due to the small sample size, the generalizability of our results should be taken with caution. Gaining parental consent, child assent, and child compliance throughout the current study proved difficult. We suggest informing parents of the benefits of assessment, evaluation, and services may be beneficial when conducting future studies. Also, given the ecological validity of the current study identifying appropriate assessment environments in addition to time constraints posed many challenges in gaining some children's compliance to participate not only in the assessment but the intervention as well.

Future Research

Regardless, of the constraints of children not being placed in their least restrictive environment, many children in the ISKIP condition still demonstrated sizeable gains in gross motor, fine motor, and health-related fitness skills. Future research should examine the effects of a universally designed integrative interventions such as ISKIP, with children when given appropriate supports within each child's least restrictive environment. Children in the ISKIP condition demonstrated significant gains in process-oriented skills (e.g., locomotor and object control skills in the TGMD-2) but not in product-oriented skills (e.g., gross motor, fine motor, and health-related fitness skills as measured by the BOT2-BF) although significance was emergent in BOT2-BF scores, there were no significant differences in ISKIP children's motor skills from pretest to posttest. Future research should examine the effects a longer ISKIP intervention on both the process and product of children with moderate to severe disabilities gross motor, fine motor, and health-related fitness skills.

Conclusion

Young children enrolled in early childhood with moderate to severe disabilities are demonstrating low levels of proficiency in gross motor skills, fine motor skills, and health-related fitness skills. Currently, many young children with moderate to severe disabilities do not receive appropriate instruction or support within existing motor time (e.g., recess or targeted fine motor skill development). However, some children with moderate to severe disabilities who participated in an integrative universally designed intervention (e.g., ISKIP) twice per week during regularly scheduled gross motor time at an early childhood center for 6-weeks (e.g. 360 instructional minutes) made some improvements gross motor, fine motor, and health-related fitness skills compared to children who only received recess. Most notably, children in the ISKIP condition demonstrated significant changes in process characteristics of gross motor skills (e.g., locomotor and object control skills) from the pretest to the posttest. While we reported no significant group change in the ISKIP group product characteristics, we did report some individual changes in children's gross motor, fine motor, and health-related fitness skills. Findings from this study suggest young children with moderate to severe disabilities can improve gross motor, fine motor, and health-related fitness skills through a universally designed motor skill curriculum, however, children must be provided the appropriate support (e.g., paraprofessionals) and be placed in their "least restrictive" environment. Future research should examine the effects of longer intervention dosages and retention effects of integrative interventions such as ISKIP on both the process and product characteristics gross motor, fine motor, and health-related fitness skills for children with moderate to severe disabilities.

