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The Effects of Movement on Literacy

A thesis

presented to

the faculty of the Department of Human Development and Learning

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Master of Early Childhood Education

by

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August 2007

Committee Chair, Dr. Pamela Evanshen

Dr. Jane Tingle Broderick

Dr. Amy Malkus

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Keywords: Movement, Literacy

ABSTRACT

The Effects of Movement on Literacy

by

Kathy S. Luppe

The purpose of this study was to extend the knowledge of the relationship between movement and cognition by examining the impact of a sensory-motor program on the literacy skills of first grade learners from one elementary school in East Tennessee.

Literacy skills were evaluated using five subtests of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) assessment.

A 2 x 2 x 2 mixed factorial MANOVA was used to analyze group, gender, and test time effects on multiple dependent variables. The analysis yielded a statistically significant result ($p < .05$) in gains for the movement group and a significant interaction between gender and group. Post hoc analysis indicated that participation in a movement program appeared to negatively impact males and positively impact females.

Replication of this study with a longer duration is strongly recommended to substantiate these findings.

DEDICATION

To my husband John and my children Hannah and Joseph. You are, quite simply, the loves of my life. It's nice to be home again.

ACKNOWLEDGMENTS

I am indebted to many who have contributed to the various stages of this body of work. First, to my friend and committee chair, Dr. Pamela Evanshen, who guided, supported, and encouraged me throughout each phase of the process. I consider her an amazing mentor, educator, and advocate for early childhood; her positive attitude made even the most tedious and challenging aspects of this endeavor wholly worthwhile. To my graduate advisor and committee member, Dr. Laurelle Phillips, whose literacy course happened to be the first I encountered as I began the graduate program. She acted enthusiastically and without hesitation to steer me the “thesis route” when I voiced the consideration out loud. She very wisely chose not to overwhelm me with the most tedious and challenging aspects of this endeavor. In so doing, she communicated her belief in me that I could tackle each step, be it simple or complicated, and contribute something meaningful to the education profession. To committee member Dr. Jane Tingle Broderick, a positive motivator, who supplied me with encouragement and constructive input. To Dr. Amy Malkus, whose suggestions and knowledge pertaining to study design and data analysis proved invaluable. Her editing skills and attention to detail added clarity and polish to the finished product.

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This study would not have been possible without support from the superintendent of schools, the principal, physical education teacher, and first grade teachers from the elementary school where the study took place, and most importantly the first grade children who volunteered in the sensory-motor lab. Your willingness to participate in this study is acknowledged and much appreciated.

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CHAPTER 1

INTRODUCTION

As classrooms become more and more diverse and as the growing number of at-risk students competes with a growing push for accountability, teachers are faced with a dual challenge: to improve instructional methods in order to meet the diverse needs of their students and to produce improved test scores to satisfy the edicts of educational policy. Never has there been a time of greater challenge for education, and never has there been such an opportunity to rethink the whole process (Dickinson, 2006). If a teacher's goal is to create an environment where all students can learn and thrive, then the educational community must recognize the importance of applying cognitive and neuroscience research and theory in the learning process (Prigge, 2002).

The brain is the organ of learning, but until the explosion of research in the nineties, educators lacked an understanding of how it worked at the molecular, cellular, and functional levels. Prior to this time, the knowledge base from which decisions were made was limited by what the behavioral sciences could provide (Wolfe, 2001b). Hart (1983) states teaching without an awareness of how the brain learns is like designing a glove with no sense of what a hand looks like -- its shape, how it moves. If classrooms are to be places of learning, then the brain must be understood and accommodated (Chipongian, 2006).

Now, with over a decade of brain research behind us, educators are readily equipped with not only an understanding of basic brain function but an arsenal of scientifically sound, brain-friendly practices that, when applied in classrooms, can enhance learning opportunities for all children. This growing body of knowledge has far-reaching implications for educational methods and practices (Kruse, 1998). As educators gain a better understanding of the learning process, they can make more informed decisions about how to structure teaching and learning (Prigge, 2002).

Brain-Based Learning

Neuroscience is currently so dynamic, the connection between teaching and the need for understanding how the brain works will inevitably grow, change, and strengthen; the educator's role will take on a brain-based dimension (Chipongian, 2006). New models of teaching, referred to as brain-based, brain-compatible, or brain-friendly, are evolving that use knowledge about the brain to design and implement developmentally appropriate practices in the classroom. These models are intended to improve student achievement, increase engagement in lessons, and move teachers away from passive models of direct instruction that have proven ineffective in many modern educational contexts (Jorgenson, 2003).

The idea of brain-based teaching is to encourage optimal gains in the classroom by stimulating various parts of the brain. Some examples of brain-compatible techniques cited by Fahey and De Los Santos (2002) are repetition, emotional attachment, mnemonic devices, high-challenge/low threat, hands-on, active, visual, kinesthetic, metaphoric instruction, context and connection to embed knowledge, frequent assessment with non-threatening feedback, and exercises that stimulate the brain. Slight variations of this list exist, depending upon which educational expert, neuroscientist, or respected brain research author is consulted, but one common thread connects these models: all tend to support progressive education reforms, favoring a constructivist, active-learning model, and all see neuroscience as perhaps the best weapon with which to destroy the outdated factory model of our school systems (Bruer, 1999).

