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Using Auditory Modalities to Develop Rhythmic Competency in Children's Fundamental Movement Skills

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Abstract

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MS, West Virginia University, 1995

BS, West Virginia University, 1994

Doctoral Study Submitted in Fulfillment

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Abstract

Physical education classrooms often have low levels of moderate to vigorous physical activity levels. This is a problem since many young elementary students are not building a foundation of fundamental movement skills necessary to be lifelong participants in physical activities. This study investigated how elementary physical education teachers used auditory modalities in their classrooms. The research question explored the emergence of rhythmic competency in fundamental movement skills to increase overall moderate to vigorous activity levels. This concurrent, mixed-methods, multiple case study used a constructivist paradigm using the schema and dynamic system theories as the underlying motor system theoretical framework. Two research sites were selected: a suburban Maryland public school system and a private liberal arts college located in the same county. The participants included 21 elementary physical education teachers and 6 physical education or exercise science majors from nationally recognized programs. Data were collected from a focus group, interviews, classroom observations, and a 10-item response Likert style survey designed for elementary physical education teachers to recognize current trends in the field of auditory modalities and rhythmic competency. The data were analyzed to identify auditory modality instructional methods for the emergence of rhythmic competencies. The results consisted of a list of best practices for use such as musical rhythms, verbal cues, and sound cues by physical education teachers and specialists. This research promotes positive social change by providing information for successfully planning interventions in the discipline of motor skill and rhythmic development that can lead to overall increased more-vigorous physical activity.

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Dedication

To my parents, Fred and Mary Hintermister.

Acknowledgments

To my husband, for his patience, flexibility, and understanding while I was working towards this degree. To my son, Paul, who was constantly asking when Mommy would be done with her homework so he could go play. I would also like to thank my Chair, Dr. Maryanne Longo, for her continued guidance, reassurance, and belief in me that enabled me to reach my professional and personal goals.

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Section 1: Introduction to the Study

Physical Activity Levels in Young Children

Physical inactivity is a complex, multilevel problem including psychological, social, and environmental aspects (Jaakkola, Yli-Piipari, Huotari, Watt & Liukkonen, 2016). According to the National Physical Activity Plan Alliance (NPAPA, 2014) about one quarter of U.S. children ages 6-15 do not meet the recommended daily minimum of 60 minutes of moderate-to-vigorous physical activity. More than 95% of U.S. children in this age range are enrolled in America's schools, which are ideal settings for children to learn how to adopt and maintain a physically active lifestyle (CDC, 2010b). However, only 34% of these youth are involved in physical activity that meets the recommended guidelines (CDC, 2010a). Research indicates that efficient early motor skill competence can positively impact physical activity levels throughout a child's life (Lloyd, Saunders, Bremer, & Tremblay, 2014).

Most team and individual sports require the skillful execution of a combination of fundamental locomotor and manipulative movement skills (Hall, 2010). Haywood and Getchell (2009) described fundamental movement skills (FMS) as the basic locomotor skills (e.g., run, jump, hop, leap, slide, and gallop) and manipulative skills (e.g., throw, catch, dribble, roll, strike, and catch), which serve as prerequisites to learning more advanced motor skills. FMS are the building blocks for sport-specific movement skills that can lead to higher levels of physical activity (Cohen, Lubans, Morgan, Plotnikoff, Callister, & Robin, 2014). Fundamental movement skills do not naturally develop without being learned, practiced, and reinforced (Logan, Robinson, Wilson, & Lucas,

2012). In general, movement coordination or the ability to move the body as a cooperative whole is essential for the development of FMS (Hall, 2010).

An integral part of a quality elementary physical education school curriculum is developing FMS that encourage moderate to vigorous physical activity levels or MVPA throughout a child's lifespan (Jaakkola et al., 2016). Evidence based physical education program interventions can improve FMS development that can increase physical activity levels in young children (Eather, Morgan, & Lubans, 2013; Lai et al., 2014). Loprinzi, Davis, and Fu (2015) suggest a further examination of the role of motor competence is necessary in the adherence of physical activity. Equally important is the identification of positive determinants in the acquisition of FMS that is essential for motoric success (Iivonen & Saakslahti, 2014). This is especially true for inefficient or ineffective motor skills because they can impact a child's participation in physical activity across their lifespan (Lloyed et al., 2014)

Rhythm and timing are two positive determinants that have been identified as necessary for coordinated movement patterns that give children the motor skill competency necessary to develop FMS, which in turn can lead to more physical active lifestyles (Scott, 2009). Additionally, combining music and motor skills for the development of locomotor proficiency and coordination provides an opportunity to increase overall rhythmic competency in FMS (Berg & Breslin, 2014). For this reason, a concurrent mixed methods multiple case study was selected to explore the role of auditory instructional modalities in the development of rhythmic competency in FMS in young elementary age students. Using a combination of qualitative and quantitative data

collection tools provided a comprehensive approach to the data analysis for a more complete understanding of the problem (Creswell, 2014). I collected data at two nationally recognized research sites and through a county-wide survey in the public school system, resulting in a better reflection of current best practices that can lead to a more in-depth analysis of strategies and solutions to the research problem.

Recent findings suggest that young elementary age students lack beat competency and locomotor/nonlocomotor skills for beat synchronization for age appropriate structured dances (Little, 2012). This is concerning knowing that rhythmic competency is essential in the development of coordinated fundamental movement patterns (Scott, 2009). Rhythm is the most motivational factor that stimulates physical activity (Eliakim, M., Bodner, Meckel, Nemet, & Eliakim, A., 2013). This is especially important since auditory modalities such as musical rhythms, verbal cues, and sound cues are an already prevalent resource in physical education classrooms that have potential to increase MVPA levels in young elementary age children (Barney & Prusak, 2015). Therefore, because of the vital neural link between the auditory and motor systems, an auditory model may be an effective instructional strategy for the student learning of rhythmic competency skills in motor learning (Gruhn et al., 2012). As a result, additional pedagogical approaches in the development of rhythmic competency need consideration throughout the physical education content areas (Cone, 2015).

Students that do not develop a foundation for FMS that lead to motor competency are strongly associated with lower physical activity levels and cardiorespiratory fitness (Hardy et al., 2012). The most common environment for young children to learn the FMS

necessary to lead physically active lifestyles is the school's physical education program (Berg & Breslin, 2014). However, Berg and Breslin noted that little research has been done on best practices that focus on the maintenance of locomotor skills in young children.

Auditory models have been a relatively ignored area of research in the field of physical education (Wang, 2007). Berg and Breslin (2014) suggest some physical education programs may or may not use auditory modalities such as musical rhythms in their learning environment. This is surprising since musical rhythm is considered a significant positive factor to motivate young children to move (Karageorghis & Priest, 2012), and to develop the rhythmic competency skills necessary for motor skill acquisition (Cone, 2015). Considering that auditory modalities is a widely available resource in exercise settings (Konukman, Harms, & Ryan, 2012), by implementing auditory modalities physical education teachers can target specific motor skills that increase children's physical activity levels (Loprinzi et al., 2015). For this reason, the primary purpose of this concurrent, mixed-methods, multiple case study was to explore the role of auditory modalities in the learning of rhythmic competency in the development of FMS that can lead to increased physical activity levels in young children.

Problem Statement

Physical inactivity is a global concern (Cohen et al., 2014); many health organizations have recognized and identified risk factors associated with a sedentary lifestyle (Ekelund et al., 2012). One strategy that has been recommended by leading health professionals in the field is to increase moderate to vigorous physical activity or

MVPA levels in children. Jaakkola et al. (2016) suggested that physical education settings are an ideal environment to improve FMS that increase total classroom MVPA. Correspondingly, research indicates that by effectively promoting early motor competence in young children physical activity levels will increase (Loprinzi et al., 2015).

Physical education settings oftentimes have low levels of classroom MVPA (Lonsdale et al., 2013). This is a problem since, according to NASPE (2010a), data indicates that some students are not mastering the FMS necessary to increase physical activity levels (see Appendix A). A study of developmental trends in dance performance of elementary-age children indicated that students in Grades 1 and 2 lack basic beat synchronization skills when performing structured dances (Little, 2012). Consequently, some students might not be mastering the coordinated movement patterns needed for motor skill acquisition that may lead to a more physically active lifestyle (Mastrokalou & Hatziharistos, 2007).

According to a NPAPA (2014) report on physical activity in children, several possible risk factors contribute to decreasing levels of physical activity in children including; the immediate environment, intrapersonal factors, socioeconomic status, school environment, and ecological factors. Although these factors may affect a child's adherence to physical activity, a commitment to the development of FMS is equally important (Culjak, Kalinski, Kezic, & Miletic, 2014). The factors that contribute to childhood physical inactivity need to be further explored, including the failure to master underlying components of motor skill competency (Loprinzi et al., 2015).

Fundamental movement skills serve as a basis for developing more complex movement skills (Cohen et al., 2014). A child can build the foundation for sports-related movement skills needed to perform in team and individual games that lead to a physically active lifestyle (Cohen et al., 2014). Childhood has been identified as a critical time period in the development of FMS (Williams, Payne, & Robinson, 2010), making it important that elementary physical education teachers provide opportunities for children to have greater odds of meeting the physical activity guidelines (Eaton et al., 2011).

It is essential that physical education classes are designed by trained physical education specialists who can design programs that produce maximal physical activity benefits (NPAPA, 2014). However, many physical education classes often have low MVPA that can play an important role in the physical activity levels of young elementary age children (Lonsdale et al., 2013). Although this may be true, it is essential for schools and community programs to support a variety of learning opportunities that increases MVPA in physical education classrooms and other settings (Jaakkola et al., 2016). Because a rhythmic accompaniment is crucial in developing the coordination and rhythmic balance that is essential for fundamental movement skills (Berg & Breslin, 2014), this study further investigated the role of auditory modalities in the emergence of rhythmic competency in FMS development.

For this concurrent, mixed-methods, multiple case study, two sites were selected. Data were collected from elementary physical education teachers and students at a suburban Maryland public school system and physical education/exercise science majors at a private liberal arts college located in the same county. All the elementary physical

education teachers in the county were asked to take a 10-question Likert survey that focused on auditory instruction, rhythmic competency, and fundamental movement skills. In addition to the surveys, one of the schools from the first site is a Title I school that has been previously recognized on a national and state level for excellence in elementary physical education and was selected for structured interviews and several classroom observational studies. Two physical education teachers at the school were separately interviewed for 30 minute structured interviews. In addition, 10 classroom observations were conducted to assess how auditory learning modalities are currently being used in their physical education classroom. Some of the themes being observed included musical rhythms, tempo, sound cues, verbal cues, rhythmic competency, fundamental movement skills, and motivational qualities of music in relationship to motor movement.

The second data collection site was a private liberal arts college with a physical education and exercise science program located in the same county. The focus group participants included preprofessional physical education and exercise science students enrolled in a creative rhythms and fundamental movement course. The focus group met for one hour. The questions designed for the participants focused on how they envisioned using auditory modalities in their own classrooms. The collected data were triangulated to better determine how auditory instructional modalities are being utilized in the development of rhythmic competency for the development of fundamental movement skills in young children.

The Nature of the Study

The primary purpose of this concurrent, mixed-methods, multiple case study was to further explore the role of auditory instructional modalities and emergence of rhythmic competency in FMS development of young elementary age students. Culjak et al. (2014) suggested that it is vital to further explore the underlying behavioral competencies of motor skills in order to understand how children develop and process the skills that lead to fundamental movement competency. However, little research has been done on best practices to ensure the initiation and maintenance of locomotor skills (Berg & Breslin, 2014). In a recent review of multimodalities in motor learning, results suggested that auditory and haptic feedback may be especially helpful in motor acquisition for elementary age students prior to seven years of age (Bazile, Siegler, & Benguigui, 2013).

Haptic feedback includes both tactile perception and is usually conveyed through the skin such as vibrations, pressure, and other kinesthetic perception that refers to receptors in muscles (Bazile et al., 2013). However, haptic guidance consistently requires a higher level of dependency on feedback compared to auditory feedback (Bazile et al., 2013). This suggests that haptic guidance may be purposeful in the initial learning stages of motor skills for some students; however, auditory modalities are more ideal for the initiation and maintenance of FMS over a longer period of time. Therefore, a combination of learning modalities is likely to increase rhythmic competency levels that have the potential to encourage classroom MVPA. Cone (2015) indicated that auditory modalities such as musical rhythms need further consideration for integration throughout the elementary physical education curriculum.

In relationship to this study, using auditory learning modalities in conjunction with a multisensory learning environment supported a constructivist perspective that enriches the overall physical education experience (Bazile et al., 2013; Gokham, 2013). A constructivist paradigm allows individual participants to construct and understand the world from their own environment in which they live and work (Creswell, 2014). Henceforth, students acquire rhythmic competency through a multi-modality classroom environment including auditory modalities, while learning and constructing rhythmic knowledge from their own personal experiences. Accordingly, this concurrent, mixed-methods, multiple case design took a constructivist approach that was used to collect open-ended and emerging data with the purpose of developing themes and patterns that draw conclusions about the research question (Creswell, 2014). As suggested by Creswell (2014), this research design allowed for an in-depth analysis of two sites at the same time over a sustained period and data were then converged to reveal reoccurring themes. In the end, a cross case analytic technique from data being collected from different sites was conducted to develop a thematic analysis (Creswell, 2007). Creswell (2007) suggested using *purposeful maximal sampling* since this type of data collection technique can show different perspectives and naturalistic generalizations and themes on the process being researched.

Data for this study were collected from teacher surveys, teacher interviews, teacher classroom observations, and a college student focus group. The physical education curriculum specialist and director of instructional resources of a suburban Maryland Public School System were contacted to assist in gaining access to collect data

from participants. Two data collection sites were selected: a suburban Maryland public school system and a private liberal arts college located in the same county. All the elementary physical education teachers in the county were asked to take a 10-question Likert survey that focused on auditory instruction, rhythmic competency, and FMS. The purpose of the survey was to gain knowledge on current instructional trends for auditory modalities and the status of elementary age student readiness for FMS development. The data generated from the survey provided descriptive statistics that contributed to the generalizations and themes that developed from the interviews, survey, focus groups, and classroom observations.

These data were coded and triangulated to identify recurrent themes in relationship to auditory instructional modalities, rhythmic competency, and FMS development. Coupled with the categorization of themes, comparisons were then made by triangulating qualitative data that will contribute to understanding and lending further insight from the emerging data results (McMillian & Wergin, 2006). In this way, the results from surveying, interviewing teachers, focus group, and classroom observations allowed a more descriptive and complete analysis on the process of how auditory instructional modalities influence rhythmic competency levels that can lead to mastering FMS.

Research Question

The central research question for this concurrent, mixed-methods, multiple case study was: “How does auditory instructional modalities develop rhythmic competency

which contributes to fundamental movement skill development that can lead to increased levels of physical activity in young children?"

Purpose Statement

The primary purpose of this concurrent, mixed-methods, multiple case study was to further explore and study the role of auditory instructional modalities in the development of rhythmic competency in fundamental movement skill development in young, elementary age students. Stodden et al. (2008) suggest that it is vital to further explore the underlying characteristics of movement in order to understand how children develop and process FMS that lead to motor skill competency. Developing FMS is not a maturational process, students need to learn the skill, practice the skill, and reinforce the skill (Logan, 2012). There is a strong correlation with low competency in FMS and lower cardiorespiratory and physical activity levels in children (Hardy et al., 2012). Keeping this in mind, the development of rhythmic competency in children has provided evidence of increasing the physical activity levels in children (Cone, 2015), therefore indicating a promising field of study for research.

Previous studies have tested an auditory stimulus using motor skills in a laboratory setting; however, there is limited research on the relationship of an auditory stimulus in a practical sporting environment (Wang, 2007). In fact, Mastokalou and Hatziharistos (2007) suggest that further exploration of the effectiveness of an auditory model including using a variety of tempos across all age groups is needed. More recent studies on rhythmical acoustical-motor coordination on a stimulus have been conducted, however, primarily in a laboratory type setting rather than a physical education classroom

(Bazile et al., 2013). With this in mind, a primary goal of this study was to gather information about how physical education teachers and student teachers integrate auditory modalities into their teaching. Specific data were explored in regards to how musical rhythms, sounds cues, and verbal cues are currently being used as an auditory stimulus for the emergence of rhythmic competency in the development and maintenance of motor skills in young children in elementary physical education classrooms.

Theoretical Framework

Two central motor theories were integrated within the theoretical framework of this concurrent, mixed-methods, multiple case design, the schema theory (Schmidt, 1975) and dynamic systems theory (Ulrich, 1997). As previously mentioned, rhythm and timing are central characteristics that are necessary to develop movement coordination (Nombela, Huges, Owen, & Grahn, 2013). The premise of the schema theory (Schmidt, 1975) suggests that discrete movements are controlled by a two-state memory process, with one memory process responsible for ordering the relative timing of sub-actions and sequencing within a movement (Lee, Wulf, Winstein, & Zelanik, 2016). Thus, the schema theory (Schmidt, 1975) proposes a hierarchical order that forms the foundation for motor movements, with the motor unit as the most basic structure (Carson, 2006).

The second memory process of the schema theory, a recall and recognition schema, allows quick motor actions to be organized in advance and represented in the memory (Lee et al., 2016). The brain's ability to engage a memory framework for muscle activity (Shea & Wulf, 2005) is essential to allowing the components of the motor nervous system to organize and accomplish the desired motor goal (Carson, 2006).

Knowing that similar cognitive and sequencing patterns that occur in motor skill acquisition (Schmidt, 2003) are also evident in musical rhythms (Levitan, 2006), an auditory stimulus may provide a key link in the understanding of FMS in children. Likewise, an auditory stimulus such as musical rhythms may provide a perceptual and temporal framework that can initiate the corresponding motor schema (Schubotz & Yves von Cramon, 2002). Under those circumstances, a dynamical system is also most likely involved in integrating with the schema theory (Schmidt, 1975) during motor skill acquisition (Rosalie & Muller, 2012).

In contrast to the schema theory (Schmidt, 1975), the dynamical systems are typically more open and complex and are in a constant state of flux becoming adaptive to the surrounding constraints to form an orderly and stable existence (Chow et al., 2007). Ulrich (1997) perceives this constant flux in dynamical systems as a process of systems and sub-systems self-organizing the coordination between the individual, environment, and task (Davids, Button, & Bennett, 2008). Henceforth, a dynamical network of social systems such as physical, chemical, biological, or social interrelate in the development of FMS (Dutt-Mazumber, Button, Robins, & Bartlett, 2011). Coupled with the schema theory, the dynamic system theory most likely works together as a conceptual framework in the emergence of timing and rhythmic competency in the development of fundamental movement skills (Scott, 2009)

Definition of Terms

The following terms are used to further describe terms that are essential to the conceptual framework of this study.

Auditory Instructional Model: Sounds or verbal descriptions used to transfer information of how to acquire movement knowledge (Coker, 1996).

Auditory Learner: Someone who focuses on sounds and rhythms to learn movement patterns.

Fundamental movement skills: The basic motor skills that serve as prerequisites to the learning of more content (sport)-specific skills. Fundamental movement skills usually consist of a combination of locomotor and manipulative skills (Hutchinson & Mendon, 2010).

Locomotor skills: Skills demonstrated by the use of hands and/or feet that enable people to move their bodies through space. These skills can consist of running, jumping, hopping, leaping, sliding, skipping, or galloping (Haywood & Getchell, 2009).

Manipulative skills: Skills demonstrated by the use of the hands and/or feet to manipulate and project objects such as throwing a softball, dribbling a basketball, or kicking a soccer ball. These skills can consist of a simple, one movement skill or of a number of interrelated skills that occur in a sequence (Haywood & Getchell, 2009).

Movement Coordination: The motion of more than one body segment in the execution of a movement pattern that requires the timing and sequencing of joint motions, or coordination. Movement coordination is a highly complex neuromuscular and

biomechanical phenomenon that involves a sequential progression of segment motions (Hall, 2010).

Rhythm: The repeated and patterned sequences of sound. The sound of the heart beating is an example of rhythm making the sound *tum, ta, tum, ta*. Skipping is an example of a movement rhythm with the sequenced pattern step-hop, step-hop, step-hop (Alter, 2010).

Schema theory: A theory emphasizing the brain's ability to engage memory framework for muscle activity (Schmidt, 1975). The schema theory suggests a single internal timekeeper is responsible for the timing and movement coordination of general motor programs (GMP) throughout the acquisition of motor skill development (Shea & Wulf, 2005).

Sound of Movement Pattern: The overall design or patterned sequence in a movement. The sound of the basketball being dribbled or the whoosh of the shot into the basket is an example of a movement pattern sound (Alter, 2010).

Limitations, Assumptions, and Delimitations

Limitations

Investigating how children develop fundamental movement skills is one strategy that may be crucial to determining whether children will continue to participate in physical activity throughout their lives (Lloyd et al., 2014). How student's process information and the instructional model implemented in class is vital for student learning when acquiring motor skills (Owens & Stewart, 2010). Unfortunately, assessing how young students' process new information can be difficult to determine in young children.

Therefore, having certified physical education teachers provide feedback is probably the most reliable form of data collection for gathering information from younger participants. For young children, taking personal surveys and interviews could be unreliable since checking for understanding and comprehension would be a limitation. Moreover, there could be a variety of responses among physical education teachers themselves regarding their own personal experiences and levels of self-efficacy in regards to utilizing auditory instructional methods for rhythmic competency. Knowing this, the data may reveal inconsistencies in the reporting.

Assumptions

1. Children naturally learn beat competency on their own without guidance or learning instruction
2. Children develop FMS on their own without formal instruction or practice.
3. Children develop motor skills primarily through a visual model by only watching the skill being performed.
4. Children are not physically active because of lack of motivation and interest not as a result of limited opportunities to master FMS that lead to sport specific skills.

Delimitations

Previous studies have tested an auditory stimulus using motor skills in a laboratory setting; however, there is limited research on the relationship of an auditory stimulus in a practical sporting environment (Wang, 2007). In fact, Mastokalou and Hatziharistos (2007) suggest that further exploration of the effectiveness of an auditory model including using a variety of tempos across all age groups is needed. Berg and

Breslin (2014) indicated that more research should be done to determine if movement programs that incorporate music are more likely to increase the maintenance of locomotor skills compared to those that do not incorporate music. With this in mind, Berg and Breslin (2014) suggest testing a synchronous piece of music that would complement the rhythms of the locomotor skills. For the purpose of this study, a primary goal was to gather information from physical education teachers in regards to how musical rhythms or auditory sounds are currently being used as an auditory stimulus for the development and maintenance of motor skills in young children.

Significance of the Study

In studies of FMS with children and adolescents, those with higher FMS tend to be more physically active over a lifespan (Canadian Sport for Life, 2011). Students with lower fundamental movement skill competency consistently demonstrate lower levels of cardiorespiratory fitness and physical activity levels (Hardy, Reinten-Reynolds, Espinel, Zask, & Okley, 2012). In every way, schools and community organizations play a significant role in contributing to the development of FMS that lead to physically active lifestyles in young elementary students (Jaakkola et al., 2016). In the same way, supporting physical education curriculums in the development of effective motor skills is an essential process in improving the overall moderate to vigorous physical activity or MVPA in elementary physical education classrooms (Cicovic, Stojanovic, Ruzic, & Tanaskovic, 2015).

One of the five strategies recommended by NPAPA (2014) to increase physical activity levels in elementary age children is to have trained physical education specialists

that design activity-based curriculums. Research indicates that evidence based physical education program interventions such as SPARK can increase physical activity levels in elementary age students (Eather et al., 2013). SPARK is a nationally recognized comprehensive Pre-K-12 physical education program developed by leading educators and researchers in the field. SPARK is a complete health and wellness package designed for schools and communities that is presented in a coordinated curriculum that focuses on positive student learning outcomes that includes increasing physical activity levels in children (http://www.SPARKPE.org). Therefore, a priority of this study was to further identify positive auditory and rhythmic competency markers in motor skill development for young elementary age students. As a result, MVPA levels can potentially be further increased in elementary physical education settings that support programs similar to SPARK (Lai et al., 2014).

Given the extent of availability and use of music in physical education classrooms (Barney & Prusak, 2015), it was quintessential to research how the specific qualities of auditory modalities such as musical rhythms, sounds cues, and verbal cues can impact student engagement and learner physical education outcomes (Barney & Prusak, 2015). More recently, studies have examined musical rhythmic constructs such as: tempo, beat, and meter (Karageorghis & Priest, 2012), in relationship to auditory modalities and motor movement (Bazile et al., 2013). This makes sense as technology is rapidly bridging music and physical activity (Hallett & Lamont, 2015). Knowing that rhythmic competency is a key underpinning in the development of successfully motor skill acquisition (Berg & Breslin, 2014; Little, 2012), auditory modalities learning attributes nicely complement

with rhythmic competency constructs which can “anchor” and develop FMS into more coordinated and fluid motor behaviors (Tierney & Kraus, 2013).