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*Instructions: Circle a **1** in the line if the consideration is present. Circle a **0** in the box if the item is not present. Circle a **(-)** if the list item is not applicable*		
Prior to Lesson		
Equipment set up prior to arrival of children	**Children have "homebase" at the start of lesson**	**Lesson setup ready**
1 0 (-)	**1 0 (-)**	**1 0 (-)**
Introduction		
All children present at start (no excluding children that are being accompanied by aide or therapist)	**Preview of activities**	**All children engaged attended to task**
1 0 (-)	**1 0 (-)**	**1 0 (-)**
Introduction Total = ___/___		
Task 1:Demonstration		
Minimum of 1 – maximum of 3 cues (aligned with lesson)	**Demonstrated from multiple angles**	**Correct physical demonstration**
1 0 (-)	**1 0 (-)**	**1 0 (-)**
Developmentally appropriate demonstration used (e.g., supports, present level of performance)	**Demonstrated repeated from multiple angles**	**Check for understanding occurs before students are sent to task**
1 0 (-)	**1 0 (-)**	**1 0 (-)**
		Circle: Verbal, repeat demonstration, Y/N questions
Within- task		
All children have own piece of selected equipment <u>or</u> share with partner	**Correct task extension or refinement was offered/occurred for all students as needed**	**Pacing of task is appropriate for all students**
1 0 (-)	**1 0 (-)**	**1 0 (-)**
	Rater Judgement Circle: 1 = correct (more than 75% of task); **0 =** incorrect or correct less than 25% of task; **(-)** needed but did not occur**; *** correct but not needed	**Rater Judgement Circle: 1 =** correct (80% or more of children successful at task); **0 =** incorrect **(**less than 80% of children are successful at task)
Instructor provides feedback with cues from the demonstration occurs at a rate of 1 feedback statement per minute	**At least one feedback provided to each child throughout the task**	**Notes:**
1 0 (-)	**1 0 (-)**	
Circle the following that occurred: Congruent, Positive, and Specific		
Closure		
Closure is approximately 15 to 30 seconds	**Teacher reviews cues, safety and procedural issues**	**Instructor checks for understanding**
1 0 (-)	**1 0 (-)**	**1 0 (-)**
Task 1 Total: _____/______		
Fidelity Totals		
Prior to Lesson: Correct Score_____ / Total Opportunities _____	**Intro: Correct Score_____ / Total Opportunities _____**	**Task 1: Correct Score_____ / Total Opportunities _____**
Transition: Correct Score_____ / Total Opportunities _____	**Conclusion: Correct Score_____ / Total Opportunities _____**	**Total Fidelity Items Correct: _____ / Total Number Possible ______**
Overall Universal Design in Physical Education Setting		
<u>Circle items that are present to promote Inclusiveness:</u> • Tasks within the Physical Education are done as a whole (not segregated) • Students are taught without any stigmatization • Tasks are designed to allow success for all children	**<u>Circle items that are present to promote Physical Access:</u>** • Children have access to all areas within the lesson space • Space is wheelchair accessible • Proper visual supports and signage posted as needed • A wide variety of equipment is available at each task • Children are allowed choices and free movement	**<u>Circle items that are present to promote Delivery Mode Representation:</u>** • Trained assistants help deliver lesson content • Various visual, verbal, sensory cues are present at each task • Proper model behavior • Instructors and assistants use a variety of instructional styles
<u>Circle items that are present to promote Engagement:</u> • Children are encouraged to engage with one another and instructors • Children are encouraged to try new skills within task • Children feel safe within task • Children are encouraged to demonstrate sportsmanship to peers • Children demonstrate appropriate behaviors within tasks • Children are encouraged to participate in conflict resolution	**<u>Circle items that are present to promote Multiple Means of Assessment:</u>** • Standardized Testing • Authentic Assessment (rubric, checklist) • Repetitive practice of each task • Verbal recall of elements of each skill or task	***Inclusiveness Total:*** _________ ***Physical Access Total:*** _________ ***Delivery Mode Representation Total:*** _________ ***Multiple Means of Engagement Total:*** _________ ***Multiple Means of Assessment Total:*** ___________ ***Total UDL Sum:*** _________

Figure 4.1 Small Excerpt of the ISKIP Fidelity Check Sheet

Table 4.1

Means and standard deviations of mean differences scores of ISKIP and Control children

Assessment	*N*	*M*	*SD*
BOT2-BF			
ISKIP	11	6.09	9.09
Control	5	1.00	1.87
TGMD-2 LOC			
ISKIP	10	6.27	3.46
Control	6	-1.17	1.83
TGMD-2 OC			
ISKIP	11	8.75	5.06
Control	6	3.60	5.15

Note. N = Sample Size; M = Mean; SD = Standard Deviation; LOC = locomotor; OC = object control.