However, as thousands of scientists rediscover the brain every day, educators must be critical consumers of the research, making connections between scientific findings and the application of brain-based findings in classrooms (Fahey & De Los Santos, 2002). Newberger (1997) stresses that we have only begun to understand the complexities of the growing brain and therefore have only begun to bridge the gap between neuroscience and education. Educators must be careful creating conditions for success based on what "brain research" suggests (Jorgenson, 2003). Neuroscience can give educators the

guidance they need to meet many new kinds of challenges, but, in turn, educators must make sure they do not misinterpret the findings or apply them inappropriately (Dickinson, 2006). The seductive appeal and a very limited brain science database are a dangerous combination, making it relatively easy to formulate bold statements about brain science and education that are speculative at best and often far removed from neuroscientific fact (Bruer, 1999).

Educators, like all professionals, should be interested in knowing how basic research, including brain science, might contribute to improved professional practice. The danger with much of the brain-based education literature is that it becomes exceedingly difficult to separate the science from the speculation, to sort what we know from what we would like to be the case (Bruer, 1999). Jorgenson (2003) cautions that although brain research and processes applied to how humans learn might revolutionize the field of education, this work is still in its infancy. Therefore, educators need to make sure applied practices are sifted from speculation, interpretation, and assumptions based loosely on scientific research.

In order to build the bridge between education and research, teachers must remain open to, and curious about, a growing field of information, then interpret the information in a way that leads to appropriate, responsible classroom practices (Chipongian, 2006). Responsible educators must read as much as possible, be analytical, be skeptical, and take action (Gabriel, 2001).

Purpose of the Study

Traditionally, educational methods and practices have treated the brain as a passive repository, and still today many current practices promote passive learning through heavy reliance on students listening, reading, and practicing in isolation (Kruse, 1998). According to Kruse, both traditional instruction and student evaluation have become more a measure of the ability to recognize and recall than a genuine understanding of concepts. The National Assessment of Educational Progress (1993) found students are learning the basic information of core subject areas, yet are not learning how to apply their knowledge effectively in situations requiring thinking and reasoning (Bennett & Hanneken, 2003). Cameron (as cited by

Gabriel, 2001) stated that teaching “the same old way,” where all kids must learn everything in the same lockstep formation, forces students to fit a mold, and educators simply cannot teach effectively in this manner. Having insight into how the mind works gives teachers a better understanding of how to diversify the curriculum to meet individual needs.

Movement is one of the underlying components of brain-based learning identified through the works of Jensen (1998), Kovalik (1994), and numerous other brain research educators. The benefits of movement and physical exercise in terms of growth and fitness needs have long been established. More controversial is the debate around the impact of movement on academic performance and mental development of young children (Fredericks, Kokot, & Krog, 2006). In many cases, movement and physical exercise have come to be viewed as a waste of precious instructional time, but there is growing evidence that would suggest otherwise. The purpose of this study was to extend the knowledge of the relationship between movement and cognition by examining the impact of a sensory-motor program on the literacy skills of first grade learners.

Research Questions

To determine if movement enhances learning in first grade literacy skills, the following research questions were posed:

1. Would the addition of a sensory-motor program which targets balance, cross laterality, and visual perception activities have a positive impact on first grade literacy skills?
2. Is there a significant difference in gains between the experimental group's pre- and posttest Dynamic Indicators of Basic Early Literacy Skills (DIBELS) scores on any of the subtest measures as compared to the control group?
3. Did gender influence any improvement that may exist?

Hypotheses

The following hypotheses were examined at the .05 level of significance:

1. There is no statistically significant difference in DIBELS Phoneme Segmentation Fluency (PSF) pre- and post-subtest scores between the experimental and control groups.
2. There is no statistically significant difference in DIBELS Nonsense Word Fluency (NWF) pre- and post-subtest scores between the experimental and control groups.
3. There is no statistically significant difference in DIBELS Word Use Fluency (WUF) pre- and post-subtest scores between the experimental and control groups.
4. There is no statistically significant difference in DIBELS Oral Reading Fluency (ORF) pre- and post-subtest scores between the experimental and control groups.
5. There is no significant interaction between gender and performance on the DIBELS PSF post-subtest scores.
6. There is no significant interaction between gender and performance on the DIBELS NWF post-subtest scores.
7. There is no significant interaction between gender and performance on the DIBELS WUF post-subtest scores.
8. There is no significant interaction between gender and performance on the DIBELS ORF post-subtest scores.
9. There is no significant interaction between gender and performance on the DIBELS Retell Fluency (RF) post-subtest scores.

Significance of the Study

Schools have become prime promoters of inactivity. Not only is movement in the classroom a rarity, physical education and recess are being eliminated, as though they were completely irrelevant to children's growth and development (Pica, 2006), to make room for more academic subjects in an effort to increase student achievement as measured by standardized tests. With growing evidence to suggest movement and physical education have a direct positive effect on important educational domains such as reading and mathematics, it could be argued that they are not extracurricular but rather vital components in students' academic success (Grissom, 2005).

Perhaps the findings of the current study will provide compelling support for daily movement and physical activity and, more importantly, convince educators that making time for movement primes the brain for an optimal learning experience. Hannaford (1995) states educators have spent years and resources struggling to teach children to learn, yet standardized achievement test scores go down and illiteracy rises. Movement could be a missing key element. No magic answers are available to make the complex process of teaching and learning successful all the time. But the revolution in brain research provides teachers with new information and insights that can increase their chances of success with more students (Sousa, 1998).