In summary, further study of an auditory learning model may reveal data that can improve physical education curriculums for the development of motor skill acquisition and maintenance (Liu & Jensen, 2009; Mastrokalou & Haziharistos, 2007). This is essential since physical education programs develop curriculums that target motor skill development that increases physical activity levels in children (Loprinzi et al., 2015). In essence, a variety of auditory modalities may not only have the possibility to motivate and inspire children to move, but also to improve motor performance as well (Berg & Breslin, 2014). This in turn may lead children to develop the motor skill competency needed to become more physically active throughout their lives.

Section 2: Literature Review

Introduction

The purpose of this concurrent mixed methods, multiple case study was to explore the application of auditory learning modalities in the development of rhythmic competency in fundamental movement skills in order to increase more vigorous physical activity (MVPA) in elementary physical education classrooms. Physical education students most likely represent one of the largest potential exercise participants in the United States; however, auditory learning modalities such as musical rhythms have received little research in the development of movement skills in physical education (Barney & Prusak, 2015). Although several factors contribute to decreasing physical activity levels in elementary age students (NPAPA, 2014), theoretically investigating school-based interventions is essential to the improvement of fundamental movement skills (FMS) development (Lai et al., 2014).

Literature Search Methods

To begin this inquiry, I conducted an extensive review of the available literature. A number of resources were used including a variety of major databases, a number of search engines, personal communications with professionals in the field of neurology and exercise physiology, and university libraries with a specialty in physical education and exercise physiology. The primary databases examined were Educational Resources Information Center (ERIC), Pro Quest Central, Academic Search Complete, and Walden University's online access to dissertations and thesis papers. Nonprofit and government agencies also provided valuable resource information, including: The National

Association of Physical Activity, The Robert Wood Johnson Foundation, Active Living Research, Centers for Disease Control and Prevention, White House Task Force on Childhood Obesity, American Heart Association, National Association for Sport and Physical Education and American Alliance for Health, Physical Education, Recreation and Dance. Additionally, I gathered recommendations for recent neuroscience literature from leading experts in the field of music on the interrelationship between the mind and body at a symposium of the Annals of New York Academy of Sciences.

The key search terms and combinations of search terms that related to the research constructs included: *attentional focus*, *auditory learning models*, *auditory mapping*, *beat and tempo*, *constructivist learning*, *fundamental movement skill development*, *group rhythmic competency*, *individual and timing and motor skill acquisition*, *music and movement programs*, *musical rhythmic structures*, *physical activity and rhythmic entrainment*, *rhythmic sound cues*, *technology applications for rhythmic competency in a physical education classroom*, *verbal and rhythmic verbal cues*, and *visual learning models*. The schema theory (Schmidt, 1975) and dynamic systems theory (Ulrich, 1997) were investigated since these theories supported timing and rhythmic competency constraints that would be necessary for successfully using motor skill movement when using auditory learning modalities. Also, different learning modalities in combination with an auditory learning model were researched in application to an elementary physical education setting, including the visual model, affective learning design model, and kinesthetic model. These learning models were further explored in conjunction with the schema theory (Schmidt, 1975) and dynamic systems theory

(Ulrich, 1997) to gather additional data on how they relate to motor timing not only as individual learning theories, but also together in the development of rhythmic competency skills within motor skill acquisition.

Liu and Jensen (2009) noted a gap in the literature concerning the effectiveness of different instructional modalities on the development of FMS. Little (2012) also indicated a strong need for young elementary age students to develop the rhythmic beat competency and synchronization skills necessary for skilled fundamental movement actions. This is in agreement with data collected from the NASPE (2010a) national assessment of FMS, which clearly indicated low performance scores on motor skills requiring a high level of rhythmic competency. Auditory models have been relatively ignored in U.S. physical education classroom setting (Wang, 2007). However, recent research has increasingly been dedicated to this field of study, most likely since rhythm and timing have been identified as key underpinnings to motor skills that can lead to physically active lifestyles (Scott, 2009), and the use of technology to bridge music and educational curriculums (Pyle & Esslinger, 2014).

Educational leaders involved in physical education curriculums are beginning to realize that a new approach is needed to address how the development of rhythmic competency should be integrated throughout physical education content areas (Cone, 2015). For this purpose, a primary goal of this literature review was to provide a comprehensive pedagogical review of some of the key research studies in the field of FMS development, rhythmic competency, motor system theories, and recent instructional trends in motor skill development. Since fundamental movement skill competence is

positively correlated with higher physical activity levels, this research study inquiry began by addressing the positive determinants of motor skill success.

Fundamental Movement Competence and Physical Activity Levels

Sports require the skillful execution of a combination of fundamental locomotor and manipulative movement skills (Hall, 2010). FMS proficiency is an essential component of this goal since they represent the behavioral competencies needed in the participation of many sports (Culjak, Miletic, Kalinski, Kezic, & Zuvela, 2014). This is significant since FMS are considered to be the foundation and building blocks that are required for sport-specific movement skills and physical activities (Cohen et al., 2014). Motor skill competence has been identified as an underlying mechanism that promotes physical activity engagement (Stodden et al., 2008). These same sports-related movements integrate a variety of motor skills including: locomotor movement patterns, object control, and stability (Loprinzi et al., 2015). Motor competence and mastery often translate to children becoming lifelong learners of physical activity (Canadian Sport for Life, 2011).

As children age, their adherence to physical activity also begins to decrease (American Heart Association, 2009). Therefore, it is essential to better understand how to effectively maintain FMS that promote physical activity during childhood. In agreement, Loprinzi et al. (2015) suggest the need to further examine the role of early motor skill competence in exercise adherence throughout a lifespan. In the same way, it is important to investigate the long-term consequences of ineffective or inefficient motor skills

because ineffective motor skills learned during childhood could have a significant impact on physical activity participation over the lifespan (Lloyed et al., 2014).

Lloyed et al. (2014) investigated the potential long-term association of motor skill proficiency at 6 years of age followed by self-reported physical activity at age 26. In this study, 17 participants were identified in 1996 as either having high motor proficiency (HMP) or low motor proficiency (LMP). Although there were several limitations in the data collection process of this study, including sample size and self-reporting measures over a long period of time, this was the first mixed longitudinal study that examined the relationship between childhood motor proficiency and physical activity levels as an adult. The recommendations from this 20-year follow-up study suggested that even with some inconsistency in the data reporting, enough evidence indicated that an increased emphasis on the development of proficient motor skills can promote physical activity levels across a lifespan (Lloyd et al., 2014).

There are many factors that influence the relationship between FMS competence and how physical activity levels change over a lifetime. Physical activity is a complex entity and the potential mechanisms of change are multifactorial (Brown, Hume, Pearson, & Salmon, 2013). Among researchers there is a consensus that physical inactivity is a multilevel problem, which can be linked to several factors including: psychological, social, and environmental (Jaakkola et al., 2016). Brown et al. (2013) suggested that stronger research designs are needed to identify potential mediators of physical activity. At the same time, past research has suggested that children who are more competent in FMS will spend more time engaged in more vigorous physical activity or MVPA (Cohen

et al., 2014). Schools and other community organizations play an important role in introducing students to different activities that support the learning of FMS that encourages physical activity (Jaakkola et al., 2016).

Quality Elementary Physical Education Programs and Motor Skill Success

Quality physical education programs provide the best opportunity for all children to learn the knowledge and skills necessary that lead to a physically active lifestyle (Alliance for a Healthier Generation, 2010). Equally important, quality physical education programs can directly impact student participation in physical activity (Trudeau & Shepard, 2005). Therefore, schools' physical education programs acknowledge the role of FMS development has on students overall physical activity levels (Jaakkola et al., 2016).

Developing motor skills is considered an essential process involved in physical education curriculum development (Cicovic et al., 2015). By the same token, research has examined FMS intervention programs and their impact on physical activity levels in young elementary age students. Recently the research in this field has compared the physical activity levels of students' basic gymnastic skill based interventions in relationship to regular physical education programs. The reasoning for these studies is since gymnastics movements are similar in nature to fundamental movement patterns; this may naturally lead to the possibility of transferring gymnastic skills to other motor learning domains (Culjak, Miletic et al., 2014; Culjak, Miletic, Kalinski et al., 2014).

In fact, the results from these studies indicated that a gymnastic based physical education intervention can simultaneously improve basic gymnastic and FMS (Culjak,

Miletic, Kalinski et al., 2014). For the most part, this suggests a positive correlation between FMS development and basic gymnastic based physical education programs (Culjak, Kalinski, Kezic, & Miletic, 2014). In another similar intervention study, a popular evidence based physical education program called SPARK, was compared to a gymnastic based and a regular routine physical education program to measure FMS success in children ages 4-6 (Mostafavi, Ziaee, Akabari, & Haji-Hosseini, 2013). Interestingly, the findings of this study indicated that the SPARK program had a higher efficacy on the promotion of FMS when compared to the two other groups: a routine physical education group and the basic gymnastics PE group (Mostafavi et al., 2013). In the same way, this suggests that additional positive determinants identified in the SPARK physical education program impact increasing physical activity levels in children. The results from these types of research studies indicated that program interventions such as SPARK can increase physical activity levels in school physical education programs (Lonsdale et al., 2013). While long-term theoretically-researched program interventions can improve FMS development that improve physical activity levels (Lai et al., 2014), there is still a lack of studies examining the physical determinants of FMS in relationship to physical fitness activity (Stodden et al., 2008).

Positive Motor Learning Constructs and Increasing Physical Activity Levels

For this reason, it is equally important to identify and research the specific learning constructs that affect motor skill acquisition. Likewise, a gap in the literature exists that needs to take into consideration the synergistic and dynamic role of motor skill competence in the initiation, maintenance, and decline of physical activity (Stodden et al.,

2008). At the same time, it is important to understand how physical activity, aerobic fitness, and FMS work together to have sustained effects on the promotion of lifelong physical activity (Lai et al., 2014). Studying the positive determinants that constitutes fundamental movement success such as rhythmic competency might reveal additional insights for already established evidence based elementary physical education programs similar to SPARK. This is significant, as Lai et al. (2014) acknowledged from a health perspective that the learning of FMS in a physical education program may be one of the most important contexts to foster physical activity in children. Knowing this, physical education teachers often have to make decisions on how to prioritize instructional learning time (Heidorn, Weaver, & Beighle, 2016). A common discussion topic in the field of physical education is how instructional time is allocated between motor skill development and aerobic fitness skills (Heidorn et al., 2016).

The Allocation of Instructional Time: Motor Skill Development vs Aerobic Fitness

In an ideal physical education setting, teachers want to allocate a majority of their class time to maintaining high levels of physical fitness while at the same time teaching the motor skills and game strategies necessary for FMS success. Nevertheless, this is difficult to accomplish for even the most experienced physical education teachers because of limited class time, resources, and large classes. All things considered, auditory learning modalities do offer the advantage of being a widely available and inexpensive resource for physical education teachers that can address these concerns (Karageorghis & Priest, 2008)

Recent studies have measured the relationships between physical fitness, motor skill, and physical activity in young children (Larouche, Boyer, Tremblay, & Longmuir, 2014; Eather, Morgan, & Lubans, 2013). From these studies, researchers have discussed the question of whether higher fundamental movement competency increases a child's physical activity level or that greater participation in physical activity improves greater FMS levels (Lai et al., 2014). In a recent preschool study, locomotor and nonlocomotor activities were assessed according to their physical activity levels in 4-year old preschool children (Iivonen et al., 2013). The results indicated that locomotor movements such as sliding and galloping (a skill that requires significant timing) were significantly associated with more vigorous physical activity or MVPA, whereas a throwing and catching combination was significantly associated with total physical activity levels, however, this also included light-to-vigorous activity (Iivonen et al., 2013).

The results from this study indicate that when learning object control skills such as catching and throwing it will be more difficult to achieve a constant MVPA for a longer period of time. This is significant, since MVPA levels in physical education classrooms are oftentimes very low, and MVPA can play an important role in health promotion (Lonsdale et al., 2013). In effect, using auditory learning modalities such as musical rhythms, sound cues, and verbal cues as an auditory hook that anchors rhythmic competency might provide an opportune time to maximize instructional learning. Linking instructional auditory hooks such as verbal and sound cues with musical rhythmic structures for motivation and maintenance allows students to maintain MVPA levels while simultaneously practicing FMS development. In short, physical education teachers

can complement lessons with engaging activities by using a combination of locomotor, nonlocomotor, object control, and stability skills. This combines the important components of physical activity, aerobic fitness, and FMS (Lai et al., 2014), all while maintaining the necessary MVPA for aerobic fitness without compromising valuable class time.

Rhythmic Competency and Emergence in Fundamental Movement Skills

Knowing that rhythmic competency is essential in the development of FMS and with evidence to suggest that the auditory and motor modalities are linked from a neural perspective (Gruhn et al., 2012), rhythm is the most effective quality of music to inspire and motivate children to move (Karageoghis & Lane, 2016). Gruhn et al. (2012) suggests that neither sports and motor training nor musical practice can improve the other modality on its own. This suggests that an auditory rhythmic based curriculum might be an ideal teaching methodology that simultaneously develops both modalities while increasing MVPA in physical education classrooms. That is to say, using a rhythmic element will most likely develop the coordination and dynamic balance that is crucial in facilitating the development of FMS (Berg & Breslin, 2014).

Auditory modalities such as musical rhythms, verbal, and sound cues are already a prevalent resource in elementary physical education classrooms. Since motor skill competency is associated with increased physical activity levels throughout the lifespan of the child, physical education teachers should develop strategies that target motor skill development, so as to help shape children's physical activity behavior (Loprinzi et al., 2015). However, auditory modalities such as musical rhythms and auditory cues are

primarily used only for classroom management or as "background" music (Barney & Prusak, 2015). Knowing that rhythm is presumed to be the most effective factor of motivational music and is a positive determinant that stimulates physical activity (Eliakim et al., 2013), this has indicated the necessity of further examining the emergence of rhythmic competency in fundamental movement skill development.

Most sports require the skillful execution of a combination of fundamental locomotor and manipulative movement skills (Hall, 2010). This combination of movement skills is what contributes to the aesthetic qualities of a sport. As Alter (2010) states, "Movement patterns function strategically in the activities and, when they produce success, experts describe them as congruent (fitting exactly) with their goals. When they are beautiful or elegant in design and motion, they also serve an aesthetic function" (p. 346). The aesthetic quality found in sports is often rooted in coordinated rhythmic movement patterns (Davids et al., 2008). By adding a rhythmic element in movement education this develops an internal sense of rhythmic flow that can increase motor coordination skills (Scott, 2009). Dribbling a basketball, timing a swing, throwing a ball, shooting a soccer ball, or executing a gymnastic sequence are all illustrations of sports-related movement skills that require rhythmic competency (Alter, 2010).

MacPherson and Collins (2009) explored the optimum performance of motor skills, concluding that rhythm should be considered a critical underpinning for motor skills development. MacPherson and Collins further suggested that when a participant "feels the rhythm" of a movement this will enhance motor skills execution. As a result, the learning and performance of motor skills in children is often associated with their

rhythmic movement coordination (Derri, Tsapalidou, Zachopoulou, & Gini, 2001). According to Scott (2009), movement coordination or the ability to move the body as a cooperative whole is essential for acquiring FMS.

Rhythm and timing are considered key underlying components in the development of FMS (Scott, 2009). When students begin to develop a rhythm for the movement skill they begin to understand not only the success of their movement actions but the inherent qualities as well (MacPherson & Collins, 2009). Similarly, Fotiadou et al. (2006) identified rhythm as integral to ocular (sight) and auditory (hearing) perception, balance ability, and kinesthetic awareness. Nonetheless, oftentimes instead of focusing quality instruction on the qualitative aspects of a movement skill such as rhythm, timing, and movement coordination, instructors will primarily focus the initial instruction on the tactics and strategies of the game (Alter, 2010).

Rhythmic flow can be described as the "ongoingness" of continuous rhythmic movement such as qualities found in running, skiing, bike riding, and swimming (Alter, 2010). Running, swimming, and cycling inherently use repeated motor movement sequences at regular intervals. Athletes who participate in these sports gravitate naturally to a balanced rhythmic movement or cadence (MacPherson, Turner, & Collins, 2007). MacPherson et al. (2007) measured the cadences for sports that are cyclical in nature, observing a correlation between cadence and the impact on cardiovascular and physiological functions. Athletes that compete in these sports often manipulate the cadence of their movements in order to increase the velocity for optimal athletic performance (Marais & Pelayo, 2003). Music with strong beats and cyclical rhythms is

often incorporated into training practices to increase the overall athletic experience (Karageorghis & Priest, 2008).

Although young children will most likely not consciously manipulate music for athletic training performances, exploring how musical timing constructs and learning modalities interrelate in the emergence of rhythmic competency may reveal new insights for the development of FMS. With this in mind, the schema (Schmidt, 1975) and dynamic systems (Ulrich, 1997) theories were selected as the conceptual framework for this study because of their interrelationships with timing in the emergence of rhythmic competency for motor skill acquisition.

The Schema and Dynamic System Theories and Emergence of Rhythmic Competency

Both the schema theory (Schmidt, 1975) and dynamic systems theory (Ulrich, 1997) naturally provide an instructional platform for auditory learning modalities that can engage, support, and anchor movement patterns (Scott, 2009). The schema theory (Schmidt, 1975) and dynamic systems theories (Ulrich, 1997) are two motor control theories that provides a structural framework for the emergence of rhythmic timing in FMS development. The premise of the schema theory (Schmidt, 1975) is centered on the brain's ability to engage a memory framework for muscle activity (Shea & Wulf, 2005). A key distinction to note between the dynamic systems theory (Ulrich, 1997) and the schema theory (Schmidt, 1975) is how the two theories present the acquisition of timing in motor skill acquisition. The schema theory (Shea & Wulf, 2005) advocates a single internal timekeeper with similar timing restraints across all movement for general motor

programs (GMP). Additionally, the generalized motor programs (GMP) serve as a memory framework for muscle activity and contain the rules that are necessary for specific movement patterns (Shea & Wulf, 2005). The rules established for generalized motor programs create the parameters that control the components of the movement performance (Schmidt, 2003). Schmidt (2003) further elaborated that the same rules for relative timing and force of the movement performance are included in these parameters. This is in line with the idea that many skilled actions require the sequential planning of movement structures that lead to the automatization of movement performance (Koedijker, Oudejans, & Beek, 2010). In like manner, the schema theory (Schmidt, 1975) suggests that quick motor actions need recall memory, so muscle performance can be organized in advance and represented in the memory (Schmidt, 2003). In turn, the ability to recall the schema of the movement skill will be able to adjust quickly to the demands of the task (Schmidt, 2003).

Schmidt (2003) suggested motor units need the continuous practice and repetition of the muscle activity in order to learn the new skill. Similar to the pattern and sequencing that occurs in motor skill acquisition (Schmidt, 2003), musical rhythm can also follow a schematic sequence (Levitan, 2006). Several key regions of the brain are activated in tasks where participants are asked to interpret the perception of rhythm (Patel, 2006). These similar schematic-sequencing patterns that occur in the brain when processing musical rhythm can also be retrieved when children develop and acquire new motor skill and movement patterns (Dr. R. Sugarman, personal communication, September 28, 2010). As evident in research (Chen, Penhune, & Zatorre, 2009) qualities

of a rhythmic stimulus such as physical accentuation and temporal organization of events can act as a cue to facilitate movement synchronization.

Fundamental movement skill development is also a dynamical system where adaptation with learning will increase the probability of successfully skill acquisition (Rosalie & Muller, 2012). Zachopoulou, Tsapalidou, and Derri (2004) described this key dynamical feature in developing rhythmic ability in motor skills "as the ability to observe, control, and differentiate the rhythm of a movement according to the environmental demands at a given time, enabling the quick motor adjustments of the performer in an unpredictable environment and assuring success in performance" (p. 3.12).

In the dynamic systems theory (Ulrich, 1997), sub-systems emerge to self-organize the coordination between the individual, environment, and task (Davids et al., 2008). These various systems and sub-systems such as physical, chemical, biological, or social systems interrelate in a dynamical network to create motor movement patterns (Dutt-Mazumber et al., 2011). Currently, there are limited studies on how the schema (Schmidt. 1975) and dynamic system (Ulrich, 1997) theories interrelate in the development of specific rhythmic competency constructs as they relate to FMS. However, more recent studies have taken an interest in motor control as it relates to rhythmic dance (Akito, Shinya, Yuji, & Kazutoshi, 2015). Since the principles of the dynamical systems theory (Ulrich, 1997) can potentially further our understanding of motor control in rhythmic dance (Akito et al., 2015), this could possibly indicate how rhythmic competency constructs will develop in fundamental movement patterns.

Although the dynamic system (Ulrich, 1997) and schema (Schmidt, 1975) theories come to different conclusions on how timing is developed in motor skill acquisition, a combination of characteristics found in both of these theories support the theoretical conceptual framework of timing as an underpinning in the development of motor skills (Scott, 2009). Correspondingly, auditory learning modalities such as musical rhythms, verbal cues, and sound cues are capable of being used as an auditory hook that anchors the parameters for relative timing during motor skill acquisition. All things considered, improving the overall rhythmic flow and coordination of motor movement performance can lead to more physically active lifestyles for children.

Auditory Modalities and Motor Learning

Auditory models have been a relatively ignored area of research in the field of physical education (Wang, 2007). In the field of motor learning, sport educators often use visual cues to demonstrate motor skill improvement since students frequently learn by observation or imitation (Sigrist, Rauter, Riener, & Wolf, 2013). Not to mention, it is probably the most convenient and efficient way to demonstrate a motor skill considering the class sizes and time constraints on physical education teachers. Although there are possibilities for auditory modalities to engage and maintain physical activity in physical education classes, they are often simply a part of the background learning environment (Wang, 2007). Wang (2004) also suggested, however, that auditory models are just as important as other instructional strategies in the learning process of a motor skill. Auditory modalities such as musical rhythms, sound cues, and verbal cues already are a

common resource available in physical education classes and can easily be incorporated into the daily structure of a lesson plan (Barney & Prusak, 2015).

Wang (2007) suggested that different forms of delivering auditory modalities convey different information to the learner. Although musical rhythmic structures might be important for the initiation, motivation, and maintenance of FMS (Liu et al., 2009), verbal and sound cues are also essential for the transfer of critical elements to a motor skill being learned. For example, auditory sounds such as the water splashing for the butterfly stroke pertains to the timing of each movement, whereas the verbal description such as slow recovery and fast forward thrust refer to the movement sequence (Wang, 2007). Using this motor sequence as an example, both the sound cues of the water splashing and verbal cues provided different information to the learner regarding the development of particular aspects of the skill to be learned. Wang (2007) suggested that information regarding the motor skill to be learned is first coded as symbols, processed by the brain, and then stored in the memory as suggested in the symbolic learning theory. To put it another way, for children a word that represents a sound cue may also represent a symbolic action where the child learns to perceive and comprehend the auditory cue as a representation of motoric understanding (Foley, 2013). This would be especially true for young children during the preoperative stages of symbolic learning (Perrotta, 2011).

Since the Symbolic Learning theory is most likely involved in early childhood motor development through imagination, creativity, and play (Vygotsky, 2004), an auditory modalities learning platform can uniquely transfer auditory knowledge of motoric understanding to young children. Especially since creative play often has

aesthetic characteristics similar to dance (Lindqvist, 2001). According to Vygotsky (2004) creative play is a combinational activity that requires the child to bring together images, actions, and experiences to imagine something new (Blatchford, 2007). Therefore, simple rhythmic sounds may be more advantageous since they need less time and effort in the coding process compared to verbal descriptions of the rhythm. As an illustration, the verbal cue *Squash* might replace a description that involves remembering how to land, reach with the toes, and give gradually with ankles, knees, and hip (Ennis & Silverman, 2003). This allows the verbal cue to compress multiple responses and descriptions into a single combined response (Ennis & Silverman, 2003).

In a similar manner, a variety of combinations of music, verbal, and sound cues may further increase an aural representation of motor skills through a creative expression of play (Foley, 2013). Keeping this in mind, auditory learning modalities provide opportunities to transfer rhythmic competency knowledge by "bridging" and "anchoring" timing components of GMP or general motor parameters while using auditory rhythmic structures to develop FMS. This creates an opportunity to increase rhythmic competency levels that inspire young children to move using innovative auditory learning platforms. Although auditory learning models are thought to be useful in tasks requiring rhythm and timing, relatively few studies have investigated the effect on skill acquisition and learning (Han & Shea, 2008).

Auditory and Visual Models Working Together

Exploring auditory learning modalities in the interrelationship of the initiation, maintenance, and learning of rhythmic competency is essential in learning the qualities of

movement that lead to physical activity in children. It is important to understand how physical activity, aerobic fitness, and FMS work together to have sustained effects in the promotion of life long physical activity (Lai et al., 2014). As children learn new motor skills it is important to assess how they transfer learning into information that needs to be executed for motor skill performance (Rosalie & Muller, 2012). As previously mentioned in relationship to creative and aural play (Foley, 2013), Chen et al. (2009) suggested that the transfer of auditory information may include the transformation into a motor representation, which can influence the motor systems that impact how we process sound.