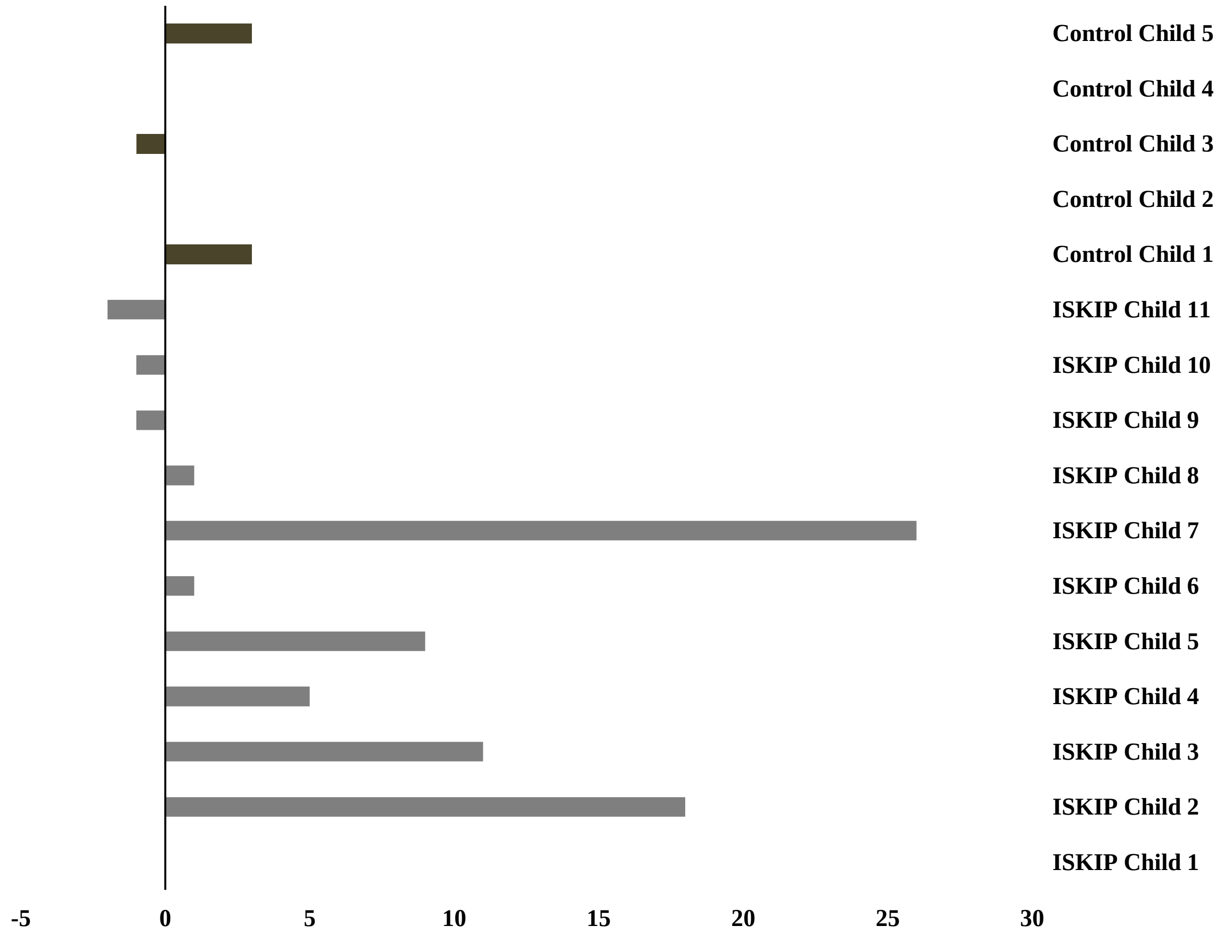

Figure 4.2 Individual Change Scores of the BOT2-BF Scores of ISKIP Children Compared to Control Condition.