Limitations

This study was limited to 42 students in five first grade classrooms from one elementary school where the study was conducted. The experimental group consisted of 21 first grade students who volunteered to participate in an after-school sensory-motor lab 2 days a week for 4 weeks. The control group consisted of a randomly selected matched number of first grade students in five first grade classrooms who did not participate in the sensory-motor lab. Only data involving reading and literacy achievement were collected and analyzed for the purpose of this study.

Definition of Terms

The essence of human learning is the brain's ability to discriminate, register, store, and retrieve meaning (Kruse, 1998). Scientists, now called cognitive neuroscientists, have been studying how our neural hardware might run our mental software, how brain structures support mental functions, and how our neural circuits enable us to think and learn (Bruer, 1999).

Ornstein and Thompson (1984) provide a basic map of different brain regions and functions:

1. The Brain Stem. All learning initially begins at a sensory level of cognitive processing via the brain stem, which contributes to our general alertness and serves as an early warning system to the rest of the brain regarding incoming sensory information (Ornstein & Thompson, 1984).

2. The Limbic System. Directly atop the brain stem, the limbic system is the emotional center of the brain and provides chemicals that influence focus, attention, and concentration. It includes the hippocampus which serves as a temporary storage for information. Nearby, the thalamus acts as a gateway valve for the flow of all information into the brain (Ornstein & Thompson, 1984).

3. The Cerebrum. The largest part of the brain, the cerebrum is divided into two hemispheres connected by a large band of neurons called the corpus callosum which acts as a communication bridge to make sense out of incoming information. Each hemisphere contributes a cognitive process, from both a "parts-to-whole" and a "whole-to-parts" perspective, which allows us to think both divergently and convergently (Ornstein & Thompson, 1984).

The cerebrum is divided into lobes, each carrying out a variety of functions: (a) the occipital lobe (located at the rear of the brain), is the visual processing area; (b) the temporal lobes (located at the sides of the brain), store permanent episodic memory; the left receives spoken words (hearing) and forwards the sounds for further processing to determine semantic meaning; the right helps process spatial information for meaning; (c) the frontal lobes (located at the front of the brain) serve as our center for thought, control voluntary movement and verbal expression and involve purposeful actions (e.g., planning, deciding, and

problem solving); and (d) the parietal lobes (located at the top of the brain) receive sensory information from the body's opposite side and play a part in reading, writing, language, and calculation (Jensen, 1998).

4. The Cerebral Cortex. The cortex covers the cerebrum and houses two thirds of all neurons in the brain. Neurons, 100 billion specialized nerve cells, are the working units of the brain, capable of making up to 50,000 connections as meaning is detected (Ornstein & Thompson, 1984).

Conclusion

Movement and physical activity meet the developmental needs of children by improving physical well-being, mental alertness, and their readiness and enthusiasm for learning, but can specific movements enhance learning, specifically reading skills? Based on compelling research suggesting movement and physical activity have a direct positive impact on student performance, the researcher will use a sensory-motor model targeting balance, cross laterality, and visual perception activities to examine its effects on reading and literacy skills in first grade students.

CHAPTER 2

REVIEW OF RELATED LITERATURE

The literature review organizes information and studies into six areas: (a) the brain and movement, (b) movement and cognition, (c) the bodily-kinesthetic learner, (d) specific movements, (e) movement and literacy, and (f) support for movement-based curriculum.

The Brain and Movement

Blaydes (2004) explains that movement, physical activity, and exercise balance brain chemicals, hormones, electricity, and system functions, changing the learning state into one appropriate for retention and retrieval of memory. She defines each category of movement in this way: 1) Movement is the navigation of one's environment, 2) Physical activity is voluntary movement that expends energy, and 3) Exercise is physical activity that gets the heart rate into the target heart rate zone.

The word exercise derives from a Latin root meaning "to maintain, to keep, to ward off." To exercise means to practice, to put into action, train, perform, use, improve. Biologically, it was part of survival in the form of hunting and gathering, raising livestock, and growing food. Historically it was built into daily life. These days people might have to consciously include it in their daily routines, but the fact remains that exercise is a natural part of life (The Franklin Institute, n.d.).

Movement is one of the underlying components of brain-based learning identified through the works of Jensen (1998), Kovalik (1994), and numerous others. The benefits of movement, of physical exercise, for fitness and health have long been established (Hanson as cited by Priest, 1993), and drummed into us by our doctors; we know it can help reduce stress, assist with memory function, and fuel the brain with oxygen. Symons, Cinelli, James, and Groff (1997) found aerobic conditioning helped to improve memory. They also concluded that exercise appeared to strengthen particular areas of the brain, and that oxygen intake during exercise may enhance greater connections between neurons.

Aerobic Exercise and Fitness Benefits

The necessity of physical activity for a growing child is well documented in terms of growth and fitness needs as well. Physical activity increases muscle tone, improves respiration and circulation, benefits digestion, aids in controlling obesity, promotes rehabilitation after illness and surgery, and stimulates proper growth and development (Hanson, as cited by Priest, 1993). In the following studies, aerobic exercise differs from other types of physical activity in that it requires elevated heart rate for a sustained period of time.

Three studies measured the physical effects of aerobic exercise in children (Cooper et al., 1975; Duncan, Boyce, Itami, & Puffenbarger, 1983; Segal & Manfredi, 1984). Students ranged in age from grade school through high school. In each, regular physical activity classes served as controls. Improvements in physical measures for aerobic exercisers were documented, including increases in running endurance, running speed, and improvement in exercise heart rates.