Visual and auditory modeling gives different types of specific information to the learner. However, both are important when information needs to find the proper pathways to be more efficiently processed (Wang, 2004). Spatial information has been shown to be more efficiently processed through visual models, whereas temporal information for the rhythm of a skill is more efficiently processed through auditory models (Lai, Shea, Bruechert, & Little, 2002; Shea, Wulf, Park, & Gaunt, 2001). Humans synchronize movements to rhythmic sound with far greater precision than to a visual stimulus (Iversen, Patel, Nicodemus, & Emmorey, 2015). In earlier studies, Liu and Jensen (2009) studied the effectiveness of auditory and visual sensory feedback for children when learning a continuous motor task and discovered that the acquisition, retention, and transfer of information for auditory sensory feedback was more effective than visual feedback and the combination of auditory and visual feedback for children. In their study, children age 4 to 7 and adults were purposely selected to compare sensory feedback when learning a continuous motor task. The results indicated significant differences in how

children and adults process sensory information. Adults performed better then children across all sensory feedback phases in regards to acquisition, retention, and transfer. One reason being is that in children the attention capacity is smaller and still developing, whereas adults are able to selectively attend to task-relevant cues (Liu & Jensen, 2009). Consequently, children's processing abilities of one specific sensory modality is overloaded when modalities are combined (Liu & Jensen, 2009).

In a more recent study, Bazile et al. (2013) reviewed previous studies on the development of rhythmical acoustical-motor coordination and synchronization to a stimulus. The results indicated that at age 5 students are weak at synchronizing finger tapping to a periodical auditory stimulus, but between the ages of 5 and 12 are increasingly able to accomplish this task. From their research, Bazile et al. (2013) designed a study using a rhythmic ball bouncing test. Similar to the finger tapping test, the results indicated that significant visual-motor coordination did not appear until around 7 years old. However, an interesting observation from Bazile et al. (2013) was that younger children's poorer performance could be linked to the absence of haptic feedback when the ball bounces off a visual racket from a monitor. For this reason, the potential difference in the developmental dynamics of sensorimotor synchronization from the results from younger age children in this study might be as a result of acoustical-motor synchronization (Bazile et al., 2013). This suggests that auditory and haptic models might have a more primary role in the development of timing and rhythmic competency in earlier years before age seven.

Sigrist et al. (2013) review of visual modalities suggested visual models are more ineffective for simpler motor tasks compared to more complex tasks. This indicates that the more complex a motor skill task, the more important a visual model becomes to give important relevant knowledge to the learner for a first movement representation of the motor skill to be performed (Sigrist et al., 2013). In other words, a preliminary suggestion might be to emphasize auditory learning modalities for young children during the initial learning stages of fundamental movement skill development.

To sum up, Liu and Jensen (2009) state one of the gaps in the literature is the effectiveness of modalities (auditory and visual) in designing effective learning environments for children in performing continuous motor tasks. This is essential since physical educators can properly design learning environments to improve the probability of knowledge transfer to the skill being learned (Rosalie & Muller, 2012). However, the reality is that physical education teacher's work with a variety of students at different developmental learning stages and usually in large classroom settings. With that being said, using a multimodal learning approach is probably the most practical and effective strategy to transfer knowledge for motor skill learning to children (Sigrist et al., 2013). As shown above, additional research would need to be conducted to explore how the combination of learning modalities interrelate at different ages, levels of motor skill complexity, and the developmental stages of the learner. Therefore, from a constructivist learning perspective, certain activities and enrichment in the environment can enhance active learning using a variety of instructional practices, such as active learning, kinesthetic, visual and auditory modalities (Gokhan, 2013).

The Constructivist Perspective and a Multimodal Learning Environment

Similarly, a constructivist theorist might suggest that young elementary age students should be given opportunities to explore rhythmic competency experiences through a creative and engaging environment that fosters and encourages physical activity. Especially since evidence indicates that musical abilities and motor control interact and develop simultaneously at an earlier developmental age (Gruhn et al., 2012). Generally speaking, it is an essential time period in the lives of young children to capitalize on the opportunity of developmental readiness for motor skill acquisition.

Studies on multisensory learning suggested that our brain has evolved to develop, learn, and operate optimally in a multisensory environment (Shams & Sietz, 2008). In agreement, recent findings in neuroscience and perceptual learning reveal key insights into how neural plasticity evolves (Proulx, Brown, Pasqualotto, & Meijer, 2014). Although most multisensory research has primarily focused on a single sensory modality such as visual, there is increasing evidence of interest in multisensory perceptual learning (Proulx et al., 2014). The ability to effectively combine sensory inputs across modalities is essential to the development of motor learning (Altieri, Stevenson, Wallace, & Wenger, 2013). This is in agreement with recent research reviews on multimodality learning in motor skill acquisition (Sigrist et al., 2013). Several studies in the field of augmented visual, auditory, haptic, and multimodal feedback in motor learning indicated that multimodal rather than unimodal is more likely to produce an optimal learning environment (Sigrist et al., 2013). The cognitive psychology of understanding is that in a multimodal rather than a unimodal learning environment the connections between the

unimodal areas strengthen, therefore, improving the multimodal representations of motor movement (Shams & Seitz, 2008). That is to say, depending on the motor skill and motor skill task to be learned, physical education teachers can manipulate different learning modalities to adapt to the students' learning process (Krakauer & Mazzoni, 2011). This would also be in agreement with the guiding theoretical principles of the dynamic systems theory (Ulrich, 1997), in which various sub-systems interrelate in a dynamical network and environment to create motor movement patterns (Dutt-Mazumber et al., 2011). To sum up, it is evident that auditory learning modalities are a central component to a dynamic multimodal learning environment for the development of rhythmic competency in motor skills for young children. Therefore, perceiving sensory information in background noise is a complex task that requires the child to extract the key features from the sound while suppressing irrelevant detail (Chandraskekaran & Kraus, 2010). Knowing this, it is most likely that a student engages attention through a variety of learning models.

Attentional Focus: External vs Internal

A primary role of attentional focus is to be able to preferentially select only the relevant information needed to complete the task (Abernethy, Maxwell, Masters, Van Der Kamp, & Jackson 2007). Auditory learning modalities are fairly easy to implement during a continuous motor task, and it provides students with an opportunity throughout the lesson to attend to an external focus (e.g. verbal cues, sound cues, and musical rhythms). This is essential, since Koufou, Avgerinos, and Michalopolou (2013) reviewed several studies that suggest that when instructions target an internal focus (such as

referring to the coordination of their body movements) for particular motor skills as compared to instructions that target an external focus (e.g. apparatus or implement), the external targeting consistently produced more effective learning.

Young children have different information-processing capabilities in regards to selective attention than adults (Sullivan, Kantak, & Burtner, 2010). Koufou et al. (2013) suggest that physical education teachers can design instruction to direct the learner's external attention according to the task being practiced to produce the correct movement form. Since auditory learning modalities are readily available during elementary physical education classes, teachers have opportune resources such as musical rhythms, sound cues, and verbal cues to offer engaging lessons that capture children's focus of attention. For this reason, the qualitative aspects of this research explored how and what types of auditory modality constructs are currently being used in physical education settings to develop rhythmic competency in motor skills. Especially during a child's development, acoustic input can be organized which can lead to the development of a hierarchical map of sounds in the child's memory (Huotilainen, Putkinen, & Tervaniemi, 2009). The formation of this type of acoustical map in the child's memory makes information processing faster and greatly reduces the demands on the memory systems (Huotilainen et al., 2009). An auditory graph as suggested by Flowers (2005), could help identify auditory and rhythmic markers that are essential in the child's hierarchical map of sounds and memory

The Identification of Rhythmic and Auditory Markers in FMS

In order to further explore this topic, an interesting study by Flowers (2005) focused on the qualitative qualities of auditory modalities such as musical rhythmic structures. Flowers (2005) initially created auditory graphs on the basis of a teaching tool; however, this auditory graph display technique also appeared to have potential for research purposes. From this premises, Flowers (2005) extensively researched auditory graph constructs such as the temporal patterning of sound events from a cognitive psychology perspective. Although the auditory graphs developed by Flowers (2005) were not specifically used for a physical education setting, in a more simplified manner an auditory template (refer to Appendix E) was created in this study for observational data collection purposes. In order to better understand the auditory constructs of musical rhythms, sound cues, and verbal cues in motor skill development, an auditory modalities template was developed to identify specific auditory representations of learner outcomes in FMS. Although auditory modalities are included in most physical education classes, there is little evidence of what components of auditory modalities will have on learner outcomes in physical education classes (Barney & Prusak, 2015). In the final analysis, this study further explored the characteristic qualities of auditory modalities that will have the most influence on the development of rhythmic competency skills in fundamental movement development.

More than 100 years ago the French-Swiss musician Emile Jacques-Dalcroze developed an educational pedagogical approach called Eurhythmics (Moore, 2008). The approach to developing a rhythmic sports based model (White et al., 2007) is similar to

the rhythmic, musical whole body pedagogy suggested by Jacques-Dalcroze. The purpose of Eurhythmics was to develop a curriculum that encourages coordination between the ear, mind, and body. Moore (2008) suggested that the integration between the ear, mind, and body anchor a child's rhythmic ability and was important in further consideration of how rhythm influences FMS acquisition. Even with a strong interest in the field of rhythmic competency in FMS from physical education teachers going back over 100 years, the lack of studies in this field until recently is relatively surprising. The apparent increase in recent years on research focusing on the musical properties and their effect on exercise performance and skill acquisition is most likely from a strong influence from developments in music technology, therefore bringing us closer to music than ever before (Hallet & Lamont, 2015). Consequently, the gap between technology, music, and physical activity is closing as curriculum development and instructional modality platforms can be bridged in physical education classrooms.

Technology is rapidly changing instructional delivery platforms and auditory modalities fit nicely with practical learning applications and best practices currently used by elementary physical education teachers. In more recent years' physical education curriculums have experimented with auditory based gaming platforms such as Dance, Dance, Revolution (Konami, 2011). Exergaming is one example of how physical education classes are utilizing technology to develop rhythm, tempo, and dancing (Hicks & Higgins, 2010). Therefore, from a research perspective it is important to identify rhythmic competency constructs that are positive determinants involved in the enhancement and establishment of the auditory-motor loop as identified by Gruhn et al.

(2012). This would be beneficial for identifying key rhythmic competency markers that could be useful to elementary physical education teachers in designing, creating, and delivering a multimodal instructional platform.

In a major review and synthesis investigating the effects of music in exercise, four factors were thought to contribute to the motivational qualities of a musical piece: rhythm response, musicality, cultural impact, and association (Karageorghis & Priest, 2012). Rhythm response was ranked as the most significant quality to effect exercise (Karageoghis & Priest, 2012). Rhythm response is described by Karageorghis and Priest (2012) as an innate human predisposition to synchronize movement with musical rhythms. Additionally, Barney and Prusak (2015) describe rhythm response as the rhythmical elements of music or key characteristics of music that elicit a bodily response.

In an earlier study, Mastrokalou & Hatziharistos (2007) conducted a study using a metronome measuring rhythmic ability and the effects of age, sex, and tempo for children 6 to 9 years of age. The measurements evaluating the rhythmic ability focused on rhythmic accuracy and rhythmic maintenance. The results indicated that a faster music tempo was easier to perform (140 beat/min) then a slower tempo (75 beats/min). In a more recent study on the effects of music on physical activity rates of elementary physical education students it was determined that regardless of the activity students were more active with music (Barney & Prusak, 2015). In agreement with Mastrokalou & Hatziharistos (2007), their study revealed that when students picked fast-tempo music, their workload intensity increased (Barney & Prusak, 2015). These physiological qualities are similar to the arousal qualities that initiate rhythm response. Likewise,

Mastrokalou and Hatziharistos (2007) suggested further research should include focusing on rhythmic maintenance under different tempos, age ranges, and motor training experience.

In a recent study, Berg and Breslin (2014) examined the impact of asynchronous music on the performance of locomotor skills in groups of children ages 9-12. This is somewhat different from the previous studies that examined motivational and physical activity maintenance of specific locomotor skills. Similar to concepts related to this research, Berg and Breslin (2014) were primarily interested in discovering how music and movement converge to enhance the performance of locomotor skills. For their study, Berg and Breslin individually examined performance skill levels of several common locomotor skills. The results from their study showed no significant differences in performance within the music and quiet group. Some conclusions from their study indicated that perhaps music affects motivation more than skill performance, or possibly synchronous or a combination of synchronous and asynchronous musical rhythmic structures would reveal different results (Berg & Breslin, 2014). However, another possibly reason for the lack of significance in performance scores might be how younger elementary students develop rhythmic competency skills when compared to older elementary students. In a movement program study that examined rhythmic accompaniment for children ages 4 to 6 significant improvements were indicated for jumping and dynamic balance compared to physical education programs that did not include a rhythmic accompaniment (Zachopoulou, Tsapalidou, & Derri, 2004). This suggested that auditory modalities may have a greater effect on this developmental age

group, whereas a combination of multimodal learning platforms may become more pertinent for older elementary age students for developing motor complex skill tasks. This would be in agreement with previous research on the effectiveness of auditory learning models and how children process sensory information during the early primary years (Liu & Jensen, 2009).

In addition to identifying rhythm response as having the most influential motivational factor too illicit a movement response (Karageorghis & Lane, 2016), researchers have examined the process of synchronizing rhythmic motor control with timing in patients with developmental coordination disorders (Wilson, Ruddock, Smits-Engelman, Polatajko, & Blank, 2013). Auditory modalities in relationship to motor interactions have been highly researched in the field of developmental motor control because of the success of potential motoric outcomes (Nomela et al., 2013). The interest for researchers in this field is how an acoustic stimulus may enhance the connection and synchronization between a rhythmical steady beat and motor behavior (Tierney & Kraus, 2013). Therefore, a key research question asked is how musical rhythm synchronizes our brain when we listen to music (Trost et al., 2014). This common phenomenon of trying foot tapping or moving the body to music is the body's natural tendency towards rhythmic entrainment (Trost et al., 2014). Rhythmic entrainment is defined by Clayton, Sager, and Will (2005) as a physical principle, "whereby two rhythmic processes interact with each other in such a way that they adjust towards and eventually 'lock in' to a common phase and/or periodicity" (p.5). Nombela et al. (2013) state the basis for many music therapeutic programs incorporate "a rhythmically structured sound pattern (such as

a simple dance tune) that creates an anticipatory template of a timed sequence marked by beats, which can be used as a continuous reference to map movements. This rhythmical auditory structure may facilitate movement by enabling the timing of muscle activation to synchronize" (pg.3).

Trost and Vuilleumier (2013) further suggested that when bodily rhythms synchronize with music these phenomena entrain the organism at different levels: the motor level, the autonomic physiological level, the attentional level, and the social level. In relationship to developing rhythmic competency in young elementary students, this same principle can be applied by using auditory modalities as rhythmic reference markers for FMS. For this reason, developing an auditory graph similar to Flowers (2005) research is essential in the identification of the most effective auditory modality markers that increase student engagement, motor performance, and rhythmic competency. These similar schematic-sequencing patterns that occur in the brain when processing auditory cues can also be retrieved when children develop and acquire new motor skills and movement patterns (Dr. R. Sugarman, personal communication, September 28, 2010). As evident in research (Chen et al., 2009), qualities of a rhythmic stimulus such as physical accentuation and temporal organization of events can act as a cue to facilitate movement synchronization. In other words, the response to hearing a beat often initiates a spontaneous movement to move according to the next predicted schematic sequencing. This finding was supported by Sugarman's (2010) remark that:

> Our walking along, or dancing along, is a symphony of elements that have been integrated into a sequence, each cueing. As a child gets the basics right, they can

> then skip, which is in fact walking, but with intentional, learned error. The music you provide is the substrate of the motor movements, providing a pattern that is connected and mimics what happens neuronal, each sound guiding the next motor element in the sequence. (R. Sugarman, personal communication, September 9, 2010).

Correspondingly, this provides an opportunity to create task designs that engage the general motor programs (GMP) to create novel movement pattern templates in relationship to the auditory cues, all while developing rhythmic competency in FMS. As previously mentioned, physical education programs have included rhythmic competency based exergames such as *Dance Dance Revolution* (Konami, 2011) in the curriculum. In this type of exergame students are challenged to coordinate the acoustic and visual rhythmic patterns from the video screen to the dance pad with their body movements. The visual and auditory rhythmic entrainment that students are processing during *Dance Dance Revolution* (Konami, 2011) mimics similar qualities as found in beat perception synchronization to produce a coordinated movement pattern. In the same way, a recent study of an object controls skills training program using exergame-based interventions, the exergame-based interventions were suggested as another technological pedagogical approach to increase enjoyment and skill levels (Vernadakis, Papastergiou, Zetou, & Panagiotis, 2015). Therefore, this reaffirms the application and role of technological platforms in the field of exercise science in young children.

Conclusion

Fundamental movement skill competency is associated with increased physical activity levels throughout the lifespan of the child (Loprinzi et al., 2015). School physical education classrooms are an ideal setting for physical education teachers to develop strategies that target motor skill development, helping to shape children's physical activity behavior (Loprinzi et al., 2015). In fact, children that are more competent in FMS are more likely to spend time in more vigorous physical activity of MVPA (Cohen et al., 2014). Oftentimes, MVPA levels in physical education classrooms are low, which is significant because MVPA can play an important role in health promotion (Lonsdale, et al., 2013). Therefore, it is essential to further investigate the role of early motor skill competence and the positive determinants that constitute successful motoric outcomes that lead to higher physical activity levels in young children (Loprinzi et al., 2015).

Rhythm and timing are key underpinning components in the development of FMS (Scott, 2019). Currently, many physical education classrooms only use auditory learning modalities such as musical rhythms as part of the background environment (Barney & Prusak, 2015). Because rhythm is presumed to be the most motivational characteristic of music that stimulates physical activity (Eliakim et al., 2013), auditory learning modalities can be a central instructional tool in the development and maintenance of motors skills in elementary physical education classrooms. Auditory cues have the potential to be an essential teacher resource to engage, motivate, maintain, and inspire students to be physically active. Students can therefore develop the necessary rhythmic competency

skills while learning new motor skills that lead to increased physical activity levels, without having elementary physical education teachers compromise valuable class time.

Section 3: Methodology

Introduction

The purpose of this concurrent, mixed-methods, multiple case study was to explore the application of auditory modalities in the learning of rhythmic competency for the development of fundamental movement skills (FMS) to increase total MVPA levels in elementary physical education settings. In order to address this problem, elementary school-based physical education programs where identified as one strategy to increase physical activity levels in young children (NPAPA, 2014). For this reason, teachers from a nationally recognized elementary physical education program and physical education majors and exercise science majors in a local private liberal arts college were asked to participate in this study. The data collected for this study revealed how the intervention of an auditory stimulus such as musical rhythms, sound cues, and music cues on sensory motor integration and timing may lead to better performance outcomes of fundamental movement skill levels in young children. These findings are intended for use in increasing total levels of MVPA in elementary physical education classrooms.

Research Design and Approach

A concurrent, mixed-methods, multiple case design was selected to study an exemplary elementary physical education classroom, so as to identify and showcase best practices of elementary school sites and preprofessional training colleges that implement quality programs. Case studies require an intensive in-depth analysis with data collected that is often longitudinal in nature (Glesne, 2011); the data from various forms of data collection in the field of fundamental movement development provided a complete

understanding of how auditory modalities and rhythmic competency promote the development of FMS. This prolonged observation reduces reactivity bias and increases the credibility of the data (Glense, 2011). I triangulated data collected from interviews, surveys, focus groups, and classroom observations.

A self-administered 10-question Likert survey was distributed county-wide to 39 elementary physical education teachers. The curriculum specialist was an essential contact to distribute surveys and to coordinate with the selected Title I school for further teacher interviews and classroom observations. In order to get a higher response rate for the surveys, the curriculum specialist suggested using SurveyMonkey, an online software program that is often utilized to distribute and analyze surveys within their school systems. The teacher questionnaires collected information about best practices for fundamental movement skill development, auditory instructional models, and motor skill readiness levels for young elementary age students. The questions on the Likert survey were designed to better answer the central research question: How does auditory instructional modalities develop rhythmic competency which contributes to fundamental movement skill development that can lead to increased levels of physical activity in young children?

I selected a Title I elementary school that has been recognized at a state and national level for further classroom observations and teacher interviews. Two teachers participated in structured interviews that followed a specific interview protocol (Refer to appendices C). The structured teacher interviews were set for specific times based on the physical education teachers' schedules. Physical education and exercise science majors

enrolled in a physical education course titled Creative Rhythms and Fundamental Movement Skills were asked to participate in the focus group. This course is designed for students studying the field of physical education or exercise science.

Data Analysis

Both qualitative and quantitative data in the form of surveys, teacher interviews, a focus group, and classroom observations was triangulated for a more complete description of the relationship between the reoccurring themes, as recommended by Creswell (2014). The Likert survey provided a descriptive analysis using a calculated weighted average for each question to determine reoccurring themes. The primary purpose for the focus group was to improve the understanding gained from the interviews and surveys (Hatch, 2002). Furthermore, Hatch (2002) emphasized the importance of a focus group in contributing to a valuable source of research triangulation. A focus group provides the researcher an opportunity for member checking from those in the field which provides additional accuracy to the data analysis (Hatch, 2002).

During classroom observations for the coding process, I used an observation chart focusing on several themes relating to the research question: rhythm, tempo, sounds, verbal cues, rhythmic competency, FMS, and motivational qualities of music (see Appendix E). In addition, I used personal memo-writing strategies to allow emergent ideas, notions, and linkages to begin to conceptualize about the phenomena being studied, as recommended by Weed (2009). This choice aligned with visual imagery being a rapidly expanding field in the field of qualitative research and education (Kingsley, 2009).

Setting and Sample for the Study

This concurrent, mixed-methods, multiple case study used a criterion-based participant selection process designed to better-reveal knowledge about the central research question. Therefore, this study consisted of 39 Maryland State certified elementary physical education teachers selected from a Maryland Public School system and six physical education and exercise science majors enrolled at a local college partnered with the same school district for student teaching experiences. The public school system can be described as suburban and rural school district with regards to diversity of population and size. The school system provided a large enough student and teacher population to constitute a diverse sample for data collection. The physical education teachers on staff were certified and highly specialized in their field, which facilitated obtaining insightful information for my data reflection.

I selected a rural Title I elementary school in this county for this concurrent, mixed-methods, multiple case study. Both physical education teachers have degree specializations beyond an undergraduate degree. The students have physical education classes three times a week. Physical education is valued by the community and school district: 90 minutes a week of physical education instruction is the minimum requirement to be allocated by elementary schools in this system.

This school was selected because the elementary physical education program has previously received national acclaim as a National Association for Sport and Physical Education (NASPE) STARS school. STARS is a national achievement program recognizing outstanding physical education programs in K-12 schools across America.

STARS schools demonstrate excellence in teaching knowledge and skills of motor development and health-related fitness. Structured interviews of the physical education teachers on staff at this school were conducted to gain knowledge regarding topics of rhythmic and fundamental movement skill competency. In addition, several classroom observations were conducted during the 2015-2016 school year to collect observable data on the intervention of auditory instructional modalities in Pre-K-5 physical education classes.

College students enrolled in a physical education class titled Creative Rhythms and Fundamental Movement Skills from a local private college participated in focus group. The students in the focus group were preprofessional students majoring in physical education or exercise science. Many of the students were also taking practicum classes that enabled them to student teach and observe teachers in the same county as the data collection. The focus group was designed to see how preprofessional majors would design curriculum for rhythmic and motor skill development from their course knowledge and student teaching experiences. Students were required to demonstrate a culmination of skills learned in the creative movement and FMS class. The purpose of this course was to design lesson programs to be utilized by future physical education teachers.

Measures for Ethical Protection of Participants

I received an approval from the Walden University Institutional Review Board (approval #01-08-14-0073971, 12/8/16) prior to data collection. In order to gain access to the participants, approval was needed from the director of instructional resources of the

school district and physical education curriculum specialist. Teachers' names were not used during survey data collection, interviews, or the focus group. The participant data collection pool also remained confidential.

Role of the Researcher

I have 15 years of K-12 physical education teaching experience in private, public, and international school settings. In addition, I have previous experience with formative and summative evaluations for administering motor and fitness assessments to young children. Some of this experience includes the administration of the Fitnessgram (Cooper Institute, 2011) for elementary school students. At the time of the study, I was not on staff at the selected locations and had no professional roles at the setting.

I collected and assessed all data related to this study. This data collection was informed by my being a highly trained physical education teacher with extensive knowledge and experiences observing young children develop FMS. For this reason, I was confident in the design and data analysis of the observation and survey data collection instrument, as well as the interview and focus group protocol.

Other Methodologies Considered

In addition to a concurrent, mixed-methods, research design, quantitative, and qualitative studies were also considered. The initial framework for this study consisted of a quantitative experimental research design. This design consisted of the random assignment of elementary age students to auditory modality treatment conditions such as musical rhythms. The treatment group performed locomotor skills to specifically selected musical rhythmic structures and was scored according to a rubric standard established by

NASPE (2010a). The nontreatment group did not include the intervention of musical rhythms. The musical rhythmic structures selected for the study consisted of instrumental music that had synchronous rhythmical cycles with a strong steady down beat.