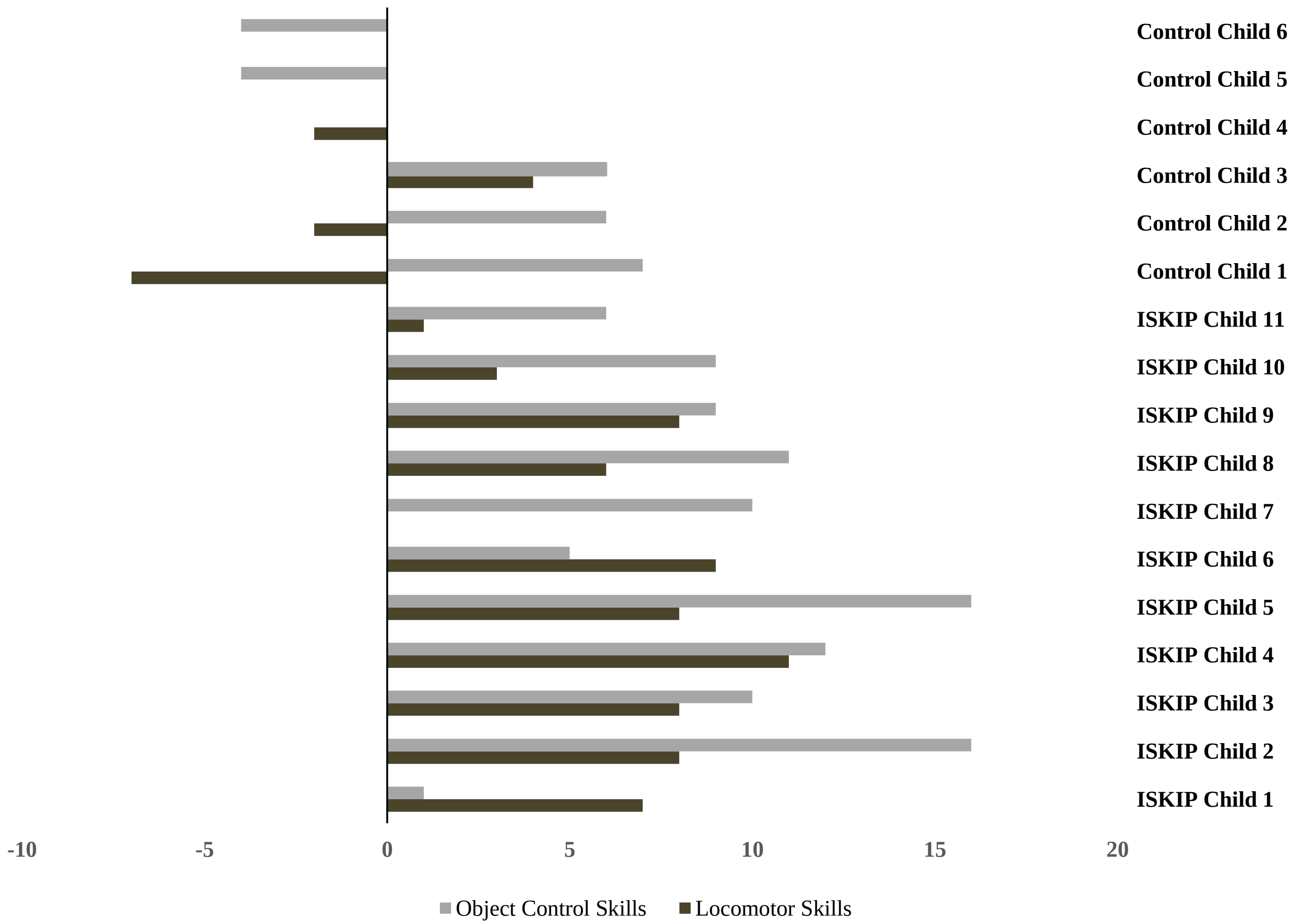

Figure 4.3 Individual Change Scores for the TGMD-2 Scores of ISKIP Children Compared to Control Condition.

Table 4.2

Paired Samples t-test ISKIP and Control groups for all assessments from pretest to posttest.

Assessment	***t***	***df***	***p***
BOT2-BF			
ISKIP	-2.22	10	.051
Control	-1.19	4	.298
TGMD-2 OC			
ISKIP	-3.80	10	.003
Control	-.634	6	.549
TGMD-2 LOC			
ISKIP	-6.00	10	.000
Control	-3.17	6	.762

Note. OC = Object Control skills. LOC = Locomotor skills.

CHAPTER 5

DISCUSSION

Importance of Instructional Support and the Least Restrictive Environment

Universal design for learning is an effective curriculum and instructional strategy across general and inclusion classrooms for children with mild to moderate disabilities. Universal design for learning demonstrated only marginal to moderate effectiveness in some children with a wide range of moderate to severe disabilities. While the curricular framework of universal design for learning seemed to be an effective strategy for a class with such a wide range of needs, preferences and learning styles, lack of support and some children not being placed in their least restrictive environment may have been a factor in gains in gross motor, fine motor, and health-related fitness for lower functioning children in the ISKIP condition. Future research should examine the effects of ISKIP across different least restrictive environments with children who have moderate to severe disabilities (e.g., general physical education, inclusive physical education, specially-designed physical education, individual physical education, etc.) with the proper supports for each individual child within the least restrictive environment.