Percy, Dziuban, and Martin (1981) compared a running program to regular physical education classes and found a significant increase in self-esteem for runners. This suggests the beneficial psychological effects of aerobic exercise that have been documented for adults may also occur for children. But the researchers admit it is difficult to determine the relationship between the physical changes and the cognitive emotional changes when they were not concurrently assessed.

Tuckman and Hinkle (1986) and Labbe and Welsh (1993) simultaneously measured physical and psychological effects of running programs with grade school children. Favorable results were found in both areas. Tuckman and Hinkle found improvements in running times, pulse rates, creativity, and divergent thinking. Labbe and Welsh found children who participated in a running program during physical education class experienced improvements in resting pulse and higher self-efficacy regarding their ability to run. At a 6-month follow-up, runners had higher locus of control scores than did the control group who had continued in regular physical education activities.

Alpert, Field, Goldstein, and Perry (1990) evaluated a group of 3- to 5-year-olds who engaged in 30 minutes of aerobic exercise each day for 8 weeks. Improvements for the aerobic group included decreases in exercise heart rate and increases in agility and self-concept. Even in preschool children, aerobic exercise is associated with beneficial physical and psychological changes.

Duke, Johnson, and Nowicki (1977) conducted a study involving both aerobic and anaerobic exercise activities for children ages 6-14 who were participants in a sports fitness camp. They completed a battery of fitness tests and a measure of locus of control. After 8 weeks, results indicated improvement on all of the fitness tests and in internal locus of control scores. However, this was a self-selected group of children interested in sports, and there was no control group. These studies indicate favorable changes in physical functioning and beneficial psychological or cognitive functioning. No studies reported a negative effect from aerobic exercise.

Key Areas of the Brain that Support Movement

More controversial is the debate around the impact of movement on academic performance and mental development of young children (Fredericks et al., 2006). Educators who have been in the profession for any length of time have seen many innovations and programs come and go (Wolfe, 2001b) and adopt a "sit tight, this too shall pass" attitude about the frequent pendulum swings. Scientists are only beginning to understand the complex interactions that take place among different brain regions during voluntary movements, mostly through careful experiments on animals ("Movement," n.d.). Running ahead of the research before sound clinical trials and testing of new hypotheses have been completed makes educators vulnerable to the criticism of jumping on yet another bandwagon (Wolfe, 2001b).

However, a compilation of research shows growing evidence indicating physical exercise not only enhances neuronal growth and greater connections between neurons (Greenough & Anderson, 1991) but also stimulates the brain for learning by strengthening these key areas of the brain:

1. The basal ganglia, a cluster of nuclei deep within the cerebrum and upper parts of the brain stem involved in learned skills that help produce smooth, continuous muscular actions in stopping and starting movement; an area of the brain that has widespread connections with sensory and motor areas of the cerebral cortex, and

2. The cerebellum, a region crucial for skilled movement and the learning of new movements, receives and integrates direct and powerful sensory information from the muscle receptors and the sense organs of the inner ear (which signal head position and movement) to ensure smooth coordination of muscle action, enabling us to perform skilled movements more or less automatically. Long known for its role in balance, posture, coordination, and muscle movements, the cerebellum has been found, more recently, to play an important role in cognition, novelty, and emotions (Hannaford, 1995; Jensen, 1998; Wolfe, 2001a). Additionally, Jensen (2000), Leamnson (2000), and Wolfe suggest strong links between the cerebellum and memory, spatial perception, language, attention, emotion, nonverbal cues, and decision making. This establishes a connection between the process of movement and the process of learning (Richardson, 1996).

Another key area of the brain that supports movement is the motor cortex. It is responsible for the muscle movements of the tongue, mouth, and throat in order to produce audible speech sounds, which is an important part of the language process. This knowledge links literacy with areas of the brain that traditionally have been seen as the locus of bodily-kinesthetic capacities (Armstrong, 2003).

Gabbard (1998) claims physical activity is good for brain development, but the effect is general rather than specific. General physical activity stimulates brain development because it supplies the brain with glucose, its main energy source. However, it is unclear as to the specific types and amounts of experience necessary to stimulate the formation of particular neural connections (Gabbard).

Welsh and Labbe (1994) reviewed studies involving the cognitive and behavioral effects of aerobic exercise in children. They found few studies concurrently measured physiological and psychological

changes, making it difficult to ascertain the role of fitness in any resulting psychological or behavioral changes. However, another review of research (Taras, 2005) demonstrates there may be some short-term improvements of physical activity (such as on concentration) but that long-term improvement of academic achievement as a result of more vigorous physical activity is not well substantiated. Studies showed either significant but weak associations between activity level and better academic performance or no correlation at all. For example, concentration appears to improve in the immediate period after children are physically active, but this improved level of concentration is not necessarily sufficient to influence improvement in school achievement (Caterino & Polak, 1999; Raviv, 1990). Mixed results were demonstrated in other studies from positive effects of physical activity (on physical fitness and self-concept) but with little (Sallis et al., 1999) or no effect (MacMahon & Gross, 1987) on academic progress in the long term.

Movement and Cognition

Numerous studies have shown positive relationships between academic achievement and physical activity (Caterino & Polak, 1999; Keays & Allison, 1995; Shephard, 1996; Shephard & Lavallee, 1994; Sibley & Etnier, 2003; Tomporowski, 2003). These studies indicate several related factors: increased arousal, reduced boredom, increased attention span and concentration, increased self-esteem, improved classroom behavior, as well as increased academic performance.