The purpose of the original quantitative experimental research design was to determine how musical rhythmic structures with synchronizing characteristics would influence the performance of FMS. More recently, Berg and Breslin (2014) followed a similar approach but using asynchronous musical rhythmic structures to record locomotor performances in elementary physical education students. Berg and Breslin concluded there was no indicative locomotor performance difference using asynchronous musical rhythmic structures when compared to no music at all. However, the researchers suggested that possibly musical rhythms were more involved with motivation and the maintenance of locomotor skills rather than skill performance indicators. Furthermore, Berg and Breslin (2014) recommended that future research designs with synchronous rhythmic structures or a combination of synchronous and asynchronous rhythmic structures might reveal different results for locomotor skill performance.

However, the original quantitative research design considered for this doctoral study was difficult to construct without more of a knowledge base from a literature review perspective. Additionally, after further consideration the quantitative design was not necessarily addressing the central research question for this study that explored the role of auditory modalities in the emergence of rhythmic competency in FMS. Therefore, the results of a quantitative framework might have revealed insights about specific rhythmic constructs most likely related to relative timing in motor skills, however, not

necessarily on the process of the development of rhythmic emergence in FMS. Together with this knowledge, auditory modalities also include verbal and sound cues that work in tandem with musical rhythmic structures and other learning modalities (Sigrist et al., 2013). In essence, to provide a more thorough explanation for the emergence of rhythmic competency in FMS, qualitative and mixed method research designs were considered.

The idea behind a qualitative research design was to use a variety of data collection tools that could reveal themes about auditory modalities as they became apparent during teacher observations, interviews, and a focus group. Therefore, data points could be identified and integrated, as suggested by Creswell (2014), that could provide a more comprehensive and in-depth analysis of the role of auditory modalities in the emergence of rhythmic competency in FMS. Given these points, by using a research study that included a qualitative component a cross case data analysis would identify emerging auditory and rhythmic markers that could be utilized for practical instructional purposes in physical education classrooms. This was essential since the gap in literature indicated that research on auditory models was mostly conducted in research laboratories and commercial exercise settings, but not necessarily in physical education settings (Karageorghis & Lane, 2016). Knowing this, having a more complete picture to identify positive determinants in the role of auditory models in the emergence of rhythmic competency in FMS indicated a stronger research design was necessary to better answer the central research question.

A concurrent, mixed-methods, multiple case design was selected because this type of research framework design best utilized a combination of the researcher's experiences,

site selection, participant pool, and both qualitative and quantitative data collection tools. The qualitative data collection tools included: teacher interviews, classroom observations, and a focus group. According to Kennedy and Lingard (2006), using a combination of qualitative and quantitative data analysis methods are being used more frequently to solve complex educational problems.

Although this concurrent, mixed-methods, multiple case research design was mostly qualitative in nature, a survey was included to reflect a more comprehensive analysis of the entire study. Survey research is often considered quantitative; however, they can be used in social research case studies when a structured approach to data collection and analysis relies on the particular logic of analysis for the case being studied (De Vaus, 2014). In this concurrent, mixed-methods, multiple case study, the purpose for administering a Likert survey was to get professional feedback from elementary physical education teachers and to share their trends in regards to the relationship between auditory models, rhythmic competency, and FMS. Gathering this type of data from professionals in their respective field added another component to the structure, logic, and analysis that contributed to the "wholeness" and particular attributes of this research design (De Vaus, 2014). Furthermore, a survey could reach another set of qualified elementary physical education teacher participants outside of the two data collection sites; the elementary school and college. All things considered, a concurrent, mixed-methods, multiple case research design was a better selection that added to the overall validity, trustworthiness, and reliability in the interpretations of the final data analysis (Creswell, 2014).

Section 4: Results

Strategy

A concurrent, mixed-methods, multiple case research design was used to investigate the relationship between auditory teaching modalities, rhythmic competency and fundamental movement skill development in young elementary age students. The first site for this multiple case study involved 39 Maryland State certified elementary physical education teachers from a suburban Maryland public school system. All elementary physical education teachers were invited to take an online survey consisting of a 10-item survey instrument using Likert scale response items.

I also collected interview data from two elementary physical education teachers from the same Maryland suburban public school system, which had a state and nationally recognized elementary physical education program. The interviews were designed to explore the topic of rhythmic competency and FMS in relationship to auditory instructional models at a more in-depth level. Furthermore, ongoing classroom observations of this state and nationally recognized elementary physical education program in the county were conducted over a 5-month period. A total of 10 observations including grades Pre-K-3 were included in the observational study; the observation chart was reviewed by the county's physical education curriculum specialist and the principal at the school where the classroom observations were being conducted.

The observation chart was developed to categorize themes regarding auditory modalities and rhythmic competency in fundamental movement development (Refer to Appendix E). To maintain confidentiality, the names of the teachers remained

confidential to me (the researcher) and cooperating supervisor. The teachers were asked to provide informed consent prior to recording any data collection. The curriculum specialist and director of instructional resources reviewed the interview script and observation chart prior to data collection to ensure participant protection.

The purpose of the interviews and classroom observations were to gain a better depth and breadth of the research from an exemplary elementary physical education program and professionals in the field. I conducted the interviews individually for each teacher at the school site's physical education office. Two separate interviews were audiotaped and transcribed for analysis. The observations gave further understanding to the topic being researched and revealed applications in the classroom that might not otherwise be described in a survey or interview.

I took steps to protect the participants' confidentiality by following the research protocol for the county public school system, which was given to me by their physical education curriculum specialist. The curriculum specialist suggested using SurveyMonkey as the survey data collection instrument since the teachers were familiar with this type of online survey. SurveyMonkey is an online service for managing electronic surveys. Furthermore, the director of instructional resources for the county reviewed the content of the survey to insure participant protection and privacy for the employees. An introduction by the curriculum specialist was sent via an email and included the survey link that participants could complete and submit anonymously. Once surveys were completed and returned, the data were exported to a format compatible with

SPSS. After exporting the data from SurveyMonkey, the raw data were entered into SPSS for analysis.

The focus group consisted of six students enrolled in a course titled Creative Rhythms and Fundamental Movement Skills. The students in this course were learning the skills and teaching strategies that relate to rhythmic competency, audio instructional models, and fundamental movement skill development. Therefore, the insights provided from this select group of students added valuable knowledge to the research and teaching application aspects for this study.

The private liberal arts college is located in the same county as the public school system where the data collection was taking place. The focus group was conducted in a reserved room at the college campus. Physical education interns from the college often student teach in the same Maryland public school system. The data collected from the focus group was transcribed for data analysis. In addition, a contact person was assigned to me by the college to ensure that participants were protected and the research was reviewed and approved prior to data collection.

Research Site 1: Maryland Public School System

The participants in this concurrent, mixed-methods, multiple case study were from a Maryland Public School system. The region can best be characterized as a rural area that is rapidly becoming suburban. Over 25,000 students are enrolled in this Maryland Public School system. All the elementary physical education teachers within this county were asked to participate in a voluntary Likert online survey delivered through SurveyMonkey.

Survey Data Analysis

The survey questionnaire for this study asked participants to complete a 10-item survey instrument using Likert scale response items. The purpose of using a Likert survey in this case study was to gather opinions and perceptions from elementary school physical education teachers on the topic of rhythmic competency and FMS from across the county. The descriptive data revealed by the survey allowed for an improved analysis to better answer the research question and triangulate the data. All 39 elementary physical education teachers in the school district were asked to complete the survey (Refer to Appendix B) voluntarily through SurveyMonkey, Internet-based survey software commonly used as a valuable data collection tool. Of the 39 teachers invited to participate, 21 teachers completed and returned the online survey. This return rate represented 54% of elementary school physical education staff employed by the county.

Participants were asked to select from responses ranging from not at all, very little, somewhat, and to a great extent to indicate their own perceptions of the influence of auditory teaching modalities and rhythmic competency on the relationship to fundamental motor skill development. The data from the teacher surveys were used to address the research question and to gain knowledge on current trends in this research study.

Table 1 shows the teacher demographics of the elementary physical education teachers in the county participating in this research study. The first four questions of the survey were questions relating to elementary physical education teachers' demographics such as: gender, years of teaching experience, what grades they are currently teaching, and years of music or dance training.

Table 1

Survey Part 1: Auditory Instructional Models and Fundamental Movement Skills (Teacher Demographic Data)

Gender	Years of Teaching	Grade Level	Prior Dance or Music Training
Male	13	Pre K-5	No
Female	6	K-5	No
Male	<1	K-5	No
Male	24	K-5	Yes
Male	< 1	Pre K-5	No
Female	19	K-5	Yes
Male	25	Pre K-5	No
Female	39	Pre K-5	No
Male	2	K-5	Yes
Male	8	Pre K-5	No
Female	15	K-5	No
Male	22	K-5	No
Female	15	K-5	No
Male	4	K-5	No
Male	2	K-5	No
Female	7	K-5	No
Female	7	Pre K-5	No
Male	<1	K-5	No
Male	6	Pre K-5	No
Male	13	Pre K-5	No
Male	5	K-5	No

Results: Part 1

Fourteen male and seven female elementary physical education teachers participated in this study. Three of the teachers were first-year physical education teachers. Four teachers had five years or less of teaching experience. Five teachers had more than five to 10 years of experience, and nine teachers had more than 10 years of teaching experience. All of the teachers were teaching physical education classes for grades K-5. In addition, eight of the teachers were also teaching Pre-K physical education classes. Three teachers indicated additional dance or musical training in addition to their college classes required for their physical education degrees or certification.

In part two of the survey (Table 2), participants answered questions 5-13 using a 4-point Likert-scale. To indicate their own perceptions of the influence of auditory teaching modalities and rhythmic competency on the relationship to fundamental motor skill development, the physical education specialists selected responses ranging from: 1 = not at all, 2 = very little, 3 = somewhat, and 4 = to a great extent. The responses were recorded as a calculated percentage weighted average for each question as displayed below:

Table 2

Survey Part 2: Auditory Instructional Models and Fundamental Movement Skills Teacher Survey Response Rate

Question	Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
Q5: Students who demonstrate competency in fundamental movement skills are more likely to be physically active.	0% (0)	0% (0)	23.81% (5)	76.19% (16)	21	3.76
Q6: Students who demonstrate competency in fundamental movement skills are more likely to demonstrate rhythmic competency.	0% (0)	0% (0)	66.66% (14)	33.33% (7)	21	3.33
Q7: Students who demonstrate rhythmic competency are more likely to be physically active.	0% (0)	0% (0)	76.19% (16)	23.81% (5)	21	3.24
Q8: Students who demonstrate rhythmic competency demonstrate a higher level of timing skills necessary for sport specific skills (for example dribbling a ball or swinging at a ball).	0% (0)	9.52% (2)	61.90% (13)	28.57% (6)	21	3.19
Q9: When playing music while students are practicing motor skills, does the level of physical activity appear	0% (0)	4.76% (1)	47.62% (10)	47.62% (10)	21	3.43

to increase?						
Q10: Does enjoyment and class participation appear to increase when music is playing while students are participating in activities?	0% (0)	0% (0)	30% (6)	70% (14)	20	3.70
Q11: When students are practicing a skill with an auditory sound such as verbal cues, sounds, or music, do students appear to stay more on task?	0% (0)	9.52% (2)	47.62% (10)	42.86% (9)	21	3.33
Q12: When musical rhythm is playing in the background while students are engaged in a movement activity do students tend to move to the beat?	0% (0)	9.52% (2)	66.67% (14)	23.81% (5)	21	3.14
Q13: When students are practicing a skill with an auditory sound (such as verbal cues, sounds, or music) do they appear to acquire new movement skills with more ease and correctly then without an auditory cue (for example, when learning to dribble a ball, does it help student learning when there is a rhythmic auditory cue to follow?	0% (0)	14.29% (3)	80.95% (17)	4.76% (1)	21	2.90

Results: Part 2

The scores ranged from 2.90 to 3.76. The highest scores on the survey indicated agreement among elementary physical education teachers taking this survey that FMS are crucial to student success in maintaining a physically active lifestyle. Likewise, the responses indicated that the physical education teachers agreed that auditory instructional models including musical rhythms, sounds, and verbal cues impacts how students learn rhythmic competency in regards to fundamental movement skill development. Although 2.90 was the lowest score, most physical education teachers agreed that using an auditory sound cue or some type of musical rhythm will increase skill development in fundamental motor skill learning. In addition, most teachers (80.95%) indicated that musical rhythms and auditory instructional models will increase performance from a motivational and student behavior perspective. Moreover, there was overwhelming agreement from the physical education teachers that musical rhythms increase student participation and enjoyment. The teachers indicated that students had a better ability to focus attention and stay on task during activities when an auditory stimulus was present.

Public Elementary School Site

The elementary school selected for this research study is located in the same Maryland Public School system as the teacher participants for the online survey. The school is located in a rural town in this county. The population of the town where the elementary school is located is approximately 7,000 residents. The small town is known for civil war history. The racial make-up of the town is over 90% white, followed by 4.5% African American, and then smaller percentages of Native American, Asian, and

other races. The demographics of the elementary school are similar. The median income for a family household is around $50,000. About 10 percent of the families were below the poverty line.

School Environment

The elementary school in this research study is a Title I school. Title I is a federally-funded program to allocate funds that are used to support all students to meet state standards, collaborate student instruction, to promote parent involvement, and professional development for the staff. In addition, the school has a Positive Behavioral Intervention and Support (PBIS) program which is a proactive approach for creating and maintaining safe and effective learning environments in the schools, and ensuring that all students have the social/emotional skills needed to ensure their success at school and beyond.

Background of Physical Education Program

The elementary school has three Maryland State Department of Education physical education teachers on staff. Two physical education teachers have their master's degree in either physical education or exercise science and are graduates of the same private liberal arts college where the second data collection site is located for this research study. The elementary school for this study was the first school in the state of Maryland to be recognized by the National Association of Sport and Physical education as a STARS school for quality elementary physical education. In addition, the physical education program at this school site has been selected as a demonstration site by the Maryland Association of Physical Education, Health, and Dance.

Physical Education Classroom Environment

The students participate in physical education classes that expose them to many different activities in the hope they will want to be physically active for a lifetime. Some of the units include: cooperative games, football, soccer, outdoor games, bowling, basketball, gymnastics, dance, fitness, floor hockey, tennis, volleyball, jump rope, and track & field. Students in grades K-2 participate in three 30-minute lessons per week and students in grades 3-5 participate in one 30-minute lesson, in addition to one 60-minute lesson per week. The Pre-K classes meet once a week for 30 minutes.

In addition, the physical education teachers design and develop special activities to encourage physical fitness and healthy lifestyles throughout the year such as: Fun Run, Turkey Bowl, Fitness Club, Student-Faculty Basketball Game, Jump Rope Contest and Play Day. They also have a special incentive program to promote teamwork with the title of **"**PE Class of the Month." This class gets their name announced on the morning announcements, as well as their picture taken and posted on the PE Bulletin board.

Physical Education Teacher Backgrounds

At the time of this study, Physical Education Teacher #1 had been teaching elementary physical education for nine years at this school in the same county system. She is also certified from the Maryland State Department of Education and has an undergraduate degree in physical education from the same college participating in this research study. She is currently completing her master's degree in exercise science. Furthermore, she is constantly updating her skills and credentials through professional

development courses and workshops offered online as well as professional courses offered by the public school system where she is employed.

At the time of this study, Physical Education Teacher #2 was in his first-year of teaching. He has an undergraduate degree in exercise science and a master's degree in physical education, and went directly to graduate school after undergraduate school. He also coaches several sports outside of school including soccer and tennis. In addition to his exercise science and physical education degrees, he has a health certification and was scheduled to teach elementary classroom health education this year at this elementary school.

Physical Education Teacher Interviews

The purpose of the physical education interviews was to further investigate how children develop FMS when exposed to an auditory stimulus such as sound, verbal, cues, or a musical rhythm. The information provided by the physical education teachers in these interviews help identify the most current trends being used by professionals in the field from a state and nationally recognized physical education program. The data collected from this interview allows for the opportunity to continue to learn and gather knowledge on best practices that lead to children learning the skills necessary to become physically active throughout their lives.

Two physical education teachers were interviewed separately at the school. The interviews were conducted in the physical education office and lasted approximately thirty minutes in length. Teacher #1 was a female physical education teacher on staff with

eight years of experience. Teacher #2 was a male physical education teacher on staff in his first year of teaching.

Question 1 – Do you feel most of the kindergarten students entering your classroom have learned age-appropriate basic fundamental skills prior to their first day of physical education class of the year?

For physical education teacher #1, her most recent accomplishment was developing a preschool physical education program with the county curriculum specialist. The program was piloted at her school and is now implemented county wide to help ensure Pre-K students are having learning opportunities to acquire the FMS necessary to be successful at the elementary level. In response to this question the teachers replied:

Physical Education Teacher #1:

> I would say that most do not have the basic motor skills and few have motor skills such as galloping and skipping. Few have these motors skills and most likely really haven't been introduced to them.

Physical Education Teacher #2:

> Few have galloping and skipping skills, however, students that had a preschool that included motor development usually demonstrate a higher level of skills then those with no training. In addition, these students are more familiar with verbal teaching cues in the classroom.

Question #2 and #3- Do you feel there is a relationship between fundamental movement competency and rhythmic competency? How do you use auditory

instructional models in your classroom (for example verbal cues, sounds, musical rhythm)?

Both physical education teachers feel there is a relationship between fundamental movement competency and rhythmic competency and use different audio instructional models strategies in their classrooms.

Physical Education Teacher #1:

> We use music for most of the lesson when we are indoors. A majority of the students notice when it is not on. We also use music as a start point and end point for classroom management and behavior. Students seem to be more attentive, on task, and generally better at knowing what they are doing when the music is on. We also use music for motivation and creative play. For example, we like to select music for certain themes according to units. Recently we had a unit with Maryland themes and the state sport is jousting. We played William Tell for the relay races. The kids got really motivated and were having fun. We also supplement the curriculum with a rhythms and dance unit for grades 3, 4, and 5.

Physical Education Teacher #2 recognizes that music also increases the intensity of exercise:

> I observe that students are working at a more intense pace and it makes them work at a higher level. There is a huge difference playing a game in the gym with or without music. Students expect music and appear to be

> more on task. The kids know what they are supposed to be doing when the music is on.

In addition to using music for behavior management and motivation, the physical education teachers use other auditory modalities to reinforce skill development such as verbal cues and fitness testing.

Physical Education Teacher #2:

> For many of our skills we break down the movement skills in groups of 4. For example, for the baseball throws we teach "point, step, turn, throw." In volleyball we use the verbal cues "toss, bump, hit, catch." The students have to practice and repeat them after me. Then we say and practice it together as a class. We will even say a lot of silly teambuilding phrases together. For example, I say "Work Together" and the kids repeat "Work Together." I will say "Teamwork" and then the kids repeat "Teamwork." We do a lot of simple verbal cues with them repeating it really keeps them engaged. The physical education teacher emphasizes, "They eat it up, and they love it. It really motivates them!"

Question #4: As a professional elementary physical education teacher would professional development workshops in auditory instructional models be a benefit?

Both physical education teachers use a mix of resources to supplement their curriculum. The easiest being resources sent from their curriculum advisor or researching

resources online. However, oftentimes they both will contact other physical education teachers they already know or have worked with on unit or teaching ideas.

Physical Education Teacher #1:

> Certainly any type of workshops that I can attend that will help student development interests me. My supervisor sends a lot of resources and I do my own networking with other physical education teachers.

Physical Education Teacher #2:

> The internet, personal experience, looking to see what others are doing, and what information is sent to me from my curriculum advisor.

Question #5: How do you incorporate technology using audio instructional models?

On-line music services are now widely used among physical education teachers. It is common for physical education teachers to have playlists ready to go for their classrooms using sites such as Spotify or Pandora. Furthermore, teachers have the mobile technology platforms to walk around their classrooms and manage music selection with ease.

Physical Education Teacher #1:

> Usually I have one long playlist using Spotify. If kids request a certain song and it is appropriate, I will add it. Usually the only unit where I am looking for specific rhythm and beat is when we are actually teaching the rhythm and dance unit. Kids love creating their own dances and

> incorporating specific skills we have used in class. Otherwise, usually I am always looking for fast and upbeat tunes that I think the kids will like.

Physical Education Teacher #2:

> I am always looking for new songs that will increase heart rate and make kids work out at a higher level.

Researcher Reflection

The physical education teachers interviewed acknowledged the importance of developing FMS and the relationship of rhythmic competency in developing those skills. The physical education teachers emphasized how music is incorporated almost on a daily basis in their physical education classroom. The teachers observed that when they use auditory instructional models such as musical rhythms or verbal cues, their students are more motivated, engaged, and on task. The teachers acknowledge that musical rhythms were primarily used for motivation and sometimes for behavior management to start and stop an activity. However, teachers also would specifically select musical rhythms that would correspond to unit themes or activities they were playing. Specific music rhythms were selected for units that are specific to developing rhythmic competency such as dance, rhythms or jump rope units. The physical education teachers would more commonly use verbal cues for specific fundamental movement skill development such as learning how to throw, kick, dribble and etc. For example, for learning to throw the ball physical education teachers use the verbal cues, “Step, point, turn, throw.” The physical education teachers use verbal cues using this same repetitive count of 4s for most of their FMS development.

Classroom Observations

Classroom observations were conducted at the same Title 1 School where the two physical education teachers were interviewed and participated in the county wide online survey. Two physical education teachers on staff were asked to sign and complete a consent form to participate in 10 physical education classroom observations for the duration of each class period over three months. Two classes from each grade level between Pre-K-3 were selected for the observations. The purpose of the observations was to observe how auditory learning platforms in the form of musical rhythms, sound, and verbal cues are currently being used to increase rhythmic competency in FMS.

Classroom Observation #1 (Refer to Appendix F): "Winter Wonderland"

The first classroom unit observed was titled "Winter Wonderland: There is Snow Place Like PE"! Grades K-3 were observed during this unit for the duration of each class period. The purpose of this unit was to introduce snow sports combined with fundamental movement skill development. The physical education class was elaborately decorated with a Winter Wonderland snow scene. When the students approached the gym entrance they read signs that were decorated with festive snowflakes titled "Walking into a Winter Wonderland." In addition, the front doors of the gymnasium had an elaborate 3D scene created with construction paper and cardboard boxes that included: skiers, snowboarders, reindeer, holiday lights, and a ski and snowboard rental shop. The teachers feed off the imagination of the children allowing them to visualize walking into a ski resort type of environment. When entering the gymnasium, the ski resort theme continued with more festive holiday lights, holiday inflatables and snowflake decorations hanging from the

ceiling throughout the gym. Several Winter Wonderland stations were created with each station including a traffic cone with a big candy cane in the middle of the cone. Each traffic cone had a picture, description, and the directions for each station. All the students had their own sleighs or "scooters" that the students would ride by pushing and pulling to get to their next station.

The Winter Wonderland Stations were:

- *Iceberg plunge*: Each student stands on a carpet square and tries to pull the other student off the carpet square using upper body strength with a small rope similar to tug of war.
- *Snowball Relay:* Students roll a giant cage ball along a path of snowflakes to "build" a giant snowball.
- *Snowball Target Shoot:* Students use three snowballs to try and hit the targets on a giant tree designed by the PE teachers. Points are awarded for different targets on the tree.
- *Ring in the New Year:* A giant candy cane was placed in the center of the traffic cones with rings stacked over it. The students played ring toss.
- *Blizzard Bowling:* A bowling alley with pins and two dodge balls to practice knocking down the pins.
- *Hot Tub:* Circular tubs filled with a bunch of fleece balls and the kids practiced tossing and catching the fleece balls in the hot tubs.
- *Skating Rink:* A skating rink was designed making a big circle with Christmas lights attached to the floor so the rink would light up. The students would slide or

"skate" two at a time inside the rink using scarves under their feet to slide. The students demonstrate creative movement skills with the music.

- *Build a Snowman:* At this station student were given snowman props to stack and create a snowman.
- *Ice Hockey:* Students practiced shooting goals and dribbling the puck with hockey sticks.
- *Jingle Jump:* The students were given several different styles of jump ropes to find their own rhythm and create their own jump rope patterns.
- *Snow Angels:* Students would lay down on a mat and move their arms and legs similar to the same motion of making a snow angel.
- *Snowboarding:* The students balance on balance boards while imagining riding through the snow.
- *Cross Country Skiing:* The student skis through the course by himself or herself or with a partner on walking balance boards.
- *Jingle Bells-Basketball Style:* The musical score to Jingle Bells was taped to the cone with the musical notes and words. In addition, a rhythmic pattern to the dribble was posted: 3 slow, 3 slow, 5 fast, 7 faster, 4 slow, 2 fast, 1 hard bounce and catch. The dribble matched the beat of the jingle bell song. Students had to sing the song and dribble to count at the same time.
- *Ski Jump:* Students run and jump once onto a trampoline on top of a high mat and then land two feet like a ski jumper.

- *Santa's workshop:* Students write a letter to Santa, parents, or teacher and mail it at the real U.S. post office mailbox set up at this station!