I conducted the two studies using ecological validity in a naturalistic school-based settings, only using the current staff and resources available. Based upon the results of our studies, I recommend that provided support services and placement of children in their least restrictive environment be carefully evaluated for young children with disabilities in early childhood center (e.g. preschool and kindergarten). Our findings are supported with literature that early childhood classroom and special education teachers do not feel qualified to teach children in physical education settings (Martin et al. 2016; Brian et al., in review), children with disabilities often placed in not supportive environments (e.g., general physical education without proper support) demonstrate lower motor skills, participation and physical activity (Bloeman et al., 2015; Pan, 2008; Qi & Ha, 2015). According to IDEA, if children with disabilities, particularly young children with moderate to severe disabilities are not receiving the appropriate services, it may be appropriate services and the children's least restrictive environment has not yet been identified. Once children with disabilities are identified of needing certain services and placed in an appropriate environment, the federal government will provide appropriate services and supports (IDEA, 2014). Therefore, I recommend future research should examine the following in order to increase the gross motor, fine motor, and health-related fitness skills: (a) training early childhood teachers to provide structured motor programming (e.g., ISKIP) (b) provide early identification assessments to provide documentation of appropriate services required for children to develop motor skills (c) use evidence from early assessment to place children in their least restrictive environment. Overall, our findings provide evidence that placing children with disabilities, especially children with moderate to severe disabilities in their least restrictive environments with appropriate supports is critical (Knight et al., 2017). Also, results of our study suggest that longer intervention dosage may be required for children with moderate to severe disabilities particularly for the product characteristics of movement.

Process and Product Measures

Children in general, inclusion, and self-contained ISKIP conditions demonstrated significant gains in the process characteristics of gross motor movements as measured by the TGMD-2 from the pretest to the posttest. Our results are consistent with previous literature demonstrating the process of movement changes quickly over time, particularly with short intervention dosages (Brain et al., 2017a; Brian et al. 2017b; Taunton et al., 2017; True et al., 2017). Moreover, product characteristics of children's movement take longer time to develop and change than the process characteristics (Clark & Whitall, 1989). To appropriately assess the additive effects of conducting and integrative intervention (e.g., ISKIP) as a whole rather than each individual skill in isolation greater intervention dosage (e.g., greater than 12 weeks) may be required.

Sensitivity versus Specificity of Motor Assessments

In regard to both studies, the TGMD-2 did not capture the true instability of most children's gross motor skills. Our findings suggest that the TGMD-2 is not a sensitive enough measure to identify certain instabilities in children's gross motor skills. The BOT2-BF was sensitive enough to capture children's instability in gross motor, fine motor, and health-related fitness skills. However, the BOT2-BF assessment failed to capture the positive changes to children's gross motor, fine motor, and health-related fitness skills. Therefore, the BOT2-BF may be too specific to detect a change in the product of children's movement during short periods between testing (e.g., six-weeks). Our results provide further support for multiple assessments not only to capture the process and product of children's motor skills but to also capture the programmatic effectiveness of integrative interventions. Furthermore, I recommend that any intervention targeting children both with and without disabilities implement multiple motor assessments to avoid a type I or type II errors. Our results demonstrate the BOT2-BF, when used as a sole motor assessment may report a type II error, while the TGMD-2 when used as a sole motor assessment may report a type I error (True, Brian, Goodway, & Stodden, 2018).

Principles of Motor Learning Essential to Developing Motor Skills

The positive and significant gains reported in either gross motor, fine motor, and health-related fitness skills across both studies are possibly due to the strong influence of motor learning principles with the ISKIP intervention (Schmidt & Lee, 2013). I employed a block lesson plan to ensure that each skill during the ISKIP intervention was taught with equal time across 6-weeks (Appendix A). Within the block lesson plan, however, I used a randomized practice schedule, within emphasis of five to eight skills per day to ensure not only a high frequency of skill practice but to increase the number of daily practice trials. Also, to elicit more opportunity for a high ratio of correct practice trials I provided a high volume of specific congruent feedback of group and individual performance for each skill (e.g., "Next, time when you jump, lift your arms to the sky") within the ISKIP intervention. Moreover, I provided a least to most skill prompting hierarchy (e.g., physical prompt, visual prompt, verbal prompt) within the ISKIP intervention to ensure I provided children optimal resources to produce maximal opportunity for correct practice trials of each skill.