It is a mistake to believe the intellect, the cognitive process, can be separated from the physical and emotional elements of an individual (Damasio, 1994) and a mistake to think the mind and body are separate entities (Pica, 2006). There's an overlap and an interrelatedness among the physical, social, emotional and cognitive domains of child development. They do not mature separately from one another, and neither do children differentiate among thinking, feeling, and moving; when a child learns something related to one domain, it impacts the others.

Theorists

The link between movement and learning stems from earlier theorists such as Delacato (1959), Ayers (1979), and as early as Piaget (1936), who theorized that motor activity is a foundational component of cognitive development. He called the first stage of intellectual development the sensorimotor stage, when children experience the world primarily through their senses and motor activities. Kephart (1975) theorized that perception couldn't be separated from motoric response. Seguin, a nineteenth century French neurologist, believed particular body movements could change mental functioning. He hypothesized that higher functions were built upon interactions between the self and the environment. He studied the concept of deliberately organizing physical exercises to enhance cognitive performance; a concept known today as perceptual motor training (Talbot, 1964). However, Hallahan and Kaufman (1997) ultimately concluded that perceptual and perceptual-motor exercises did not result in benefits for students' reading achievement.

In more recent years, many educators reflect the views of earlier theorists, citing evidence supporting the link between movement and learning. Pica (1998) states the more closely we consider the elaborate interplay between brain and body, the more clearly we see movement as an integral part of all mental processing. Wolfe (2001a) summarizes there is not a single movement center in the brain, which suggests that movement and learning have constant interplay. Constant repetition of physical movements causes the skills involved to become more automatic, as eventually the cerebellum begins to control these movements. Ratey (2001) theorizes that our physical movements can directly influence our ability to learn, think, and remember. A person's capacity to master new and remember old information is improved by biological changes in the brain brought on by physical activity. Our physical movements call upon some of the same neurons used for reading, writing, and math. If motor development provides a framework the brain uses to sequence patterns needed for academic concepts, then using movement in the learning process can help many children retain and retrieve information more efficiently (Blaydes, 2004).

Hannaford (1995) states movement activates the neural wiring throughout the body, making the whole body the instrument of learning. If you think of the brain as a muscle (Ratey, 2001), one of the best ways to maximize it is through exercise and movement (Blaydes, 2004). Movement, physical activity, and exercise prepare the body and brain for optimal learning (Blaydes). Because a child's earliest learning is based on motor development, so too is much of the knowledge that follows (Pica, 2006). Just as nutrition and hydration impact behavior and cognitive performance (Wolfe, Burkman, & Streng, 2000; Hannaford), movement is one more foundational piece (Jones, 2005).

Physical Activity and Academic Achievement

Research shows a positive relationship between physical activity and academic achievement. In one study, begun in 1951 in an elementary school in Vanves, France, the school day was divided so that 4 hours were devoted to academics and 1 to 2 hours to physical education, art, music, and supervised study (Bailey, 1976, as cited by Priest, 1993). By 1960, not only were health, fitness, discipline, and enthusiasm superior in the experimental program, but academic performance also surpassed control classes. Similar experiments in Belgium and Japan produced comparable results (Carlson, 1982), illustrating the importance of physical education to a successful academic program. Caterino and Polak (1999) found mental focus and concentration levels in young children improved significantly after engaging in structured physical activity.

A study conducted in Trois Rivieres, Ontario, Canada with 546 primary school students who received an additional 5 hours per week of physical education (additional time was taken from academic subjects, with the exception of English) yielded favorable results. At the end of 6 years and throughout the last 5 years of the study, the children in the experimental group (extra physical education) had consistently better academic grades and achievement in physical education as compared to their counterparts in the control group (Shephard & Lavallee, 1994).

Grissom (2005) studied the relationship between physical fitness and academic achievement among fifth, seventh, and ninth grade students. When physical fitness test scores were compared to mean Stanford Achievement Test, Ninth Edition (SAT-9) reading and mathematics scores, there was a consistent positive relationship between physical fitness and academic achievement. As overall physical fitness test scores increased, mean achievement scores also increased in a statistically significant way. A tentative conclusion was reached: conditions that promote a healthy body also promote a healthy mind.

The California Department of Education (2002) conducted a study that indicated a distinct relationship between academic achievement and physical fitness. Researchers matched scores from the 2001 spring administration of the SAT-9 with results from the state mandated physical fitness test known as the Fitnessgram, which measures six major health-related areas of physical fitness. Both tests were administered to students in grades 5, 7, and 9. Reading and math scores were matched with the fitness scores of 353,000 fifth graders, 322,000 seventh graders, and 279,000 ninth graders. Findings indicate that higher academic achievement was associated with high levels of fitness at each grade level. This study provides compelling evidence that a student's physical well being has a direct impact on his or her academic achievement.

Sparrow and Wright (1993) studied the effect of physical exercise on the performance of cognitive tasks of physically active men (mean age of 24.8). The results suggested that short duration (6 minute) aerobic exercise has no effect on cognitive performance. One explanation for these results is that exercise effects are specific to either the type of exercise task or the cognitive task. The nature of the fatigue or activation associated with motor activity might be qualitatively different from one task to another. Likewise, certain cognitive tasks might be more amenable to the influence of physical exercise than others.