The physical education teachers had a stereo system with two large speakers set up on the stage. The physical education teacher's playlists were plugged into the stereo and ready to go before class began. An auditory modality observation chart (Refer to Appendix E) was used for each class to observe and record data. Grades Kindergarten through third grade were observed during the Winter Wonderland unit. The teachers used the same playlist for all classes participating in this unit. The teachers also included a variety of verbal cues for instruction.

The playlist included a variety of artists including Crazy Frog and the song "Happy" by Pharrell Williams, which were popular music choices by all grades. The teachers played music that was oftentimes instrumental; however, most music contained motivating and inspiring lyrics. Most songs had a fast tempo ranging from 130-140 bpm (beats per minute) with a mostly consistent synchronous rhythm and a strong steady down beat. Oftentimes the music was inspirational and motivating to keep the students maintaining a higher heart rate when exercising.

Researcher Reflection

An interesting observation about this unit is the teachers did not use music to manage stations or as a behavior management tool. The students already understood to rotate to a different station by moving on their scooters or "sleigh" to another station that was available. This allowed the students to keep moving throughout the lesson. The

music was primarily used in this lesson for inspiration, motivation, skill development, rhythmic skills, and fitness maintenance. The teachers incorporated several FMS in this lesson including: walking, running, hoping, striking, jumping, throwing, catching, sliding and dribbling. In addition, the teachers creatively blended in some stations in which students where focusing on rhythm and timing within the class lesson.

In particular, the students would consciously attend to the musical rhythms within four of the stations while practicing FMS. These stations included: Jingle Jump, Skating Rink, Snowboarding, and Jingle Bells Basketball. Jingle jump required the students to use a variety of jump ropes. The students would have to practice timing their jumps and finding their own rhythmic pattern when jumping. Oftentimes the students would naturally jump to the beat from the background music being played during the lesson. The skating rink station allowed students to develop their own creative movement styles while sliding. This station gave students an opportunity to explore rhythm individually while combining creative movement skills and patterns while practicing skills such as: sliding, turning, and spinning. Again, the students at this station would skate and develop a sense of rhythm to whatever song was playing at the time during the lesson. This station was a great example of students exploring their own individual rhythmic styles during creative movement. The snowboard station was another station where students could explore rhythm while imagining a rhythmic body motion similar to snowboarding down a mountain. This station made the students think internally about finding their own balance and rhythm to not fall off the board when imagining snowboarding down the mountain.

The Jingle Bells Basketball Station actually required students to synchronize their dribble to the musical score sheet and lyrics on the cone. The students were also required to sing jingle bells while dribbling to the count and tempo. Therefore, the students didn't necessarily use the background music in the gym. They had to develop their own tempo while dribbling and singing to jingle bells count. An interesting observation with this station was the age range where students started demonstrating success. A couple of skilled second graders and some third graders could synchronize dribbling and singing to successfully complete the task at this station. Most students in grades in kindergarten were still working on bounce and catch with a few dribbles in between.

Starting in first grade, students were dribbling with some level of success; however, when more cognitive demands were added such as singing and dribbling to a beat, the task became increasingly difficult. Most likely adding another cognitive demand such as singing and dribbling to a beat was placing too many executive cognitive demands at once for the younger ages when learning how to dribble. Once the students could get a basic dribble down it was only then the students could begin to allocate executive function resources to add the singing component while dribbling to the beat. Success for the task of singing and dribbling at the same time was more clearly demonstrated by the third grade class once basic dribbling skills were already mastered. This suggests that beat competency skill tasks most likely have to be further broken down and practiced at younger ages before combining them together.

At the snowball target throw station teachers focused on verbal cues as a primary auditory instructional model. The physical education teachers created a simple poster

with 4 verbal cues listed in order at this station: step, point, turn, and throw. The poster included verbal cues with a picture of each skill task to be demonstrated. The students were required to verbalize the cues while demonstrating the fundamental movement skill of throwing. The students practiced throwing at the target using verbal cues first and then without using the verbal cues. Interestingly during practice some students would repeat the verbal cues to themselves using self-talk suggesting this might increase motor memory and retention that develop schematic templates when learning FMS.

Classroom Observation #2: Basketball Skills

Kindergarten, first, and second grades were observed separately during this unit. Students entered the classroom having assigned squads. The basketball lessons focused on the FMS of dribbling. The dribbling game introduced was PacMan, named after the iconic video game. Before the game began every squad was called so each student could get their own basketball and find a spot on one of the basketball court lines. Students had to dribble and follow the lines on the basketball court while dribbling. The teachers selected a few taggers to try and dribble after the "PacMan." Before the music began the teachers introduced 4 verbal dribble skill cues with the students. The four dribble verbal cues were: feet apart, knees bent, finger pads, and head up. The teachers demonstrated by modeling a correct dribble while verbalizing the basketball cues. The teachers and students then practiced the skill together. The students would model and verbally respond the four basketball verbal cues in unison as a response to the teacher's demonstration.

The verbal cue response repeated by the students and teacher together was similar to a rhythmic chant. The students appeared to be motivated, engaged, and on task when

chanting the verbal cues back to the teachers while dribbling in place. Once the students practiced the verbal cues and dribbling in their own dribble space the teachers began the games. Music was used to start and stop the games. The teachers would periodically stop the game to change taggers and have students review, demonstrate, and repeat the verbal cues by again chanting the basketball skills in unison. Music was played during the game to increase motivation and enjoyment. Music was consistently played at a medium and faster tempo while students were playing the basketball game PacMan. A variety of musical rhythms were played during this game that included lyrics and instrumental music. Lyrics were used from popular songs such as "Happy" by Pharrell Williams and "Roar" by Katy Perry.

Researcher Reflection

An interesting observation for Kindergarten and first graders learning the basic dribble was many of the students would consistently verbalize the verbal cues to themselves again using self-talk while practicing the skills, even during the game. Some of the more advanced dribblers in second grade were verbalizing the skills less to themselves while dribbling, however, became more attentive to the beat and meter of the musical rhythms while dribbling. The students even appeared to be dribbling to the beat of the songs that had a steady strong down beat. In this type of lesson students might enjoy sounds and musical rhythms similar to PacMan or video games to add another dimension of auditory engagement when practicing their dribble skills.

During the PacMan lesson, some students were moving and swaying their body to the rhythms of the music while dribbling when a song came on that they enjoyed. This

may be because the older students had begun to master the dribbling skills therefore not placing as many cognitive demands on the executive functions of the brain. The students appeared to be developing schematic templates in relationship to their motor learning as suggested by the schema theory (Schmidt, 1975), therefore, allocating more attentional resources to more complicated dribble tasks. This suggests students might begin focusing their attentional resources from repetitive verbal learning cues to listening and enjoying the rhythmic beat of the music while practicing and developing rhythmic basketball skills. Dribbling is a great lesson to incorporate rhythmic activities with a manipulative. A consistent rhythmic auditory learning pattern that includes a strong down beat provides an auditory cue that can initiate rhythmic timing when developing skills FMS. Research can further explore the complexity of rhythmic skill level tasks for each grade level. In addition, simple verbal cues appear to be an effective auditory learning platform for learning FMS in young ages. Exploring the type of verbal cues, sounds, and musical rhythm combinations that optimizes auditory learning platforms in the development of FMS in young students could be a continued opportunity for further research.

Classroom Observation #3 (Refer to Appendix G): American Ninja Warrior Unit

This unit was titled after the popular television show and physical fitness challenge American Ninja Warrior. The physical education teachers used Whittle equipment that has been purchased by the county and is rotated throughout elementary schools in the county. Whittle equipment is a giant indoor obstacle course set up over large gym mats. The obstacle course contains colorful ladders, ramps, hanging bars, monkey bars, climbing ropes and curved bars. The Whittle equipment can be set up in

creative designs that challenge students with a variety of fitness levels. For this unit the physical education teachers created several stages named after the popular American Ninja Warrior fitness challenge TV series. In addition, the teachers had several challenges set up on the side of the gym away from the Whittle equipment such as: high climbing ropes, a bouldering climbing wall, a ninja warrior poses mat for flexibility, flat agility ladders, jump ropes and weighted balls for core exercises. The physical education teachers created professional American Ninja Warrior posters for each stage of the obstacle course. The school name was also placed in front of American Ninja Warrior posters to personalize the unit. The teachers created an American Ninja Warrior Hall of fame for students that successfully completed various stages as performance incentives. Furthermore, some stages included cooperative play and a "Challenge by Choice" options requiring students to complete stages working with a partner.

The 17 American Ninja Warrior stages used were:

1. Climbing Mt. Everest
2. Walking the plank
3. Climbing the pyramids of Egypt
4. Escaping Mt. Vesuvius
5. Crossing the Golden Gate Bridge
6. Altitude climbing high ropes
7. Stair stepping Big Ben
8. Bouldering Mt. Rushmore
9. American Ninja Warrior Poses

10. American Ninja Warrior abdominal crunches
11. Rocky Mountain challenge
12. Descending Niagara Falls
13. Bermuda Triangle
14. The Grand Canyon
15. Mount Midoriyama
16. Ninja agility ladders
17. Ninja jumps

The music being played for the Whittle unit was the physical education teachers' standard playlist on Spotify. The tempo of the music was around 130-140 bpm (beats per minute). A wide variety of music selection was used that included many popular music artists such as: Pharrell Williams, Kelly Clarkson, and Katy Perry. In addition, electronic music such as Crazy Frog was frequently used to get the students warmed up and engaging in the class activities.

Researcher Reflection

This is a fantastic unit that engages upper body and core muscle groups for the entire physical education class period. The stations had creative themes that included destinations in the United States but also international destinations as well. This would be an excellent unit to incorporate musical rhythms, sounds, and verbal cues that geographically compliment the themes of the stations. For example, for the Egyptian pyramids the students might like a familiar song style such as "Walk Like an Egyptian" by the Bangles or modern Egyptian music that has a fast rhythmic tempo. However, some

popular song choices such as these would also need to be tailored to be lyrically appropriate for elementary schools. In addition, American Ninja theme music from the popular television show would also be appropriate and motivating for students. Specific stages within the unit could use auditory rhythms to develop rhythmic competency. The ninja stages that included rhythmic development and maintenance included the jump ropes and the agility ladders. These stages incorporate rhythmic footwork timing drills to better develop rhythmic competency in mastering FMS.

Classroom Observation #4 (Refer to Appendix H): Space Jam

Grades Pre-K and 3rd grades were observed for the unit Space Jam. The gym was set up to replicate the solar system with the Sun station centered in the middle of the gym with the planet stations revolving around the sun station. The students were placed on teams stationed at the Sun in the center of the basketball court. Each team member would take turns going to a planet to work on a specific basketball shooting skill. The other team members would be stationed in the center of the gym at the Sun station to practice dribbling and dribbling tricks until it was their turn to go to another planet. A team member could score points for their team as they traveled to another planet to make basketball shots. In addition, teams were given a worksheet to tally each time a team member visited a planet. At the end of class, the teams counted how many times team members visited planets and how many points were scored at each planet while traveling the solar system (Refer to Appendix G for Space Jam worksheet).

Each station included the name of the planet, a picture of the planet, and several facts about the planet. In addition, various facts about the solar system were posted

throughout the gym walls. The stations included: Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto (This planet was labeled as a dwarf planet).

Researcher Reflection

Musical rhythms and verbal cues were emphasized in this unit. The physical education teachers would periodically stop the activity to review the shooting and dribbling verbal cues. The physical education teachers used music sparingly for classroom management to start and end the activity. A combination of musical rhythms and verbal cues were used during this class lesson. The students would rotate throughout the solar system tagging other students at the Sun station when it was their turn to travel to a planet. The students not traveling to other planets and stationed at the Sun station would practice dribbling and dribbling tricks while the musical rhythms were playing. Some students practiced dribbling while swaying rhythmically to the music almost like a dribble dance. Other students focused more on the mechanical aspects of the dribble, most likely focusing on their dribble while listening and enjoying the background music. The musical rhythms being played had a fast to medium tempo with a steady down beat. Walking, dribbling, and shooting were the three FMS practiced. Several times during the lesson the physical education teachers would review the verbal cues: feet apart, knees bent, head up, flip the wrist, and follow-through. The students would have to repeat and demonstrate in unison back to the teachers. After repeating and demonstrating the verbal cues together the teachers would then continue playing the musical rhythms allowing the students to practice their skills within in the lesson.

This unit combined dribbling and shooting skills while learning about the solar system. Rhythmic competency was continually being practiced using auditory models such as musical rhythms or rhythmic verbal cues. It was apparent the students enjoyed the space theme when combined with the basketball unit. In fact, a casual observation was that some students that might not typically enjoy basketball even showed enthusiasm because they could travel to different planets to learn facts about the solar system. Dribbling a basketball just happen to be the "ride" to get them to the next planet. This unit would also work well with musical space rhythms or sounds from movies such as Space Jam, Star Wars, ET, and Close Encounters.

Research Site 2: Private Liberal Arts College

College Campus Environment

The site selected for the focus group was a private, selective liberal arts college that offers an exercise science and physical education program located near the Baltimore and Washington D.C. area. The college offers a comprehensive exercise science and physical education undergraduate and graduate program. What makes this program unique is that students also receive a liberal arts education in addition to the sciences that are needed in their fields of study. The Exercise Science and Physical Education major program provides numerous options for students including teaching certification and preparation for graduate study in a wide variety of fields such as exercise science, sports medicine, physical education and physical therapy. In addition, students can study at the European campus for an international experience.

Student Profile

Student enrollment at the college is approximately 1,669 full-time undergraduate students and 624 full-time master's degree students. Fifty-three percent of the students are women and students come from 35 states and 15 countries. Furthermore, 34% of students are first generation college students.

Focus Group Setting

The students participating in the focus group are all enrolled in a physical education class titled "Creative Movement and Fundamental Movement Skills." This class is designed for physical education majors to develop the skills necessary to teach rhythmic competency and FMS development for young elementary age students. The focus group was conducted on campus in a private classroom designed for meetings. The focus group was arranged one hour prior to their class time in the evening. Twelve students were invited to participate in the focus group on a voluntary basis. Of the 12 invited students, six were ontime and attended the focus group on the prearranged day and time for the session. They were compensated with a $25-dollar American Express Gift card for their time and contributions to the focus group.

Focus Group Conversation

There were four predetermined central questions followed by extension questions to help guide the focus group conversation (Refer to Appendix D). The focus group conversation was approximately one hour in length. Six table tents that included student's first names were set up at each seat. The week before gathering as a focus group the students were given a copy of the topic questions prior to the focus group conversation.

The students were encouraged to write down any thoughts prior to the conversation and were asked to hand in the notes at the completion of the focus group conversation. I used the notes and classroom follow-up to review and as a member checking strategy to confirm what information was said in the conversation during the focus group. The questions designed for the focus group related to the central research question. The purpose of the predetermined questions was to act as a guide for topics to be further discussed in conversation. All students were encouraged to comment and contribute to the conversation knowing that their input wasn't being judged or graded and was being used for research and future possible curriculum development purposes.

The focus group conversation began with introductions around the table to make participants feel more at ease and comfortable with the setting. However, most of the students were already familiar with each other from class or previous classes. After introductions, I began the focus group by reminding the students the purpose of why they were gathered to participate in the focus group. The student participants were reminded the purpose of the information they were providing was to help identify the most current trends and gather knowledge on the best practices that lead to children learning the skills necessary to develop successful FMS. The college students were asked to reflect on student teaching experiences in their field practicums with current professional physical education teachers and any current course work at the college related to the topic.

Question 1:

In your coursework or student teaching experiences what have you learned about fundamental movement skill development in relationship to developing sports related skills?

All of the students in the focus group agreed with the connection that having stronger FMS can lead to developing stronger sport skills. The students felt that many young elementary students who begin to master FMS were ready to learn the skills necessary to cooperate in team and individual sports. They also commented about the social-emotional aspects of having stronger fundamental sport skills and one student stated:

> Children will have more confidence in themselves and what they are doing therefore more likely enjoying sports and continuing to participate.

Furthermore, another participant commented on an issue not previously addressed in regards to safety when kids learn to master FMS:

> As a future physical education teacher space management and safety are a primary concern, it is crucial that my students learn to master FMS early to minimize accidents. Students need to have controlled and fluid motions in the gym and be aware of their body space.

As a consensus, the group agreed that young elementary age students need to master basic FMS such as walking, galloping, skipping, running, hopping, throwing, and catching. It was emphasized that these are key movement skills that physical education

teachers need to focus on early in the motor development of their students. One participant commented,

> Yes, kids who already have a set of sport skills to work with will only have to learn the rules of the game, and the rest will start to come naturally.

Question 2: Do you feel there is a relationship between fundamental movement competency and rhythmic competency?

Some students felt there is a connection in the relationship between rhythmic and fundamental movement skill competency. However, in general they felt the connection was more related to social and emotional aspects of rhythm more than actual rhythmic skill level, as one student shared:

> I believe that it makes it easier to learn and more enjoyable to move with rhythm. If you can't fundamentally move you will not be able to participate and enjoy the activity.

However, two of the students in the focus group that were on the college basketball team noted that some basketball players might be great on the basketball court but that doesn't necessarily mean they have rhythm on the dance floor. These participants were suggesting that some rhythmic movements might be sport specific to the timing of a particular sport skill or a dance move. Suggesting that students might not necessarily learn the same type of rhythm that is needed for dancing would be needed for a specific sport skill.

Question 3: From what you have learned in your coursework and student teaching experiences what are some ways you can develop rhythmic competency levels in young elementary age students?

The students had several suggestions and great ideas since many of them are student teaching and currently enrolled in the creative rhythms and fundamental movement course at the college. Many students were also developing their own routines that were expected to be used in their future physical education classes. They were also getting guidance from their university instructor and professional physical education teachers at their student teaching practicum sites. Some ideas suggested collectively by the students include:

- Incorporating clapping and counting are great ways to get kids involved when learning rhythmic and fundamental movement competency. Anytime kids have to clap and count while moving to a beat reinforces this concept.
- Pairing verbal cues with musical rhythm and matching locomotor skill words such as jump hop, skip. Also, musical rhythms could incorporate louder sounds or verbal cues such as stomp to the beat, or clap to the rhythm.

Some students in the focus group suggested that specific types of musical rhythm will naturally lead students towards rhythmic competency, especially if they are familiar with the song. For example,

> Students could skip to the rhythm of the beat or maybe they might find a musical rhythm that they can relate to or make a connection with while they are practicing movement skills.

One student shared:

> The physical education teacher at the school where I student teach just plays a variety of styles of music and has the student move and essentially feel the beat to their own understanding.

Another student in the focus group had a similar answer about how the physical education teacher at her practicum site uses an exploratory approach to rhythmic competency:

> The physical education teacher at the school I was student teaching at had the student's just move around on their own to find their own individual beat to different styles of tempos and musical rhythms.

Other students in the focus group have seen more structured rhythmic activities at the schools where they student teach including spin off games such as musical chairs or specific dance and rhythm units incorporating Lummi sticks or line dancing. In addition, some students in their field practicums observed physical education teachers teaching rhythm and timing during jump rope units.

Two members of the focus group played on the college basketball team and one particular player remembers a basketball coach that made them warm-up and work out to music. It was not only great for reinforcing rhythmic competency and fundamental movement basketball skills but it made the team work together in unison:

> My coach would design rhythmic footwork and shooting drills for practice. He would select some great music that would have us work to together doing drills such as step, step, bounce, bounce and then pretend taking a shot at the hoop, then having us make the sound "swoosh." We would be practicing flow and rhythm together as a group. It was a lot of fun while we practice skills together.

A basketball player in the focus group also further elaborated in the conversation how he would create and integrate a blend of rhythm and timing in footwork sport skills. From his past experiences with coaches using musical rhythms he saw the value not only in developing FMS but also team building skills and team cohesiveness.

Question 4: How might technology impact the use of auditory instruction in the physical education classroom?

The students in the focus group had numerous ideas and input on how they will incorporate technology in their physical education classrooms in the future. These groups of physical education educators are a part of the millennium class that understands that technology is now interwoven into most learning platforms through a variety of academic disciplines. Some thoughts from the focus group in response to this question included:

> Technology is really going to be more mobile platforms and as future physical education teachers we will be able to walk around the gym and access different styles of music for a variety of learners in the classroom to instantly grab student attention.

Focus group participants also mentioned that with technology becoming more mobile, future physical education teachers will have better opportunities to increase student participation and engagement. A student in the group stated:

> When we were in school we did have *Dance Dance Revolution* and Wii *Just Dance*, but there were limitations with player use and physical education classes often have 30 or more students.

Developing more mobile platforms for physical education teachers to access suggested that students in their classrooms would find more opportunities to develop rhythmic and FMS on a more personal level. One student in the focus group expanded on this idea by explaining,

> We now have the option of bringing in Bluetooth speakers with our iPad and managing class from our iPad. Instantaneously we can immediately grab our student's attention with some type of auditory sound or musical rhythm.

Further expanding on this idea another student commented,

> We pretty much would not have to use a physical education consumer catalog anymore; we would go to the web to instantly access music selections through mobile devices. We can use sites such as Spotify and Pandora. Even kids can search through and find their own song to find a beat. I would even take it a step further and maybe use my iPad and a projector to aid in instruction on the gym wall.

After discussing the possible technology learning platforms for physical education classrooms of the future, the focus group students were asked to reflect on how they would actually use audio-based technology in the classroom in relationship to rhythmic competency and FMS. The students were encouraged to "think outside the box" and be creative in their responses, and to remember there is no wrong response. Emphasizing this point, the focus group students replied with creative ideas and areas of research for further development and exploration. One creative response from a student in his senior teaching practicum replied,

> I am currently student teaching in an elementary physical education and math classroom. The teacher for the math classroom has developed avatars that are used as motivational tools to increase student engagement. Each student has their personal avatar to recognize and celebrate personal success. In the future, I could see myself possibly designing this type of format for the physical education classroom and maybe be able to project the avatars on the gym wall or something.

Many focus group participants agreed they would use a combination of audio and visual learning platforms in their physical education classroom because of the technological availability. Another student suggested:

> I would use instructional video and interactive websites to guide my teaching.

Expanding on the idea of projecting visual instruction on the wall, another student commented on how she would probably do more of a combination of auditory and visual learning platforms to develop rhythmic competency for FMS:

> I have not seen projectors used in any classes that I have observed, however, I have seen YouTube lessons being used. I could envision using YouTube for teaching a variety of different skill sets. Hundreds of free videos can be projected. I envision all forms of technology coming into the physical education classroom, if you think our generation is tech savvy, you should see what students in grade school are doing now.

Another student in the focus group commented on how they observed a rhythmic teaching strategy they observed in a Kindergarten classroom that they could incorporate in physical education lesson plans.

> I was in a kindergarten classroom and a teacher used an old song, "Who Let the Dogs Out." The teacher was teaching reading and replaced the lyrics with the sound of the alphabet. For example, instead of saying "Who let the dogs out" she would have all the kids sing back to her "Who let the aaa…aaa...aaa out" in rhythmic pattern that goes with the beat of the song. The kids loved it and made it easier for them to remember the sounds to the alphabet. I can envision replacing lyrics to similar songs with physical education motor skills for increasing rhythmic competency.

The focus group participant also suggested a need to access more songs with a simple 4 or 8 counts. The student suggested,

> Making music match simple counts like 4 or 8 is something kids can do and practice to improve rhythmic skills for FMS.

Another perspective discussed from the focus group students when matching musical rhythm to movement was in regards to fitness testing. Currently most students are familiar with the Fitnessgram fitness tests that are being used in physical education classrooms in many Maryland Public School systems. The students in the focus group have noticed how auditory sounds are being used for students to exercise in unison to the auditory cues for skills such as the sit-up, push-up, and pacer tests. The focus group students agreed that elementary age physical education students are receptive to the Fitnessgram tests because they have been trained to the auditory cues since early instructional grades. However, most agreed that the fitness tests now need and should have upgrading. As one student in the focus group commented,

> I would like to see incorporated for the musical learner, music rhythms that is more upbeat with the pace and music that matches the beat of the pushup and sit-up testing with more motivational music in the background to increase performance levels. More motivation and learning that keeps up with the pace is what I would love to see for development in the future.

Researcher Reflection

In a consensus opinion, the group acknowledged the relationship between developing rhythmic competency in relationship to learning FMS. In addition, there was a strong consensus that the development of FMS is necessary for motor learning development. All the preprofessional participants in the focus group acknowledged that

technology learning platforms will be used in their physical education classrooms. Several of the participants have already thought about programming designs. Many of the participants indicated that video and audio technology learning platforms will also be incorporated into their daily lessons. Some of these ideas include: using more mobile technology interfaces to manage and teach classes, using technology learning based platforms to increase student motivation and feedback, and using services on the web such as YouTube to demonstrate audio and visual skill lessons for the development of motor skills.

Data Analysis Conclusion

The purpose for using a cross case analytic technique in this study was for the use of collecting open-ended and emerging data to discover thematic patterns in order to draw conclusions about the research question (Creswell, 2014). In this study, the central research question was "How does auditory instructional modalities develop rhythmic competency which contributes to fundamental movement skill development that can lead to increased levels of physical activity in young children?" To answer the central research question, two research sites were selected using several data collection techniques.