Our results of regression or no change (+0 to -7) in gross motor, fine motor, and health-related fitness skills for children in the control condition and some children in the self-contained ISKIP condition further demonstrate the potential influence of including motor learning principles in teaching gross motor, fine motor, and health-related fitness skills. Children in the control condition of recess receive no structured opportunities to develop motor skills. Therefore, there is no sequential order in which they learn skills, planning of the frequency and exposure to certain skills, in addition to no feedback to skill performance. Based upon results in both studies at the pretest and posttest, free play and recess may not be an appropriate environment for children to develop gross motor, fine motor, and health-related fitness skills. Most notably, some children in the self-contained ISKIP condition that I provided structured opportunities rooted in principles of motor learning did not increase gross motor, fine motor or health-related fitness skills. Through the entirety of the intervention, these children may not have engaged in the activities to reap the benefit of motor learning principles. In fact, these children may have demonstrated high levels of sedentary behaviors, high rates of incorrect practice trials for skills, and disregard for specific congruent feedback. Therefore, simply providing the principles of motor learning within the ISKIP intervention is not enough. Future research should examine the association with process variables (e.g., response to feedback, number of correct/incorrect practice trials, the time allotted and frequency of each skill) within the ISKIP intervention influences gains in gross motor, fine motor, and health-related fitness skills for individual children.

Newell's Constraints Interpretation for Learning Motor Skills

Results of both the current studies yielded that children in the control condition did not improve gross motor, fine motor, or health-related fitness skills over the 6- week period. Our findings are consistent with previous literature demonstrating that children who only receive recess or unstructured opportunities to do develop gross motor, fine, motor and health-related fitness skills (Brian et al., 2017a; Brain et al., 2017b; Taunton et al., 2017).

However, most children in the ISKIP condition across both studies showed a great positive change in gross motor, fine motor, and health-related fitness skills. Our findings support through the theoretical framework of Newell's constraints in the development of the ISKIP intervention. I provided a structure within ISKIP to elicit positive change and development of gross motor, fine motor, and health-related fitness skills. I provided ISKIP lessons to perturbed each individual child's gross motor, fine motor, and health-related fitness skills. For example, I elicit freezing degrees of freedom through providing control parameters such visual prompts (e.g., sticker on non-dominant foot and dominant throwing hand) to produce a more proficient movement pattern. I also provided multiple variations to accommodate needs, present level of performance, and learning styles within the overall ISKIP environment (e.g., multiple presentations of each skills and a variety of equipment) and each individual motor tasks (e.g., various levels for practice trial, multiple distances to complete each task) More I provided positive and appropriate experiences within a structured environment to account for individual constraints of each child, specifically children disabilities.

Dynamical Systems Interpretation of Non-Significant Change

Children with Disabilities Need More Time to Develop Motor Skills

The lack of significant gains in gross motor, fine motor, and health-related fitness skills of children with moderate to severe disabilities in the second study may be explained through a practical translation of DST. The development of motor skills is age-related yet not age-dependent (Schmidt & Lee, 2013). Rather development of motor skills occurs through the organization of the multiple interactions (individual, environment, and task) in relation to the development of an individual's motor process is dependent on three specific factors: degrees of freedom, order parameters, control parameters and attractor states (Kelso, Holt, Kugler, & Turvey, 1980; Kugler, Kelso, & Turvey, 1980; Kugler, Kelso, & Turvey, 1982; Thelen, 1985). Development of motor skills is also not linear; it occurs through stages of movement patterns stability and instability also known as attractor states (Langendorfer & Roberton, 2002). I feel that through the ISKIP intervention, I perturbed children with moderate to severe disabilities' motor system from one attractor state of stability, to an attractor state of instability. However, the intervention dosage was not long to shift children into another state of stability within each child's motor system. Essentially, the ISKIP intervention was not long enough to provide enough control parameters (e.g., environmental affordances or rate limiters) to change the order parameters of children's motor patterns. The short dosage of intervention was influenced by the environmental constraints of the ecological validity of school-based intervention (e.g., time). However, with higher ISKIP intervention dosage, children with moderate to severe disabilities may demonstrate significant gains in gross motor, fine motor, and health-related fitness skills.