The Bodily-Kinesthetic Learner

A considerable amount of research suggests that matching teaching strategies with learning styles will help increase student achievement (Gardner, 1985; Slavin, 2000; Woolfolk, 1998). Everyone has a dominant learning style (Maal, 2004). Students are more apt to respond favorably to subject matter if it's presented in a manner that accommodates their learning preference (Beck, 2001). Gardner identified the bodily-kinesthetic learner as one of nine multiple intelligences. Because about 85% of school-age children are predominately kinesthetic learners (Hannaford, 1995), using movement in the learning process can help many children retain and retrieve information more efficiently (Blaydes, 2004). Research shows that movement is the young child's preferred mode of learning because they best understand concepts when they're physically experienced (Pica, 2006).

A multisensory approach engages learners (Maal, 2004). Sousa (1998) supports sensory engagement during learning to help students make relevant connections between and among subjects. Cognitive research strongly reaffirms that we learn best when we are actively involved in interesting and challenging situations, yet in too many schools, students sit quietly and passively for long stretches in rooms with little visual stimulation, listening primarily to "teacher talk." A heavy reliance on the spoken or printed word effectively shuts down other sensory input available to the brain in its search for meaning (Kruse, 1998). Educators must engage the whole brain (McCarthy, 1990). Physical education is one of the few disciplines that incorporates most of the eight identified intelligences simultaneously in lessons (Blaydes, 2004).

One ingredient for an enriched environment to determine academic success is to stimulate all the senses but not necessarily all at once. A multisensory enrichment develops all of the cortex, whereas an input from a single task stimulates the growth of only a precise area of the brain. Enriched environments allow the child to be an active participant rather than a passive observer (Diamond, 1999).

Movement is the foundation for thought and the building block of skills needed to express knowledge. All thought, no matter how concrete or abstract, can only be revealed through activity, and activity is a function of muscle: we use our eye muscles to read, we need fine-motor control to hold a pencil in order to write, and we must control our tongue and jaws to speak (Jones, 2005). Bodily-kinesthetic intelligence is related to physical movement and the knowing/wisdom of the body, including the brain's motor cortex which controls body motion (Lazear, 1991).

The bodily-kinesthetic learner processes knowledge through bodily sensations, can be very athletic or show fine-motor skills for crafts, drawing, or fixing things, and constantly uses body language and gestures (Armstrong, 1987). Kinesthetic learners need movement and action; they like practical applications and process information best from hands-on, team activities, and animation, including changing seats and moving around (Maal, 2004). A kinesthetic learner, for example, may not understand the concept of using maps until given an opportunity to explore directions and locations through physical movement (Bennett & Hanneken, 2003).

Blaydes (2004) states that bodily movement facilitates learning for all students because the brain likes to learn, and will learn naturally, this way. Additionally, kinesthetic learning supports access to all three ways of remembering: (a) semantic (least effective) - which includes symbols, words, numbers, text, recall, and facts; (b) episodic - which includes smells, sounds, and talking in pictures (remember when we sat under that tree to learn fractions?); and (c) procedural (most effective and meaningful to learner) - which includes muscle memory (e.g., riding a bike or driving a car). Kovalik (1994) adds that students retain information better when movement is used with the intention to teach academic concepts kinesthetically.

Looking Beyond Learning Modalities

On the other hand, Jones (2005) suggests educators look beyond learning modalities or preferences students have toward kinesthetic and tactile modes of learning and examine the role movement plays in the establishment of memory circuits in the human brain. The role movement plays in

learning reaches beyond modality preferences. Creating an interactive environment, allowing movement, integrating movement into learning activities will increase circulation and oxygen flow to the brain, which in turn can increase student attention. Activities that are planned with movement built in include: the use of manipulatives; students changing their location in the classroom; clapping, dancing, stretching; and helping students monitor and manage their own movement in the classroom (Prigge, 2002). Movement increases blood vessels that allow for the delivery of oxygen, water, and glucose ("brain food") to the brain. This can't help but optimize the brain's performance (Pica, 2006). Based on these points, could we be safe in assuming that all brains learn best through active rather than passive learning activities?

Movement Programs

In support of the notion that physically active children learn better, several programs and recommendations have surfaced to encourage movement activities for children. The National Association for Sport and Physical Education (NASPE) recommends that elementary school students participate in a minimum of 60 minutes of moderate and vigorous activity every day. However, only 25 % of American children participate in any type of daily physical activity (NASPE, 2006).

Boost-Up/SMART (Stimulating Maturity through Accelerated Readiness Training), a program developed by a group of parents who wanted to help their children with special needs, is designed to integrate movement into the classroom by stressing physical balance, eye-tracking, spinning, cross pattern walking, laterality/directionality, and fine-motor activities. Their definition of school readiness for children is not being able to sit, pay attention, and write names, but rather to have a stimulated brain that is ready to learn (SMART Curriculum Guide, 2004). Theirs is not a physical education program but an academic program, and their main goal is to stimulate the brain stem to prepare the brain for learning.

The Action Based Learning™ Lab, developed by neurokinesiologist Jean Blaydes, is based on research supporting the link between movement and increased academic performance. It is rooted in the concept that the brain-body's movement and learning systems are interdependent and interactive. In other

words, motor development provides the framework the brain uses to sequence the patterns needed for academic concepts. The lab features a series of progressions and stations, each designed to prepare the brain for input and processing. Sensory-motor components of balance, coordination, spatial awareness, directionality, and visual literacy are developed as children roll, creep, crawl, spin, twirl, bounce, balance, walk, jump, juggle, and support his or her weight in space. Levels of physical fitness are increased and academic concepts are reinforced.