The two data collection sites included a private liberal arts college and a Maryland Public School System located in the same county. At the private liberal arts college, a focus group was conducted consisting of six physical education and exercise science majors enrolled in a creative rhythms and FMS class. Surveys, interviews, and observations were conducted in the suburban Maryland Public School System. The surveys were distributed to all elementary physical education teachers in the county with

a 52% return rate. In addition, two physical education teacher interviews and 10 physical education classroom observations were conducted at a designated Title 1 Maryland physical education demonstration school.

For both case studies, the data were analyzed using multiple data collection techniques. In addition to the data analysis results, a researcher reflection summarized the key findings from each data collection tool. From this strategy, thematic data analyses identifying emerging and key findings were color coded with reoccurring data that was consolidated to create an overall portrayal of the research conclusions (Creswell, 2014). Several key research themes were identified across all forms of data collection strategies and case sites in this study: Auditory learning models, fundamental movement skill development, individual and group rhythmic competency, musical rhythms, musical rhythmic structures, beat and tempo, verbal and rhythmic verbal cues, sound cues, rhythmic sound cues, self-talk, rhythmic self-talk, joint shared rhythmic competency, rhythm and its role in a culturally responsive physical education classroom, and technology applications for rhythmic competency in a physical education classroom (Refer to Appendix E for thematic chart).

Why Auditory Learning Models in Physical Education?

A significant tenant in the adoption of implementing auditory learning models in a physical education curriculum is the connectivity between the auditory and motor learning systems (Pope, 2010). Transferring perceptual-motor skill learning to successfully apply and adapt too individual and team sports is essential in developing fundamental motor skill competency success (Rosalie &

Mueller, 2012). Owens and Stewart (2010) suggest that sport educators need to develop a strong foundation in a combination of visual, auditory, and kinesthetic instructional modalities. Rosalie and Muller (2012) summarized the mechanisms underlying the transfer of perceptual-motor skill learning in sports:

> Perceptual-motor behavior is motivated by performance demands and evolves over time to increase the probability of success through adaptation. Performance demands at the time of an event create a unique transfer domain that specifies a range of potentially successful actions. Transfer comprises anticipatory subconscious and conscious mechanisms. (Rosalie & Muller, 2012, p.1).

Knowing that multiple learning styles are involved in the transfer of perceptual-motor skill learning, an auditory learning model is one particular learning model that might bridge the transfer of time to create a unique transfer domain to specify a possible successful action. For example, Dr. Sugarman describes the process of how an auditory schematic template can be transferred to perceptual-motor schematic templates to produce the desired motoric action:

> Our walking along, or dancing along, is a symphony of elements that have been integrated into a sequence, each cueing. As child gets the basics right, they can then skip, which is in fact walking, but with intentional, learned error. The music you provide is the substrate of the motor movements, providing a pattern that is connected and mimics what

> happens neuronal, each sound guiding the next motor element in the sequence. (R. Sugarman, personal communication, September 9, 2010)

According too recent cellular and neuronal research the auditory system should not be seen as separate individual processing stations but as a distributed and integrated circuit, with experiences that "sculpt the auditory system and create automatic response properties that develops a 'biological' memory" (Kraus & White-Schwoch, 2016, p.1). Knowing rhythmic competency is a motoric underpinning for fundamental movement skill mastery, an auditory learning model should be one of the essential teaching strategies used by physical education teachers (Wang, 2007). Scott (2009) proposes that movement actions follow a spatial sequence and in order for motor skill performance to be successful this sequence of movements should also follow an effective rhythm. Furthermore, some evidence has suggested in young children the development of both domains of music and motion synchronicity together where children acquire abstract knowledge not just in a concrete experience but a holistic bodily experience as well (Pope, 2010). From a neuropsychological perspective as reviewed by Gruhn et al. 2012 states:

> Neither sports and motor training nor musical practice can improve the other modality on its own. Rather motor and auditory systems are neutrally linked and procedurally integrated during neuropsychological development. The ability to perform a fluent movement in space calls for the same ability that is needed to frame a melodic line. In music, time and

space interact: Musical time appears as a projection of sound in space.

(Gruhn et al., 2012, p.15).

When participants actively listen to musical rhythms this process engages the brain to develop a perceptual hierarchy that identifies patterns and structural anchors (Neuhaus, Knosche, & Friederici, 2009). Chen et al. (2009) suggest that the transfer of auditory information may include the transformation into a motor representation, which can influence the motor systems that impact how we process sound. As a result, this makes auditory learning models an opportune teaching strategy to transfer motor learning skills to children that especially require timing skills**.** By adding a rhythmic element in movement education this develops an internal sense of rhythmic flow that can increase motor coordination skills (Scott, 2009).

In physical education classes auditory cues are often simply a part of the background learning environment unless the instructor specifies that students need to direct their attention to the sound (Wang, 2007). However, Wang (2004) also suggests that auditory modeling is just as important as other instructional strategies in the learning process of a motor skill. In fact, since auditory modeling is fairly easy to implement during a continuous motor task it provides a chance to allow students an opportunity throughout the lesson to attend to an external focus (e.g. verbal, sound, and music cues).

Fundamental Movement Skill Development

Building blocks for sport skills. Relevant research agrees that FMS are considered to be the foundation and building blocks that are required for sport-specific movement skills and physical activities (Cohen, Lubans, Morgan, Plotnikoff, & Robin,

2014). The focus group unanimously agreed that there is a positive connection in having stronger FMS that can lead to developing stronger sport skills. They also agreed that young elementary school students who begin to master FMS were ready to learn skills necessary to cooperate in team and individual sports. One participant in the focus group noted:

> Yes, kids who already have a set of sport skills to work with only have to learn the rules of the game and the rest will come naturally.

This is in agreement with research that indicates that the development of motor skill competence is an underlying mechanism that promotes physical activity engagement (Stodden et al., 2008).

Sport skill competency and physical activity levels. According to Canadian Sport for Life (2011), movement, competence and mastery that are developed when learning FMS often translate to being a lifelong learner of movement and physical activity. This statement also agrees with the physical education teachers being surveyed on the positive relationship of building motor competency and physical activity:

Teacher Survey Response Rate: Question 5

Q5: Students who demonstrate competency in fundamental movement skills are more likely to be physically active.

Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
0% (0)	0% (0)	23.81% (5)	76.19% (16)	21	3.76

During interviews, physical education teacher #1 expressed concern for the lack of motor skill competence of kindergartners and how they focused their curriculum to

meet those needs, stating “Most students entering kindergarten do not have the basic motor skills and few have locomotor timing skills such as galloping or skipping.” This is also evident in data assessments conducted by NASPE (2010a), who establishes national assessment standards to “identify critical outcomes in specific content areas at particular grade levels” (NASPE, 2010a), data indicates that some students are not mastering the FMS necessary to increase physical activity levels (Refer to appendix A for descriptive statistics). Knowing this, the physical education teachers observed in this study planned several fundamental movement skill development activities throughout the school year that are developmentally appropriate for grades Pre-K-5. The teachers’ planning focused on core FMS such as: running, walking, hoping, striking, jumping, throwing, catching, sliding, dribbling, and shooting. In fact, during classroom observations fundamental movement skill development was the primary focus for stations. This reaffirms the importance of developing FMS in the formative early childhood years of movement motor skills.

Rhythmic Competency

Rhythmic Skill Acquisition. Wang (2007) asked, “Why is rhythm a critical piece of information for motor skill acquisition?” (p. 3). To answer this question, researchers have studied organic motor system theories on the nature of the development of rhythm in motor skill acquisition. According to Wang (2007), one of the key components of motor schema is the unique rhythm of a motor skill and how the attractive state of motor movement distinguishes itself from other motor skills (Schmidt & Lee, 1999). Knowing that rhythmic competency is a key underpinning to be able to

successfully master FMS, recent findings suggest that young elementary age students lack beat competency and locomotor/nonlocomotor skills for beat synchronization for age appropriate structured dances (Little, 2012). These same types of structured dances incorporate many of the foundational FMS required for successful motor skill development. Referring to the table below, this is particularly concerning since the data from this research study also strongly indicates a positive correlation with fundamental movement skill development and rhythmic competency.

Q7: Students who demonstrate rhythmic competency are more likely to be physically active.

Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
0% (0)	0% (0)	76.19% (16)	23.81% (5)	21	3.24

Additionally, when interviewed, physical education teachers indicated a positive relationship between rhythmic competency and physical activity levels and how they developed rhythmic competency during the school year. The teachers suggested that rhythmic competency is primarily taught during a rhythms and dance unit. These units focus on tasks specifically to develop rhythm and timing. However, during classroom observations it was apparent that physical education teachers were integrating rhythmic competency skills when appropriate at stations, skill demonstrations, warm-up, and cool-downs. The physical education teachers consistently designed lessons that integrated individual and group rhythmic competency when learning FMS. Rhythmic competency skills were integrated within several fundamental movement skill stations such as: dribbling a basketball while consciously attending and synchronizing to the beat of

music, jump roping to the beat of music, balancing on a balance board while swaying to musical rhythms and using their imaginations to snowboard down a mountain, timing rhythmic footwork when using the agility ladders at American Ninja Warrior stations, and students creatively finding their own rhythm when sliding and "skating" at the imaginary skating rink during the Winter Wonderland Unit.

Musical Rhythms

Rhythmic Structure

Musical rhythms can be routinely implemented in any physical education class to influence exercise behaviors (Barney & Prusak, 2015). As a result, physical education teachers can adjust the activity level of an activity or the intensity of the skill being practiced to the tempo of a song (Harms & Stu, 2012). In addition, the tempo and beat can provide an underlying rhythmic structure that can underpin rhythmic regularity and perception (Gruhn et al., 2012), therefore providing a motoric rhythmic sequence for practicing FMS. Knowing this, data were collected to explore how different musical rhythmic styles and tempos appear to influence fundamental movement skill development and physical activity levels. Questions 9 and 10 from the teacher surveys address this relationship between musical rhythms, participation, and physical activity levels in young elementary age children.

Q9: When playing music while students are practicing motor skills, does the level of physical activity appear to increase?

Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
0% (0)	4.76% (1)	47.62% (10)	47.62% (10)	21	3.43

Q10: Does enjoyment and class participation appear to increase when music is playing while students are participating in activities?

Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
0% (0)	0% (0)	30.0% (6)	70.0% (14)	20	3.70

The results from this survey are also in agreement with relevant research that music might be a beneficial environmental change that will increase physical activity levels and increase activity levels in elementary physical education classes (Barney & Prusak, 2015). This is also consistent with statements by physical education teacher #2 during the teacher interview describing the motivational aspects of musical rhythms when used in his elementary physical education classroom:

> I observe that students are working at a more intense pace and it makes them work at a higher level. There is a huge difference playing a game in the gym with or without music. Students expect music and appear to be more on task. The kids know what they are supposed to be doing when the music is on.

Konukman, Harms, and Ryan (2012) also acknowledge from management styles in physical education that once students become accustomed to music and realize when it is taken away how much they miss and enjoy music and student's classroom behavior tends to improve dramatically when the music return.

Rhythm Response

The motivational quality of music that exerts the greatest influence on bodily response is rhythm response (Barney & Prusak, 2015). It is finding this 'flow' and

‘groove’ that brings the whole person and group into rhythm which is the purpose in children’s drumming circles (Mackinlay, 2014). Comparatively, elementary physical education classrooms have similar opportunities where children can experience individual and group rhythmic experiences while developing motor skills. Keeping this in mind, an auditory observation chart (Refer to Appendix E) was created to gather data on musical rhythmic structures used by physical education teachers to further explore rhythmic competency. The data collected from the auditory observation chart explored how musical rhythmic structures were being integrated in teaching lessons used by the physical education teachers that inspire, motivate, develop, and maintain rhythmic competency during fundamental movement skill acquisition.

Interestingly, research has often measured the effects of music and exercise intensity in health clubs and gyms but not necessarily in schools (Barney, & Prusak 2015). The research conducted by Barney and Prusak (2015) made the straightforward connection that music in general has a positive effect on physical activity levels in physical education class. However, this study wanted to further explore other qualities of music that influenced rhythmic competency in fundamental movement skill development.

The data from the classroom observations revealed that the physical education teachers preferred to play musical rhythms with a rhythmic structure that consisted of a steady down beat and a fast tempo (130-140 bpm). Again this supported the same research conducted by Barney and Prusak (2015) that students preferred a fast-tempo as their activity levels increased. Although the teachers indicated in the interviews they primarily picked music to increase exercise intensity levels and for student enjoyment,

some songs also supported a musical rhythmic structure suitable for a rhythm response that encourages rhythmic competency in the development of FMS. For example, during classroom observations the teachers played a popular song that is a student favorite, "Who Let the Dogs Out" by the group Baha Men. This song contains several musical rhythmic stretches of synchronous rhythms with heavily accented strong down beats. Although this song was not initially indicated to be selected by the physical education teachers because of a particular rhythmic structure, this song has a rhythmical structure that is conducive to initiating a strong rhythmic response while dribbling a basketball. During the classroom observation many students would dribble the basketball with a strong rhythmic style, similar to a consistent rhythmic down strike on a drum while staying in sync to the song. The students would naturally get excited almost creating a "dribble jam" similar to a "music jam" because of the apparent strong rhythmic response that radiated an action to make students move to the "groove" or beat. In like manner, students were staying on-task while practicing and developing individual and group rhythmic competency skills all while dribbling a basketball to one of their favorite tunes and having fun in class. Popular song favorites such as "Happy" by Pharrell Williams and "Roar" by Katy Perry also initiated similar rhythm responses and emotions from students when practicing FMS.

In light of the data results from the classroom observations, this suggests songs with steady synchronous musical rhythmic structures and heavily accented strong down beats, can initiate a rhythm response. In support of this musical rhythmic structure, research indicates that auditory discrimination is processed more accurately on an

accented beat, rather than unaccented beats, suggesting the importance of strong rhythmic beats (Fujorka, Trainor, Large, & Ross, 2009). Additionally, musical rhythmic structures with inspiring lyrics may positively affect how a student feels when developing motor skills. Knowing this, physical education teachers can creatively select and design musical rhythms that reinforce rhythmic fundamental movement skill development while setting positive class dynamics to support a motivational learning environment.

Verbal Cues

This research study not only explored the characteristics of musical rhythmic structures in physical education class, but also the role of verbal and sound cues in relationship to rhythmic competency. Developing rhythmic competency is an essential underpinning of fundamental movement skill success (Scott, 2009). Again this was reiterated by the focus group participants. The data revealed the possible importance of pairing musical rhythms with verbal cues when developing rhythmic competency:

> Incorporating clapping and counting are great ways to get kids involved when learning rhythmic and fundamental movement competency. Anytime kids have to clap and count while moving to a beat reinforces this concept.
>
> Pairing verbal cues with musical rhythm and matching locomotor skill words such as jump hop, skip. Also, musical rhythms could incorporate louder sounds or verbal cues such as stomp to the beat, or clap to the rhythm.

Pairing verbal cues with musical rhythm was also a teaching strategy discussed in the teacher interviews and was often used in demonstrations during classroom observations. In fact, from observation the instruction seemed to be most effective when the teachers would:

1. The teachers would introduce verbal cues and demonstrate verbal cue skills step by step while students observed.
2. The students would repeat the verbal cues and demonstrate the skill to the teachers.
3. Teachers and students would repeat step 2 together until the teacher was ready to transition students into the next extension activity or lesson.

During classroom observations the teachers would usually combine musical rhythms during the activity to maintain exercise intensity, class motivation, and classroom management. Accordingly, the teachers would periodically check for understanding by stopping the music and then review rhythmic verbal cues while conducting teacher-lead demonstrations together as a class. Students were periodically selected to lead demonstrations alongside the teacher demonstrations. Again it is to be emphasized that when the students were learning and practicing the verbal cues teachers always used a rhythmic cadence. This was a clever teaching strategy used by the physical education teachers to carefully select rhythmic verbal cues as another way to transfer rhythmic competency learning knowledge about the skill being practiced to the students. The teachers would then transition the students back into class activities using musical rhythms to maintain the rhythmic maintenance.

Questions 11, 12, and 13 from the Likert survey also address the relationship of how physical education teachers perceive the relationship between musical rhythms and verbal cues and how this may influence fundamental movement skill development.

Q11: When students are practicing a skill with an auditory sound such as verbal cues, sounds, or music, do students appear to stay more on task?

Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
0% (0)	9.52% (2)	47.62% (10)	42.86% (9)	21	3.33

Q12: When musical rhythm is playing in the background while students are engaged in a movement activity do students tend to move to the beat?

Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
0% (0)	9.52% (2)	66.67% (14)	23.81% (5)	21	3.14

Q13: When students are practicing a skill with an auditory sound (such as verbal cues, sounds, or music) do they appear to acquire new movement skills more easily and correctly than without an auditory cue (for example, when learning to dribble a ball, does it help student learning when there is a rhythmic auditory cue to follow?

Not at all	Very Little	Somewhat	To a Great Extent	Total	Weighted Average
0% (0)	14.29% (3)	80.95% (17)	4.76% (1)	21	2.90

The results from this survey indicate that the elementary teachers in the county mostly agree that musical rhythms and verbal cues increase fundamental movement skill learning. However, question #13 from the survey also indicates there are some teachers

that didn't give a conclusive answer on how this relationship positively interacts. This could be from how the question was phrased for the survey. The survey was given to teachers prior to the data collection for classroom observations. After collecting the data from the classroom observations and only from after further review of the relevant research, it became apparent that survey question #13 probably should have been rephrased into three separate questions.

Verbal cues, sound cues, and musical cues provide three different sets of information to learners in regards of motor development learning (Theodorakis, Hatzigeorgiadias, & Zourbanos, 2012). Therefore, combining them in the same question may have caused some confusion for the readers of the survey. In fact, it wasn't until after classroom observations, when I realized how the teachers coupled specific instructional verbal cues (specific elements regarding the skill being learned) with musical cues (rhythmic cues that were primarily used for motivation and physical activity maintenance) that these are separate learning constructs that needed to be questioned separately.

Evident from the data collection results and research, verbal cues are an essential auditory teaching strategy used by physical educators. It is vital for physical education teachers to have a "to go list" of verbal cues to adopt into their teachers "toolbox". Well-constructed verbal cues enable teachers to provide short and accurate phrases (Valentini, 2004) that focus on the critical movement skills to a student (Rink, 1993), that can elicit learning (Valentini, 2004). Therefore, reducing the volume of information given to a child who is learning motor skills allows more attentional resources to focus on

performance skill tasks (Bobrownicki et al., 2015). By decreasing the informational load by using one or two-word verbal cues, students can be reminded how to perform a movement by understanding exactly what part of their skill performance to focus on (Kowalski, Webbert, & Aiella, 2015). Furthermore, verbal cues give a student a clear image of the correct movement pattern (Konukman & Petrakis, 2001). According to Konukman and Petrakis (2001) when selecting proper teaching cues,

> It is especially important for beginners, because cognition and motor performance are interdependent in the early stages of learning. Young children and special populations need cues that are easy to understand and that help them form a mental picture of the skill. (Konukman & Petrakis, 2001, p.3)

Rhythmic Verbal Cues

During classroom observations the teachers consistently had prepared and well-rehearsed verbal cues designed for their lesson plans. The verbal cues were also posted clearly throughout the gym with critical elements of each FMS. In addition, a picture of each motor movement of the FMS was paired with the corresponding verbal cue. When teaching the FMS of dribbling, this skill was broken down into four simple verbal cues, "feet apart, knees bent, finger pads, and head up." However, in relationship to developing rhythmic competency, the teachers took it one step further and created rhythmic verbal cues that followed a rhythmic motor learning sequence to correspond with the motor skill of dribbling. First, the students watched and listened while the teacher sequentially demonstrated the skill using a rhythmic chant with a cadence. Second, the class was lead

together with the teachers leading the verbal cues for a dribble again in a rhythmic chant with a cadence. Third, the teachers repeated this cycle until all students had an opportunity to try and synchronize a rhythmic chant with a cadence in the dribble. This further supports the research that there is strong evidence of a relationship between the ability to synchronize music and movement with an external timekeeper (Trost et al., 2014). This teaching strategy was a great example of blending the development of individual rhythmic competency into a larger whole of group rhythmic competency. In effect, this could be a key element to incorporate into the development of rhythmic competency skills and is especially true when transferring rhythmic knowledge using critical learning components of motor learning skills for young children.

Having the verbal cues constructed into a rhythmic chant with an appropriate motoric cadence appeared to reciprocate a timed, rhythmic verbal and motoric response from the students. Once the teachers and students established a group rhythmic flow teachers would then transition into the class lesson. During the main activity lesson, the rhythmic verbal cues was often reinforced and repeated during motor skill practice and acquisition throughout the class period. Periodically reviewing the verbal cues in a rhythmic chant together appeared to also increase classroom cohesiveness and reinvigorate students to maintain a higher level activity of fitness levels, also while refocusing student task attention to motor learning.

Verbal Sound Cues

Another style of auditory cues that was shared by a participant in the focus group was on the college basketball team. This participant commented on the role of verbal sound and visual cues during warm-up basketball drills as a child;

> My coach would design rhythmic footwork and shooting drills for practice. He would select some great music that would have us work to together doing drills such as step, step, bounce, bounce and then pretend taking a shot at the hoop, then having us make the sound "swoosh." We would be practicing flow and rhythm together as a group. It was a lot of fun while we practice skills together.

In fact, data collected from this participant was the first time during this data collection process that the focus was on verbal sound cues other than clap or stomp. For this study, verbal sound cues represent an auditory representation of a word. Verbal sound cues in this particular instance were associated with the word "swoosh". A verbal sound cue is different from verbal cues because they do not use words to identify specific critical elements about a movement skill, but rather an "auditory sound image". A carefully selected verbal sound cue that is paired with an action word may evoke a mental visual picture of motoric and auditory success to a student or athlete. In other words, this transfers knowledge of critical element motoric success from an auditory, aural, or kinesthetic perspective to the student. For this example, the basketball player used the verbal sound cue "swoosh" which most likely refers to the performance task of visualizing an auditory sound of "all net" to a basketball player when making a successful

basket. A sound that is universally agreed among basketball players to elicit a positive "feeling of flow" and success most likely from a basketball shot that was fundamentally executed correctly. It might be possible that through audiation there is a connection to the meaning of sound cues such as "swoosh" which provides an aural interpretation through understanding of musical syntax (Foley, 2013). For children the word "swoosh" may represent a symbolic action where the child learns to perceive and comprehend the image of the symbol (Solovieva, Gonzalez, Claudia, & Rojas, 2015). In other words, sound cues such as "swoosh" might elicit a positive motoric response that would be especially useful during motor skill development. It might be that an aural schematic template of motoric understanding can transfer this knowledge to the learner, especially for younger children because of how they process information. It is most likely easier for children to listen to simple rhythmic sounds and need less time and effort in coding then compared to verbal descriptions (Wang, 2007). Therefore, simplifying the verbal critical cue elements into an auditory and mental image of the motoric response may be successfully recreated at this age. This would be in agreement with Piaget theory (1952), especially for young children during preoperative stage of symbolic learning, where a child is still learning to distinguish objects (Perrotta, 2011).

According to (Gruhn et al., 2012) music and movement interactions that focused on better motor coordination at an early age may result in the development of better musical discrimination and audiation skills, even suggesting a developmental synchronicity between the domains of music and motion at a young age. Overall

incorporating sound cues in the repertoire of rhythmic motor movements in combination with rhythmic verbal cues and musical rhythms in young children may be advantageous.

Self-Talk

During classroom observations, the teachers were consistently combining verbal and visual cues with a variety of musical rhythms, beats, and tempos.

As noted earlier, an interesting observation when the students were learning the verbal cues was how the students rhythmically chanted the cues back to the teacher. This appeared to develop teamwork, class cohesiveness, and motivation to learn together. During the teacher interviews, physical education teacher #2 also emphasized the importance of breaking down FMS into learning verbal and motivational cues while at the same time establishing class camaraderie,

> For many of our skills we break down the movement skills in groups of 4. For example, for the baseball throws we teach "point, step, turn, throw." In volleyball we use the verbal cues "toss, bump, hit, catch." The students have to practice and repeat them after me. Then we say and practice it together as a class. We will even say a lot of silly teambuilding phrases together. For example, I say "Work Together" and the kids repeat "Work Together." I will say "Teamwork" and then the kids repeat "Teamwork." We do a lot of simple verbal cues with them repeating it really keeps them engaged. The physical education teacher emphasizes, "They eat it up, and they love it. It really motivates them!"

This teaching approach is consistent with research on the integration of verbal and motivational cues for developing motor skills in young children. When teachers have students repeat instructional and motivational verbal cues, children increase opportunities for self-talk (Theodorakis et al., 2012). Research indicates that self-talk can improve FMS performance in a variety of motor learning environments and tasks (Theodorakis et al., 2012). In addition, research is considering how self-talk interplays between explicit instructional verbal cues and motivational cues;

> Although the effects of instructional external focused on self-talk on learned or novel tasks have received research attention, research has yet to explore the interplay between motivational self-talk and the different stages of learning. When a skill is well learned (later stages of learning) which is usually performed automatically with little effort, motivational self-talk might be more effective then instructional self-talk. (Zourbanos et al., 2013, p. 172).