Strengths and Limitations

The two studies provide multiple strengths but are not without limitation. The two studies are innovative in both studies first of its kind to our knowledge. Specifically, providing an ecologically valid study examining the effects of a universally designed curriculum to develop gross motor, fine, motor and health-related fitness skills across general, inclusion and self-contained early childhood (preschool and kindergarten) classrooms. Additionally, examining the programmatic effectiveness of motor skill intervention through both process and product measures. The two studies are also significant in that our results have implications for early identification and assessment, placement into services and children's least restrictive environment, and appropriate curriculum strategies for teaching children with mild to severe disabilities in general, inclusive and group-based environments. Another major strength to both studies is the randomization of children to either the ISKIP or control condition occurred at the individual child level instead of at the classroom level. I assigned each individual child across the three general, inclusion, and self-contained classrooms to wither the SKIP or control condition, as opposed to all children enrolled in one classroom being assigned to the same intervention or control condition.

Although both studies provide much strength, there are also a few limitations. One limitation is the short ISKIP intervention dosage (e.g., 6-weeks/360 minutes). While the children in the general and inclusion classes demonstrated significant changes in both TGMD-2 ($t(109) = 6.270$, $p < .001$, $d = .22$) and BOT2-BF scores ($t(109) = 2.331$, $p = .022$, $d = .14$) from pretest to posttest as compared to control children, only the TGMD-2 scores demonstrated no significant differences between children with and without disabilities ($F(1, 52) = .075$, $p = .785$, $\eta^2 = .00$). Results still demonstrated significant although marginal differences ($F(1, 52) = 4.85$, $p = .030$, $\eta^2 = .04$) in BOT2-BF scores between children with and without disabilities. Moreover, children in the ISKIP self-contained class only demonstrated significant differences in TGMD-2 object control ($t(10) = -3.80$, $p = .003$, $d = 2.04$) and locomotor scores ($t(9) = - 6.03$, $p < .00$, $d = - 4.02$) scores but not BOT2-BF scores ($t(10) = -2.21$ $p = .051$, $d = -1.39$), although BOT2-BF scores were emergent. Given these results, a longer ISKIP intervention dosage may be warranted to significantly impact gross motor, fine motor, and health-related fitness skills of children with disabilities. Our findings are supported through a study conducted by Taunton and colleagues in 2017, demonstrating that while children with disabilities demonstrated significant gains in gross motor skills during a 6-week universally designed motor skill intervention, gains in gross motor skills were not at the same rate of change as children without disabilities. The second study examining the effects of the ISKIP intervention on gross motor, fine motor, and health-related fitness skills of children in a self-contained classroom has a small sample size ($N = 19$). While results of this study provide valuable insight into the effectiveness of the ISKIP intervention on gross motor, fine motor, and health-related fitness skills of children with moderate disabilities, the generalizability of our results to a larger population should be taken with caution.

Future Research

Given the results of the two studies, future research should examine the effects of a longer ISKIP intervention dosage (e.g., +12 weeks) on gross motor, fine motor, and health-related fitness skills of children in general, inclusion and self-contained early childhood centers. In tandem with a larger intervention dosage, future research should examine the programmatic effectiveness of a longer intervention dosage using both process and product oriented motor assessments. Future studies should replicate the ISKIP intervention in a variety of school-based settings. Specifically, delivering the ISKIP intervention with appropriate supports and in the least restrictive environments for children with moderate to severe disabilities. To further the ecological validity of the ISKIP intervention, this study should be replicated across multiple grade levels (e.g., grades 1-6) and across various implementers (e.g., classroom teachers, special education teachers, physical education teachers, and adapted physical education teachers).

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