Specific Movements

What should a movement program contain? Feigley (1990) states physical education programs need to be far more than mere physical fitness activities or preparation for sporting proficiency. It isn't enough to simply move. Educators must consider the content of movement programs or the type of movement program that is used to stimulate brain function (Fredericks et al., 2006). Physical educators must do more than just roll out the ball. Activity alone is insufficient for learning to take place. Teachers must get students to think while activity is taking place; then movement is beneficial (Carter, 1998; Leamson, 2000; Wolfe, 2001a). A study by Longhurst (2002) found that a regular physical education program made no significant difference to the motor proficiency or academic performance of learning disabled children, while significant improvements in both areas were noted in groups of children engaged in sensory- and perceptual-motor programs.

Sensory-Motor Programs

Many researchers (Barrett, 2000; Blaydes, 2004; Hannaford, 1995) verify that not simply movement, but sensory-motor integration, is fundamental to school readiness. Learning readiness must be preceded by proper brain wiring for brain-body communication. Sensory-motor integration is a precursor to learning readiness, along with gross- and fine-motor development (Jones, 2005). Hannaford concurs, stating every movement is a sensory-motor event, linked to our understanding of our physical world from which all learning is derived.

Barrett (2000), creator of the SMILE Lab © (Sensory-Motor Intensive Learning Environment Lab), which consists of a series of carefully thought out activities through which children gain and improve gross-motor and cross-lateral movement skills, found that students involved in sensory-motor developmental activities experienced more success in school. He made this connection: the academic delays of some students as noted by classroom teachers correlated with a lack of depth perception, balance, and gross-motor development he observed in the gym (Jones, 2005). This prompted Barrett to create a series of sensory motor activities, much like those used in gymnastics training, to help children develop cross laterality, visual acuity, and both dynamic and static balance.

Barrett's (2000) work has yielded numerous positive results that reveal a direct correlation between gymnastics-related (sensory-motor) movement activities and enhanced reading scores. He found that students who used the SMILE Lab averaged over 25% higher on Florida Comprehensive Achievement Test (FCAT) scores for both reading and math when compared to at-risk students who did not regularly visit the lab. During the 1999-2000 school year first grade students increased their reading scores an average of 22% between pre- and posttesting on Standardized Achievement Tests, while the control group dropped by 1% in average SAT scores. Participants in the SMILE Lab group raised their aggregate average from 50% to 72% over the same period.

Additionally, Title I second grade students involved in the SMILE Lab twice weekly nearly doubled their increases in grade level equivalency (GLE) in both reading and math. The control group showed no noticeable improvement. K-1 students who visited the lab twice weekly for 12 weeks as part of a research study for a doctoral dissertation were administered a pre- and post- Gates-McGinitie Reading-Readiness Test which generated statistically significant increases in reading readiness levels.

Barrett (2000) theorizes that students who fail to experience sufficient movement, or who experience developmental delays in visual perception, tracking, balance, and gross-motor skills, and fall behind in school need sensory-motor remediation, not content remediation. Content assimilation can only

happen when basic sensory-motor skills have developed, when the ability to use both sides of the brain-body in an integrated fashion for efficient action has developed (Jones, 2005).

Fadigan (as cited by Barrett, 2000) has extensively reviewed the research of educational, neuroscience, and psychology experts. His findings reveal the brain develops its ability to process information first at level one (conception to 2 years), when various sensory-motor skills are developed; then level two, when cognitive skills or multiple intelligences are acquired; then finally to level three, after enhancement of levels one and two, when content assimilation occurs. He offers an interesting consideration: most public and private schools teach exclusively at level three, and when a student exhibits problems assimilating content at this level, he or she is given remediation (usually in the form of additional content either in one-on-one tutoring or small group instruction), which doesn't adequately address the root of the problem. These students need experience at the sensory motor level to create neurological pathways, and only then can content assimilation occur.

Kokot (2003) reveals similar findings. For a child to experience success in learning areas, a number of underlying sensory-motor systems have to be functioning as well. If the vestibular, proprioceptive, tactile, visual, and auditory systems are malfunctioning, they will fail to support the child's attempts to learn academic work, sit still, pay attention, complete tasks, and learn appropriate social behaviors. Furthermore, she states these sensory systems develop according to a hierarchy. Success on one level is necessary for success on the next. If any of these developmental steps have been interrupted or skipped, it is likely to affect the degree to which the child experiences academic success.

Goddard-Blythe (2000) has developed the primary ABC model upon which all later learning depends: attention (A), balance (B), and coordination (C). If these skills are not developed at the time children enter school, children run the risk of later developing specific learning difficulties -- not because they lack intelligence, but because the basic systems fundamental to learning are not fully in place at the time they start school. Movement that is meaningful for development will ensure these skills develop.

Jensen (1998) cited three critical components of movement: 1) spatial awareness, 2) spinning, and 3) cross laterality. Spatial awareness, needed for school readiness, is reliant on healthy gross-motor development (Corso, 1993). In fact, Olds' (1994) research has found that until children have had experience orienting their bodies in space by moving up, on, under, beside, inside, and in front of things, it is possible they will have difficulty dealing with letter identification and orientation of symbols on a page, important skills for reading. Movements that involve spinning stimulate the inner ear as well as the cerebellum. Sensory data are regulated in the inner ear and helps one to maintain balance, to turn thinking into action, and to coordinate movements. Playground activities such as swinging, rolling (e.g., somersaults), and jumping are especially valuable because they stimulate the brain and the inner ear (Hannaford, 1995; Jensen). Kephart emphasized the importance of laterality, noting that if a child cannot distinguish left from right, then it may be difficult for the child to tell a "b" from a "d" (Hallahan & Cruickshank, 1973). Crossing the midline integrates the brain to organize itself. Neural activation occurs to many parts of the brain and equally to both hemispheres. Increase in blood flow makes the brain more alert and energized for learning (Dennison, 1995).