Motivational Group Rhythmic Self-Talk

The data results from teacher interviews and observations in this study did reveal students engaging in motivational and self-talk verbal cues to increase motoric performance. During the teacher interviews, physical education teacher #2 placed a strong emphasis on self-talk from not only an instructional strategy or learning fundamental movement skill tasks but also from a motivational self-talk perspective. Students in classes would commonly feed off the motivational cues together when prompted by the instructor such as “teamwork” or “work together”. The physical

education teacher also said they would just come up with fun silly phrases to get motivated and have class cohesiveness. Motivational self-talk was also discussed by the college basketball player in the focus group. He commented when growing up his coaches would develop basketball routines having them work together as a team that included motivational verbal cues. The purpose of the self-talk was not only to increase individual motivation but rhythmic group motivation and team cohesiveness as well.

Rhythmic Self-Talk

During classroom observations, the use of self-talk was more apparent on an individual basis when students were at stations. During observations, students would continue to integrate verbal cues as a method of self-talk while practicing skills, even without a teacher instructor prompt. The self-talk would be the same verbal cues that have been practiced with the physical education teachers during group instruction. Furthermore, the self-talk auditory rhythms were similar to the timing and rhythmic chanting practiced during group instruction for verbal cues. Concluding the possible role of rhythmic self-talk might be another key component in the development of rhythmic competency in motor skills competency for young children. This would have significant applications in the development of rhythmic competency for fundamental movement skill development in the physical education classroom. Again suggesting the possibilities of rhythmic self-talk in the learning and memorizing of a sequence of motor skill tasks while developing rhythmic competency skills.

In similar research, Valentini (2004) suggests reinforcing verbal cues with a variety of different beats and musical rhythms as a powerful tool to help children retain a sequence of tasks;

> One should point out that learning improves both qualitatively and quantitatively when combining visual and verbal cues. This combination is particularly useful in an elementary school setting, where just a visual model may not be sufficient. (Valentini, 2004, P.3).

Possibly once young elementary age students learn the rhythmic verbal cues for critical movement skill success an action word that represents a sounds cue can evoke the correct motoric response. In particular, perhaps children use body movement as a crucial role in the learning process as their experiences are holistically acquired by the entire body (Gruhn et al., 2012). Moreover, preliminary research indicates that musical rhythm can entrain a listener's visual attention (Escoffier, Jian Sheng, & Schirmer, 2010). Likewise, a sound cue can create a "feeling" and an "auditory image" as another way to transfer rhythmic competency knowledge to the student. Therefore, physical education teachers should incorporate a variety of rhythmic verbal, sound, and music cues in the repertoire of motor movements in young children.

The Combination of Joint Shared and Individual Rhythmic Competency

Interestingly in music education programs that utilize children's drumming circles, a similar auditory feedback loop is used to share a "narrative of call and response, synchronization, prediction, interruption and imitation" (Mackinlay, 2014, p. 4). From

Mackinlay's (2014) recent research on how drumming circles make children feel, her study has highlighted the concept of self, self-worth, self-esteem, and the concept of "being together in time.". One student from the drumming circle in the study comments,

> 'drumming makes space to form social relationships, to join together as one large group of learners, and work together for a common purpose'. He smiles. 'Not only is it fun be in 'flow' together, it's FUNtastic!'
>
> (Mackinlay, 2014, p.12)

From the classroom observations the verbal cues coupled with the rhythmic chanting in unison seemed to ignite this similar auditory feedback loop found in children's drumming circles. Again this suggests that pairing rhythmic verbal and sound cues with a rhythmic modality such as musical rhythms provide an auditory environment for complete student rhythmic participation. All the students are engaged and focused at the same time, which produces an atmosphere of auditory rhythmic teamwork and social togetherness.

The results from this research study clearly indicates that using a combination of musical rhythms in combination with instructional and motivational verbal/sound cues can create an innovative instructional platform for developing rhythmic competency skills in FMS in young children. In addition, physical education teachers can create learning environments that not only promote and maintain physical fitness maintenance but also encourage a culturally responsive classroom that fosters teamwork, cohesiveness, and diversity. How does group rhythmic competency affect the individual rhythmic competency and self-efficacy of learning FMS for young children? Knowing there is a

possible synergistic effect between individual and group rhythmic competency, physical education teachers should be encouraged to explore different individual and group rhythmic combinations to promote student learning. In a physical education classroom this could also be known as "rhythmic teamwork". Physical education teachers have several opportunities to explore and experiment with verbal, sound, and music cues in combination with a variety of musical rhythmic structures. Furthermore, warm-ups, cool-downs, class themes, ice breakers, and skill stations are all great opportunities to not only review common sport skill components but to reinforce rhythmic teamwork and rhythmic self-concept. The results from this study suggest that individual and group rhythmic constructs work in tandem while developing rhythmic competency skills in children's FMS.

Technology

Physical Education Application

Tony Hall, a keynote speaker at the 2011 International Association of Physical Education in Higher Education, gave his keynote lecture regarding technology in physical education suggesting interactive technology needs to be a solution rather than a divide for sedentary living (Hall, 2012). One key to bridging this divide is to enlarge the physical educator's knowledge base (Pyle & Esslinger, 2014). The results from this research study support not only the need but also the willingness of physical education teachers wanting to increase their technology knowledge base through interactive technology. This was especially apparent from the data retrieved from the focus group since these participants are part of a millennium class that already widely integrates technology platforms. A

participant from the focus group has already envisioned several ways he can incorporate technology in his physical education classroom:

> I have not seen projectors used in any classes that I have observed, however, I have seen YouTube lessons being used. I could envision using YouTube for teaching a variety of different skill sets. Hundreds of free videos can be projected. I envision all forms of technology coming into the physical education classroom, if you think our generation is tech savvy, you should see what students in grade school are doing now.

Another participant in the focus group commented,

> I would use instructional video and interactive websites to guide my teaching.

It is not surprising that results from the focus group data in this research study indicated the widespread use preservice teachers envision integrating technology in their physical education classrooms. Especially since research has shown a greater exposure to technology increases the affinity of technology in physical education classrooms (Juniu, Scrabis-Fletcher, & Zullo, 2015).

The physical education teachers who were surveyed were not specially asked about technology applications and platforms in physical education, however, the physical instructors that were interviewed were also in agreement with the focus group that interactive websites do complement lesson planning and guiding. Knowing this there are several sites that are accessible for PE teachers to increase their knowledge base

including: www.pecentral.com, www.letsmove.gov, www.aahperd.org, naspe, www.braingym.com, pe4life.org, and www.spark.org.

Websites are an easily accessible tool that most physical education teachers are familiar with navigating and can provide resources for physical education teachers to find "inspiration for units, outlines, lesson plans, and national and state standards as well as new ideas to augment their knowledge and experiences" (Pyle & Esslinger, 2014, p.3).

Technology Applications and Rhythmic Competency in Physical Education

The reason technology applications in physical education were explored in this research study was because of the potential role of auditory modalities in the development of rhythmic competency in young children. Currently, because of the availability of iPads, iPods, other mobile devices, and downloading music platforms technology has changed the way auditory knowledge can be transferred to the learner, especially in the domain of physical education.

Data collected from this study indicated the widespread use of mobile audio devices, iPads, Bluetooth devices, and interactive websites. In addition, many physical education teachers are familiar with software such as Garageband (www.apple.com/ilife/garageband) a software application where teachers can create, write, or edit music according to their class needs (Pyle & Esslinger, 2014). By and large, developing technology platforms can provide better opportunities for physical education teachers to engage students especially from an individual and group rhythmic perspective.

All things considered, dance will not just have to be a part of the physical education curriculum but new rhythmic approaches can be integrated in other physical education content areas as well (Cone, 2015). A combination of rhythmic activities in physical education can include: P.E. content stations, group activities, challenge by choice activities, special events, teambuilding activities, field day events, prep rally, warm-ups, and cool-downs just to name a few. To maximize these student learning opportunities, engaging technology platforms can help teachers to connect with young elementary students to develop and maintain the rhythmic competencies needed necessary to become engage in a lifetime of physical activity.

Section 5: Conclusions

The purpose for conducting this concurrent, mixed-methods, multiple case study was to gather more information on how auditory models can be used to develop rhythmic competency skills. It specifically explored the use of auditory models to develop rhthmic competency skills needed in the development of fundamental movement skills (FMS) that increase total more vigorous physical activity (MVPA) levels in physical education settings. According to data assessments conducted by NASPE (2010a), rhythmic competency is a key underpinning to be able to successfully master FMS (Little, 2012); this suggests that many students are not mastering the movement skills necessary to increase physical activity levels (see Appendix A).

Recent research indicates there is a strong link between auditory and motor learning systems (Pope, 2010). Furthermore, Kraus and White-Schowoch (2016) suggest that the auditory system is a dynamic system that through movement experiences and repetition develops a 'biological' memory that creates automatic response properties. Auditory learning constructs (e.g, musical rhythms, rhythmic verbal cues, sound cues, rhythmic self-talk, etc.) can be used as rhythmic markers that mimic similar rhythmic markers as used in motor skill development and movement (Wang, 2007). This results in better opportunities to improve rhythmic competency levels within fundamental movement skill levels that may improve physical active lifestyles for young elementary age children.

Physical education students make up a substantial group of potential exercise participants in the United States, but auditory learning modalities such as musical

rhythms that might be used to engage them in developing movement skills in physical education have not received significant research (Barney & Prusak, 2015). This is surprising since music is widely prevalent and accompanies most elementary physical education programs (Harms & Stu, 2012). Auditory learning modalities such as musical rhythms, sound cues, and verbal cues can be easily incorporated into any physical education classroom unit. As such physical education teachers have an opportunity to further increase student rhythmic competency engagement by manipulating auditory instructional modalities in lesson designs. These factors guided my development of the central research question, "How does auditory instructional modalities develop rhythmic competency which contributes to fundamental movement skill development that can lead to increased levels of physical activity in young children?"

For this concurrent, mixed-methods, multiple case study, I converged the data and used a triangular research process using multiple forms of qualitative and quantitative data collection tools such as: teacher surveys, a focus group, teacher interviews, and classroom observations. Using a constructivist theoretical paradigm, emerging data were collected and coded using a cross case analytic approach between the public school system and physical education and private college to identify developing themes and patterns in order to draw conclusions and interpretations from the research question, in alignment with Creswell (2014).

The final data analysis from this research study indicated that integrating a combination of auditory learning modalities such as: musical rhythms, verbal cues, rhythmic verbal cues, sound cues, and rhythmic self-talk cues all interrelate in the

development of individual and group rhythmic competency skills in the development of FMS. Furthermore, the results revealed that when auditory modalities were being used in the physical education classroom, students demonstrated:

- increased motoric engagement,
- more on-task rhythmic skill development,
- increased motivation,
- increased exercise intensity, and
- overall increased student enjoyment of the lesson activities.

Additionally, the data suggested that rhythmic verbal cues, sound cues, and rhythmic self-talk were the primary auditory learning modalities to transfer knowledge to the learner regarding critical skill elements of FMS. However, musical rhythms and motivational cues were primarily used to increase rhythmic motor maintenance, enjoyment, exercise intensity, and on-task behavior in the physical education classroom. The data suggests there may be a possible synergistic *rhythmic competency effect* when developing individual and group rhythmic competency, and that learning rhythmic skills as a group may increase individual rhythmic skill acquisition levels. This is important because it suggests a preliminary positive relationship between individual rhythmic self-efficacy and group rhythmic self-efficacy when learning rhythmic competency in a group setting.

The data from this study also indicated that physical education teachers are currently using audio-based technology platforms to motivate and inspire children to increase physical activity levels in their classrooms. Using the iPod, iPad, and MP3

players in combination with music downloading streaming services Spotify and Pandora are common occurrences in the physical education settings. Many physical education teachers are familiar with software such as Garageband, a software application that teachers can use to create, write, or edit music according to their class needs (Pyle & Esslinger, 2014). Using a combination of auditory learning modalities in conjunction with audio-based technology platforms can be integrated into elementary physical education classrooms to further engage rhythmic competency skills in the hope that this will further develop FMS that may increase physical activity levels in young elementary age students.

Interpretation of Findings

In February 2010, First Lady Michelle Obama launched the Let's Move Campaign to significantly reduce childhood obesity within a generation in the United States. According to the Center of Disease Control and Prevention (CDC, 2010), the lack of adequate children's physical activity is a major contributing factor in lifelong health-related consequences such as childhood obesity. However, the majority of American children do not meet the physical activity recommendations (National Physical Activity Plan Alliance (NPAPA, 2014). It is thus vital to further explore theoretically sound school-based interventions to improve fundamental movement skill development (Lai et al., 2014).

Research indicates that further study of auditory instructional modalities may reveal data that can improve physical education curriculums for the development of motor skill acquisition and maintenance (Liu & Jensen, 2009; Mastrokalou &

Haziharistos, 2007). Elementary age students lack the beat competency and beat synchronization skills needed for rhythmic competency that leads to fundamental movement success (NASPE, 2010a). For this reason, this study was initially structured on the premise of the schema theory (Schmidt, 1975), which advocates a single internal time keeper with similar timing restraints across all movement for general motor programs. According to Little (2012), young elementary age students need to develop the rhythmic beat competency and synchronization skills for skilled fundamental movement actions.

Achieving this goal requires the sequential planning of movement structures that lead to the automatization of movement performance (Koedijker, Oudejans, & Beck, 2010). I therefore explored linking the musical constructs of beat competency and synchronization according to the principles of schema theory for developing rhythmic timing in motor skills, especially since entrainment can be used to synchronize bodily rhythms and music can "lock in" to a common phase for a motor skill (Trost et al., 2014). However, the results from this study also clearly indicated that relative timing is just one piece of rhythmic information transferred to the learner in the development of rhythmic competency in fundamental movement skills.

Keeping this is mind, the preliminary results from this study suggests many rhythmic constructs contribute to the development of rhythmic competency for the development of FMS in young elementary students. Although this may be true, auditory modalities appear to work best in combination with other learning modalities as the most effective way to transfer rhythmic competency knowledge to students. This conclusion is based from the data revealed in this study that different auditory learning constructs such

as: musical rhythms, rhythmic verbal cues, rhythmic self-talk, and sound cues conveys different types of rhythmic knowledge to the learner. Knowing that rhythmic competency consists of several rhythmic constructs, the data from this study indicates that the dynamic systems theory (Ulrich, 1997) is intertwined in the emergence of rhythmic competency in the development of FMS. This is similar to findings in recent research that also indicates the involvement of a dynamical systems perspective in relationship to rhythmic dance that remains largely uninvestigated (Miura, Fuji, Yamamoto, & Kazutoshi, 2015).

According to the principles of the dynamic systems theory (Ulrich, 1997), various systems such as physical, chemical, biological, or social systems interrelate in a dynamical network to create motor movement patterns (Dutt-Mazumber et al., 2011). In fact, according to dynamical system theorists it is the nonlinear processing tools of these systems that can exhibit nonlinear self-organizing features to organize emerging movement patterns (Dutt-Mazumder et al., 2011). In other words, principles of the schema theory may anchor relative timing for rhythmic constructs of the general motor systems (Schmidt, 1975) during motor skill movement. However, the principles of the dynamical systems theory (Dutt-Mazumber et al., 2011) most likely create various systems and sub-systems of rhythmic competency constructs that can lead to the emergence of rhythmic competency. Another key point is that the data from this study suggest there might be a positive relationship with the affective entrainment hypothesis that states through music there is a link between rhythmic entrainment processes and emotion induction (Trost et al., 2014). This hypothesis would be in agreement with the

Affective Learning design (Headrick, Renshaw, Davids, Pinder, & Araujo, 2015) that studies the aspect of emotion-laden responses in motor movement. As a result, this most likely impacts rhythmic self-efficacy constructs in the development of rhythmic competency in FMS. Therefore, knowing that numerous rhythmic competency constructs are possibly involved in the development of FMS, a nonlinear pedagogy that involves manipulating key rhythmic task restraints on learners might be advantageous in facilitating the emergence of rhythmic competency in FMS (Chow, Davids, Button, Shuttleworth & Renshaw et al., 2007). Figure 1 shows the possible interrelationships among the dynamic systems theory (Ulrich, 1997), the schema theory (Schmidt, 1975), and the affective entrainment hypothesis (Juslin & Slobada, 2010; Trost et al., 2013) in relationship to auditory learning models, nonauditory learning models, and rhythmic constructs in the emergence of rhythmic competency in FMS.

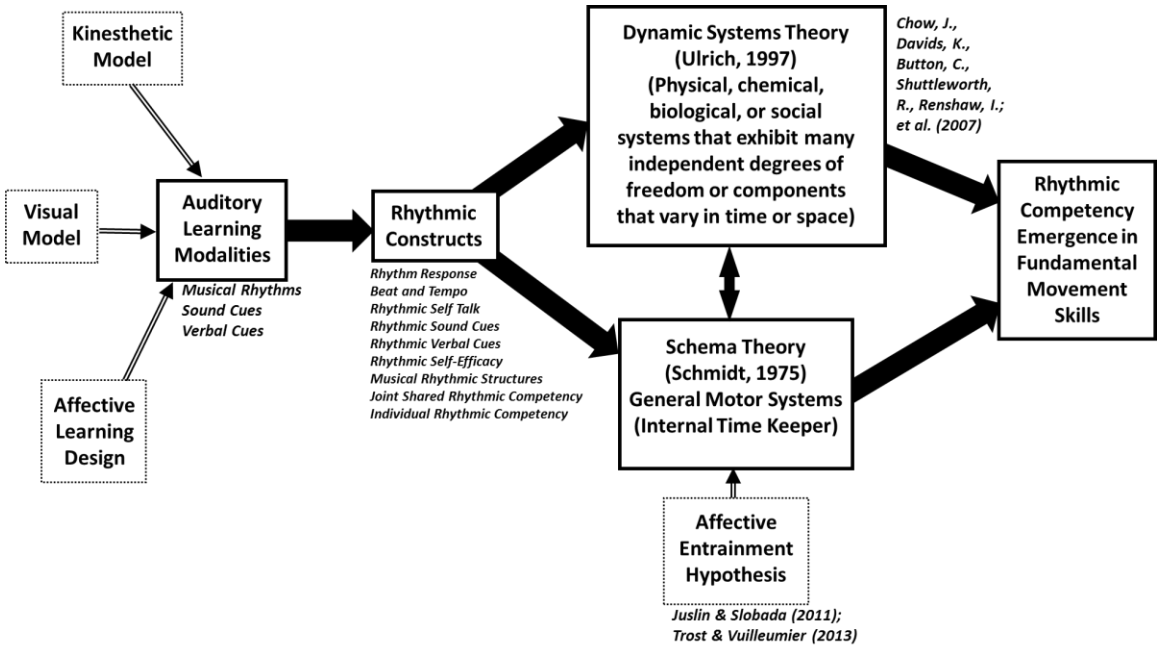

Figure 1. A flowchart showing the development of rhythmic competency in fundamental movement skills.

Using this combination of manipulating different auditory modalities with rhythmic constructs and nonauditory learning models may provide an opportunity to link the memory representation of the practice tasks for the learning and performing of FMS (Lin, Winstein, Fisher, & Wu, 2010). As stated,

> This analysis reflects the dynamical interaction between the maturing organism, the environment, and task. The environments are the aspects that are most capable manipulated in a teaching setting to enhance motor development (Garcia & Garcia, 2006, p.4).

Knowing the dynamic systems theory (Ulrich, 1997) may be more closely intertwined with the schema theory (Schmidt, 1975) than previously thought in the development of rhythmic competency in FMS, these two theories should also be

considered in combination with other learning models: Visual, Kinesthetic, and Affective Learning Design (Headrick et al., 2015). This suggests that the process of developing rhythmic competency skills in FMS is a much more dynamic and fluid process then originally indicated, especially in younger elementary age students.

Limitations of the Study

The design for this concurrent, mixed-methods, multiple case study was a multiple case study collecting data from two research sites: a suburban Maryland Public School System and a private liberal arts college located nearby. Therefore, since this was an exploratory study, only generalizations can be made regarding the results from the data analysis. The parameters of this multiple case study are bound by the demographics of the student and teacher populations at the research sites. Although both research sites are highly recognized programs in physical education, the results represent a limited data collection pool. Therefore, at this point only future research suggestions can be recommended for further data collection possibilities to gather a more complete picture that answers the central research question, "How do auditory instructional modalities develop the rhythmic competency skills for FMS in young elementary age children?"

For example, the results from this initial concurrent, mixed-methods, multiple case study suggested that several rhythmic constructs and learning models evolve in the development of rhythmic competency for FMS in young children. Several constructs identified in this study need further research and consideration for the development of rhythmic competency to make conclusive statements. Additionally, conducting a similar or a new research design in another suburban, urban, or international school setting could

reveal an entirely new set of rhythmic constructs relating to this research study. Therefore, it cannot currently be concluded from this multiple case study that a complete representation of rhythmic constructs that relate to the development of FMS in elementary students have been identified because of the parameters of this study. However, informed generalizations and inferences can be suggested from the results of this study for the development of future research designs.

Recommendations

The data from this concurrent, mixed-methods, multiple case study clearly revealed several additional constructs relating to rhythmic competency in the development of FMS in young children. How do physical education teachers and exercise scientists take the knowledge learned from this research and transform it into practical curriculum development? First, this study indicates a need for a stronger research base of knowledge for the development of rhythmic competency within FMS.

Future research designs could focus on rhythmic constructs that are integral in the development of FMS such as: rhythmic timing, rhythm response, rhythmic verbal cues, sound cues, musical rhythmic structures (synchronous vs. unsynchronous), beat, tempo, individual and group rhythmic self-efficacy, individual and group motivation, and rhythmic self-talk. However, as previously indicated because of the limitations of this study new rhythmic constructs could emerge in future research designs. Moreover, auditory modalities are just one key teaching and learning strategy that can bridge rhythmic competency knowledge to learners. Auditory modalities need to also be further researched in combination with other learning models such as: visual, kinesthetic, and

affective learning design models. In addition, data from this study revealed that how rhythmic constructs are presented, organized, and integrated into a lesson or unit can influence the development of rhythmic competency for FMS. For example, short specific rhythmic verbal cues or sound cues may increase the critical learning elements of a motor skill, whereas musical rhythmic structures might encourage rhythmic maintenance, fitness, motivation, and overall enjoyment of the activity. The data results from this concurrent, mixed-methods, multiple case study support further recommendations:

- To continue research opportunities in the study of rhythmic competency, auditory learning models and nonauditory learning models in the development of FMS.
- To continue to use recognized elementary physical education demonstration sites to further explore rhythmic competency curriculum opportunities in a practical learning environment.
- To further explore the role of auditory learning modalities in relationship to rhythmic competency and fundamental movement development in a culturally responsive physical education classroom.
- To further explore the role of auditory learning modalities in relationship to rhythmic competency and FMS in special learning populations.
- To further explore the role of auditory learning models in combination with other learning models such as visual, kinesthetic, and affective learning design models in the development of rhythmic competency and FMS.

- To further explore opportunities using best practices in rhythmic competency in the development of appropriate grade level rhythmic tasks throughout physical education curriculums.
- To further explore increasing physical education teacher's knowledge base in rhythmic competency.
- To further identify auditory and rhythmic markers in already established researched based elementary physical education programs.
- To further explore web-based development platforms that can merge technology and auditory modalities to create innovative educational platforms in this field of study. This allows an artistic presentation of the research, which is needed to connect and engage students.
- To further explore bringing music artists, dance artists, athletes, exercise science and physical education professionals together for exploration of rhythmic competency and fundamental movement development in curriculum platforms.

Implications

The majority of American children and youth do not meet the daily physical activity recommendations (NAPA, 2014). Currently many young elementary age students are not mastering the FMS that are necessary to be able to pursue lifelong physical activities (NASPE, 2010a). Children with lower levels of FMS are more likely to demonstrate lower levels of cardiorespiratory fitness and physical activity levels (Hardy et al., 2012). Knowing that physical active lifestyles is a major component to maintaining

a healthy lifestyle this study further examined underlying mechanisms that constitute motor competence (Stodden et al., 2008). The results from this study indicate there is a positive relationship between auditory learning models and the development of rhythmic competency skills that can lead to the mastery of fundamental movement patterns and skill acquisition.

Currently, there is a gap in the literature on how to develop instructional strategies to improve motor skill learning in a practical learning environment (Liu & Jensen, 2009). In this study, the development of rhythmic competency in young children was further examined because of the positive impact the development of rhythmic competency can have in the development of FMS. Knowing this, researching auditory modalities such musical rhythms can be used as a powerful change agent to motivate and inspire individuals and groups to move, therefore, becoming more physically active. The data from this study indicated that auditory learning models especially in the form of musical rhythms can have strong individual preferences. How a student interprets a musical rhythm, how their body moves, and how they feel about their body in relationship with rhythmic moving is an individual and group experience. In addition, both rhythmic competency and musical rhythms closely interrelate with the socio-emotional and self-efficacy aspects of individuals, families, and community groups as a whole. With this in mind, rhythmic self-efficacy interrelates with the socio-emotional aspects of young elementary age students that can encourage a culturally responsive physical education classroom environment.

The results from this study would be especially useful to sports and educational research consortiums that focus on motor skill development in young elementary age students. These types of organizations develop and deliver the resources necessary for educators to have the tools to make an impact in their classrooms. Since the majority of young students are enrolled in school physical education, teachers are essential in providing students with the structured learning environment that develops a variety of rhythmic competency skills needed for fundamental movement success. Therefore, organizations whose members consist of physical education teachers, dance teachers, coaches, exercise science professionals, and leaders in the field of health and physical education may find this research helpful. These types of organizations provide access to data and research to professionals in these fields who have the most direct impact on student learning such as: K-12 schools, families, colleges, special learning populations, and after school programs.

Conclusion

Bruno Mar's "Uptown Funk" song was blasting in the gymnasium with the sound of basketballs dribbling to the beat. Was this a dance class or a basketball unit (Cone, 2015)? According to Goodwin (2010), this was one example of a physical education teacher using his rhythmic sport formula of knowledge base and expertise of sports to incorporate rhythmic task designs that increases the enjoyment of learning a new skill. Auditory modalities such as musical rhythms, sound cues, and verbal cues can be used as a powerful change agent to motivate and inspire individuals and groups to move, therefore, becoming more physically active.

Auditory modalities are an essential learning model for transferring key rhythmic knowledge to the learner to develop rhythmic competency skills. Surprisingly though, there is limited research on auditory modalities such as musical rhythms and learner outcomes in physical education (Barney & Prusak, 2015). This is significant since studies have indicated that further study is necessary in auditory learning models to reveal possible data that can improve physical education curriculums for the development of motor skill acquisition and maintenance (Liu & Jensen, 2009; Wang, 2007). In view of this, physical education teachers and professionals in the field need the resources and accessible knowledge base to create and implement rhythmic opportunities in their respective disciplines.

School is an ideal setting for children to learn how to adopt and maintain a physically active lifestyle (CDC, 2010). An integral part of an elementary physical education curriculum is the development of FMS that increase total MVPA in and outside school settings (Jaakkola et al., 2016). Auditory learning models can be used as a tremendous asset to inspire children to move while also developing key rhythmic competency skills needed in the development of FMS. Through developing rhythmic competency in fundamental movement skill acquisition students begin to enjoy new coordination and fitness challenges, all while collaborating with peers (Cone, 2015). By letting children move and explore musical rhythms, beat, and sound cues, children are given opportunities to feel comfortable and joyful in their own rhythmic “experience”, while developing the rhythmic competency skills necessary for fundamental movement success that can lead to a physically active lifestyle.

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Appendix A: Kindergarten and Second Grade Standard 1 Descriptive Statistics & Frequencies

Table 1: Kindergarten Standard 1 Descriptive Statistics & Frequencies

Assessment	Mean	SD	N	% Students at Each Criterion Level				
				0	1	2	3	4
Dribble With Hand								
Form	2.05	1.16	562	0.2	46.1	20.3	15.7	17.8
Continuous Action & Control	2.11	1.10	562	0.2	39.1	26.2	18.3	16.2
Hopping								
Form	2.36	1.05	478	0.6	28.5	18.0	40.0	13.0
Consistency of Action	2.65	0.93	479	0.6	12.8	24.7	44.8	17.2
Running								
Form	2.86	0.74	264	0.4	0.8	30.3	49.2	19.3
Consistency of Action	2.42	0.78	264	0.4	9.5	45.5	37.1	7.6
Sliding								
Form	2.71	0.81	474	0.8	6.1	27.8	51.9	13.3
Consistency of Action	2.88	0.72	474	0.2	5.5	14.8	65.6	13.9
Striking								
Form	2.55	0.87	313	0.3	15.3	22.4	53.0	8.9
Continuous Strikes & Boundaries	2.20	0.95	313	0.3	29.1	28.4	34.8	7.3
Underhand Catching								
Form	2.81	0.74	202	0	4.0	28.2	48.0	19.8
Catching Success	2.98	0.70	202	0	3.0	18.8	55.0	23.3
Underhand Throw								
Form	2.29	0.67	185	3.2	3.8	54.1	37.3	1.6
Distance & Boundaries	2.28	0.62	185	3.2	4.3	54.6	37.3	0.5
Weight Transfer								
Form	2.22	0.92	150	2.0	18.0	32.7	36.0	11.3
Weight Support & Control	2.95	0.52	150	0.7	0.7	6.7	78.0	14.0

Table 2: Grade 2 Standard 1 Descriptive Statistics & Frequencies

Assessment	Mean	SD	N	% Students at Each Criterion Level				
				0	1	2	3	4
Approach & Kick a Ball								
Form (first trial)	2.38	0.86	120	0.8	13.3	42.5	34.2	9.2
Dance Sequence								
Patterns & Transitions	2.06	0.70	120	1.7	16.7	55.8	25.8	0
Beat of the Music	2.10	0.63	120	0	15.0	60.0	25.0	0
Dribble With Hand & Jog								
Form	2.30	0.77	1142	0.4	14.9	42.0	39.6	3.1
Space & Distance	2.29	0.81	1142	0.4	16.6	40.7	37.7	4.5
Ball Control	2.33	0.75	1142	0.4	13.2	41.2	43.0	2.2
Galloping								
Form	2.22	1.02	234	0.4	26.9	37.6	20.1	15.0
Consistency	2.79	0.94	234	0.4	7.7	30.3	35.0	26.5
Gymnastics Sequence								
Still Beginning and End	2.21	0.76	173	1.7	9.8	59.5	23.7	5.2
Balances	2.21	0.93	173	1.7	19.7	43.9	24.9	9.8
Weight Transfer	2.18	0.80	173	0.6	20.2	42.2	34.7	2.3
Jump Forward								
Form	2.72	0.80	953	0.2	8.0	28.2	41.9	20.9
Distance	2.78	0.64	953	0.2	2.1	31.1	44.2	21.5
Jumping & Landing Combination								
Jump On to the Box	2.20	1.01	148	0.7	29.7	29.7	29.1	10.8
Jump Off of the Box	2.41	0.96	148	0.7	18.9	31.8	35.8	12.8
Locomotor Sequence								
Locomotor Pattern	2.10	0.83	166	0	24.7	45.8	24.7	4.8
Transitions	2.00	0.89	166	0.6	30.1	45.2	16.9	7.2
Overhand Catching								
Form	2.61	0.88	181	1.7	8.8	33.2	41.4	14.9
Catches the ball	2.80	0.81	181	2.2	2.2	28.7	49.2	17.7
Skipping								
Form	3.34	0.89	226	1.3	4.4	6.6	34.1	53.5
Consistency	3.34	0.89	226	1.3	4.4	6.6	34.1	53.5
Striking With Paddle								
Success	2.57	0.74	182	0	10.4	26.4	58.8	4.4
Control	2.02	0.90	118	0	37.4	25.8	34.6	2.2

Appendix B: Auditory Methodology and Movement Survey

Purpose: To gather information from elementary physical education teachers on rhythm and timing skills in relationship to fundamental movement skill development in young elementary age children.

BIOGRAPHICAL DATA:

Gender:	[ ] Male [ ] Female
Current grades teaching:	_____
Years of teaching experience:	_____
Education level:	_____
Previous dance or music training:	_____

Fundamental Movement Skills and Rhythmic Competency:

1. Students who demonstrate competency in fundamental movement skills are more likely to be physically active.

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

2. Students who demonstrate competency in fundamental movement skills are more likely to demonstrate rhythmic competency.

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

3. Students who demonstrate rhythmic competency are more likely to be physically active.

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

4. Students who demonstrate rhythmic competency are more likely to demonstrate fundamental movement skill competency.

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

5. Students who demonstrate rhythmic competency demonstrate a higher level of timing skills necessary for sport specific skills (for example dribbling a ball or swinging at a ball).

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

Auditory Instruction, Rhythm and Fundamental Movement Skill Development

6. When music is playing while students are practicing motor skills, does the level of physical activity appear to increase?

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

7. Does enjoyment and class participation appear to increase when music is playing while students are participating in activities?

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

8. When students are practicing a skill with an auditory sound such as verbal cues, sounds, or music, do students appear to stay more on task?

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

9. When musical rhythm is playing in the background while students are engaged in a movement activity do students tend to move to the beat?

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

10. When students are practicing a skill with an auditory sound (such as verbal cues, sounds, or music) do they appear to acquire new movement skills with more ease and correctly then without an auditory cue (for example, when learning to dribble a ball, does it help student learning when there is a rhythmic auditory cue to follow)?

[ ] To a Great Extent [ ] Somewhat [ ] Very Little [ ] Not at all

Again, thank you for your time and professional feedback. The information you have provided will better able me to reflect on the most current research of fundamental movement skill development in young children. This will allow others in our field to continue to learn and gather knowledge on best practices that lead to children learning the skills necessary to become and stay physically active throughout their lives.

Sincerely,
Sally Severy

Appendix C: Interview Protocol

Researcher opening statement

Introduction to study and purpose:

Thank you for your time and willingness to provide professional feedback for my dissertation "Using Auditory Modalities to Develop Rhythmic Competency in Children's Fundamental Movement Skills". A 2010 report released by the Centers for Disease Control and Prevention indicated a decrease in physical activity levels in children. Investigating how children develop fundamental movement skills is one strategy that may be crucial in determining whether children will continue to participate in physical activity throughout their lives. The information you will provide will help me identify the most current trends used by professionals for fundamental movement skill development in young children. This will allow our specialty to continue to learn and gather knowledge on best practices that lead to children learning the skills necessary to become and stay physically active throughout their lives. Consequently, the primary purpose of this mixed method concurrent study is to investigate the relationship between rhythmic competency and fundamental movement skill development in young elementary age students.

Interview questions:

1. Do you feel most of the kindergarten students entering your classroom have learned age appropriate basic fundamental movement skills prior to their first day of physical education class of the year?

   Extension questions:

   If so, in which skills do students demonstrate the most competency?

   If not, which skills do you feel students need to acquire a better mastery before they enter kindergarten?

   Do you feel exposing children to more rhythmic activities and games as a toddler will improve developing fundamental movement success when starting the elementary school years?

2. Do you feel there is a relationship between fundamental movement competency and rhythmic competency?

   Extension questions:

   Do you think increasing students' rhythmic competency levels will also increase fundamental movement skill levels in your students?

3. How do you use auditory instructional models in your classroom (for example verbal cues, sounds, musical rhythms)?

   Extension questions:

   Which type of auditory instruction do you use most often and why?

   Do you use auditory instruction most often for classroom management?

   How often do you use auditory instruction for learning fundamental movement skills?

   Is auditory instruction primarily used only during specific rhythmic units?

   Are there any other ways in which you utilize auditory instructional models that we haven't discussed?

4. Do students with special needs seem to be more receptive to learning models that involve musical rhythms, beats, specific sounds, and verbal cues?

   Extension Questions:

   Which type of auditory model do special needs students seem to be most receptive to?

   Do these same students increase participation levels and stay more on task when an auditory model is used?

   Do you notice that participation decreases, movement patterns deteriorate, or attention span is shortened when the auditory stimulus is removed?

5. As a professional educator would workshops during professional development in auditory instructional models be a benefit?

   Extension Questions:

   Do you feel you have easy access to resources to supplement your lesson planning and instruction when teaching rhythm and timing skills?

   Would additional activities with complimentary resources that utilize auditory instruction be beneficial to your teaching?

Appendix D: Focus Group Protocol

Researcher opening statement

Introduction to study and purpose:

Thank you for your time and willingness to provide professional feedback for my dissertation "Using Auditory Modalities to Develop Rhythmic Competency in Children's Fundamental Movement Skills." A 2010 report released by the Centers for Disease Control and Prevention indicated a decrease in physical activity levels in children. Investigating how children develop fundamental movement skills is one strategy that may be crucial in determining whether children will continue to participate in physical activity throughout their lives. The information you will provide will help me identify the most current trends used by professionals for fundamental movement skill development in young children. This will allow our specialty to continue to learn and gather knowledge on best practices that lead to children learning the skills necessary to become and stay physically active throughout their lives. Consequently, the primary purpose of this mixed method concurrent study is to investigate the relationship between rhythmic competency and fundamental movement skill development in young elementary age students.

Focus Group Questions:

1. In your coursework or student teaching experiences what have you learned about fundamental movement skill development in relationship to developing sport related skills?

   Possible extension questions:
   a. From your student teaching experiences have you observed that children with higher fundamental movement skills usually have stronger sports related skills?

   b. From your student teaching experiences have you observed that children with higher fundamental movement skills usually are more generally active?

2. Do you feel there is a relationship between fundamental movement competency and rhythmic competency?

   Possible extension question:
   a. From what you have learned in your coursework and student teaching experiences what are some ways you can develop rhythmic competency levels in young students?

3. As you develop your own style of teaching how might you use auditory instructional models?

   Possible extension question:
   a. How would you use the following types of auditory methods to develop rhythmic competency for fundamental movement skills?
      1. Musical rhythm
      2. Sounds
      3. Verbal Cues

4. Are there any other ways in which you might utilize auditory instructional models that we haven't discussed?

   Possible extension questions:
   a. How might technology impact the use of auditory instruction in the physical education classroom?
   b. What type of resources might help you to better develop rhythmic competency and fundamental movement skill development in young children?

Appendix E: Auditory Modalities Observation Chart/Thematic Chart

Auditory Modality: Class Lesson: Grade: Date:

MUSICAL RHYTHM

Musical Artist and Style:

Musical Rhythm (circle): Instrumental lyric synchronous rhythm asynchronous rhythm steady down beat

Motivational qualities (circle): slow tempo medium tempo fast tempo inspirational

Type of setting (circle): Warm-up class lesson cool down fitness maintenance fitness testing skill development station management

Fundamental movement skills being developed while music is playing:

Walking running skipping gallop hop striking jumping throwing dribbling dancing

SOUND

Specific sound being used:

Type of setting (circle): warm-up class lesson cool down

Rhythmic qualities of the sound: synchronous asynchronous

Purpose of sound: To initiate movement maintain fitness level develop FMS Skills

Fundamental movement skills developed during sound cues:

Walking running skipping gallop hop striking jumping throwing dribbling dancing

VERBAL CUES

Action words:

Movement initiation movement maintenance develop FMS skill classroom management

Fundamental movement skill developed during verbal cues:

Walking running skipping gallop hop striking jumping throwing dribbling dancing

Themes and key words identified through cross data analysis during the data collection process. Each theme was assigned a letter and key groupings and words relating to that theme were highlighted identified by color throughout all forms of data collection strategies.

Auditory Modalities (A)

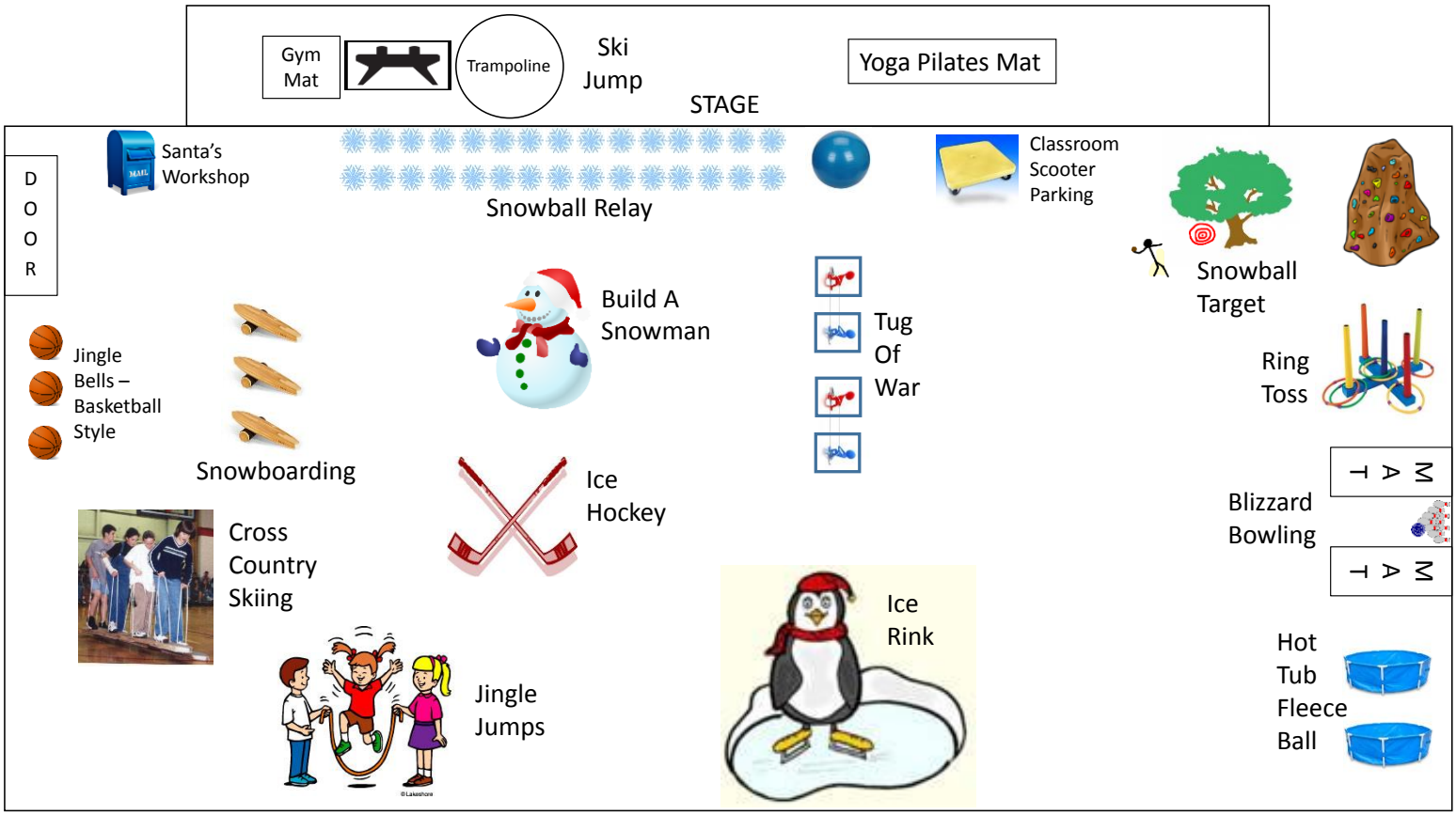
Music (Yellow)	Sound (Pink)	Verbal (Green)
Rhythm response	Sounds Cues	Verbal cues
Musical structure	Swoosh	critical elements
Beat	Classroom Management	short and concise
Tempo	Aural representation	few in number #
Meter	Auditory image	rhythmic cadence
beat synchronization	Pairing with verbal and music cues	rhythmic self-talk
intensity	Auditory sound/motoric response	Pairing
steady downbeat	Stomping/clapping	Motivation cues
popular songs and artists		“Work Together”
motivational		“Teamwork”
FMS rhythmic maintenance		group self-talk
Exercise pace/intensity		individual self-talk
BPM (130-140)		rhythmic self-talk
Hip Hop		
Electronic		
Country		
Rap		
Rock		

Fundamental Movement Skills (B) Red	Rhythm and Culturally Responsive Classroom (C) Silver
building blocks	joint-shared rhythmic competency
individual rhythmic competency	multicultural
motor skill success	special learning populations
movement competence	multicultural rhythms
rhythmic underpinning	cohesiveness
visual/Kinesthetic	teamwork
stronger FMS=Stronger sport skill	

rhythmic skill acquisition sport self-efficacy higher physical activity levels higher fitness levels	diverse rhythmic structures class line formations circles/squads

Technology (D)
IPAD
IPOD
MP3
Bluetooth
Youtube
Downloading streaming services
Pandora, Spotify
Websites
Apple Software-Garageband
Technology familiarity
Mobile devices

Appendix F: Winter Wonderland

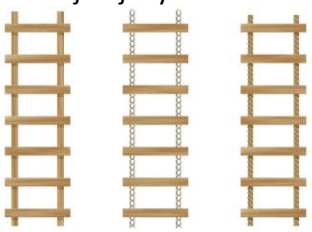


Appendix G: American Ninja Warrior

Climbing
Ninja
High
Altitude

Ninja
Jumps

Ninja Ajility Ladders



American Ninja Stages

Climbing Mt. Everest
Walking the Plank
Climbing the Pyramids of Egypt
Escaping Mt. Vesuvius
Crossing the Golden Gate Bridge
Stair Stepping Big Ben
Descending Niagara Falls
The Grand Canyon
Mount Midoriyama







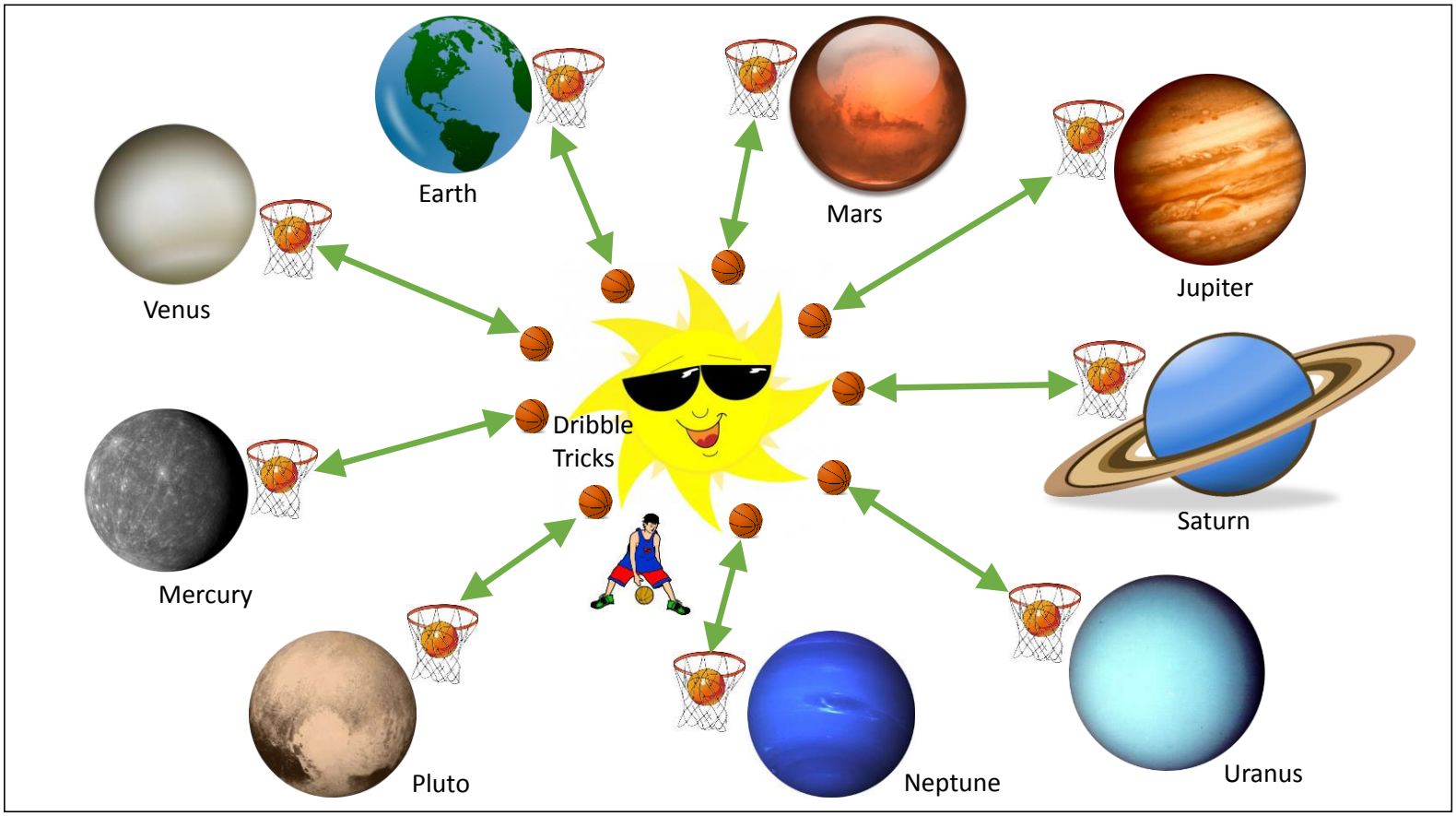
Bouldering
Mount
Rushmore

Meeting
Place
Bermuda Triangle

Ninja Core
Excercises

Ninja
Warrior
Poses

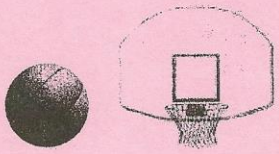
Appendix H: Space Jam Basketball



Space Jam Basketball

How many times did your team visit each planet? Put a tally each time your team visits a planet.

Mercury	Venus	Earth
Mars	Jupiter	Saturn
Uranus	Neptune	(Pluto)



1. Which planet did your team visit the most? Why?

2. How much money did your team collect?

Appendix I: NASPE Permission

National Association for
Sport & Physical Education
an association of the American Alliance for Health, Physical Education, Recreation and Dance
NASPE Sets the Standard

1900 Association Drive,
Reston, Virginia 20191
Telephone (703) 476-3410
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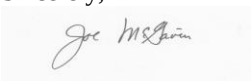

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