Balance and visual perception activities are also beneficial. Eye-tracking exercises and peripheral vision development help in reading (Blaydes, 2004). Balance also improves reading capacity. The vestibular (inner ear) and cerebellum (motor activity) systems are the first systems to mature. These two systems work closely with the RAS (reticular activation system) located at the top of the brain stem and are critical to our attention system (Blaydes).

Dennison (1995), the developer of Educational Kinesiology, defines it as the study and application of specific movements which activate the brain for optimal storage and retrieval of information. He and his colleagues developed a commercial program called Brain Gym® that consists of a series of movements, postures, and activities that facilitate learning by waking up the mind/body system and bringing it to learning readiness (Hannaford, 1995). Dennison describes brain function in terms of three dimensions:

1. Laterality: the ability to coordinate one cerebral hemisphere of the brain with the other. This skill is fundamental to the ability to read, write, and communicate.

2. Centering: the ability to coordinate the higher and lower parts of the brain. This skill is related to feelings and expressions of emotions.

3. Focus: the ability to coordinate back and front lobes of the brain. This skill is directly related to participation and comprehension.

Brain Gym activities were created to either stimulate (lateral dimension), release (focusing dimension), or relax (centering dimension) individuals involved in particular types of learning situations.

Because of lack of empirical data on the efficacy of Brain Gym, Ferree (2001) conducted a study to extend the knowledge of the relationship between motor activities, cognitive performance, and behavior in fourth grade students, as well as to test the claims of the Brain Gym program. The study found no significant difference between the performance of the Brain Gym group and the other groups (an exercise group and a non-exercise control group) on behavior or a variety of cognitive tests that included verbal fluency, arithmetic, and concentration. However, the Brain Gym and exercise groups out-performed the non-exercise control group in arithmetic. It is also worth noting that more students in the Brain Gym group answered all the arithmetic problems correctly. Ferree concluded that because the general health benefits of exercise are well-established, the possibility that exercises may help a person's mind work better seems like a bonus, but that following a specific Brain Gym exercise regime will not necessarily lead to better results.

Shapiro (2004) examined the effects of adding midline-crossing activities associated with Brain Gym to physical education instruction on overhand throwing skills of first grade students. Both the experimental and control groups significantly improved overhand throwing ability. Brain Gym intervention neither added nor detracted from the experimental group's learning process.

Spielmann (2005) conducted a study to determine how to increase students' learning abilities by incorporating a movement-based curriculum in her second grade classroom. Both formal and informal assessments were used to measure the effectiveness of Brain Gym to increase overall academic skills, and whether the frequency of movement has a correlation with student output. Findings supported the use of Brain Gym movement activities. Spielmann reported that Brain Gym activities served to enhance the curriculum, increase positive attitudes, and show academic progress of students in vocabulary, reading comprehension, and math skills.

Fredericks et al. (2006) conducted a study of first grade children in South Africa to test the efficacy of a movement program, based largely on the Holistic Approach to NeuroDevelopment and Learning Efficiency (HANDLE) approach, on academic skills. The HANDLE Institute, based in Seattle, focuses on the underlying causes of learning and other neurodevelopment problems, rather than the behavioral symptoms. The findings suggest a developmental movement program has a positive impact on learners over a remarkably short (8 week) period. The experimental group showed a greater improvement in their reading and mathematical skills compared to learners in the other three groups. Learners in the experimental group also were reported to be more alert and quicker in their responses in the classroom after the exercise period. The researchers suggest further research to confirm the strong possibility that carefully designed, developmental movement programs during early childhood may make a difference to those learners who are at risk when it comes to learning problems.

Movement and Literacy

Scientists believe that language emerged, at least in part, from the physical movements of primates and early humans: their gestures, facial expressions, postures, and other gross and subtle motor actions (Varney, 2002, as cited by Armstrong, 2003). Today, we know the cerebellum, responsible for coordinating complex physical movements, is also an important contributor to language capacity. This influence may extend beyond oral language to reading skills (Armstrong, 2003). The importance that the

body has in the first literacy experiences of young children is expressed in their large-motor movements; not a quiet, passive experience, but rather a physical performance.

Can specific movements enhance learning, specifically reading skills? Armstrong (2003) states we need to reconceptualize the processes of reading and writing to consider the needs of students who are movers, builders, touchers, and squirmers. In other words, we need to discard the traditional image of the silent, motionless reader or writer and envision other, more tactile and mobile ways in which literacy can be achieved and practiced.

Literacy programs need to address in some significant way the role that the physical body has in reading and writing (Armstrong, 2003). He questions if there would be a need to teach the alphabet inside the classroom if every schoolyard had a playground that included 26 giant alphabet sculptures for kids to climb on and crawl under, around, and through. Educational programs that have made efforts to link letters and sounds with particular body movements believe that providing a motoric equivalent to a letter shape or a speech sound will give the beginning reader a much better chance of remembering sound-symbol relationships (Armstrong).

For help learning the visual patterns of letters, educators since Montessori have used physical and tactile methods, especially in the field of special education. Montessori's teachings suggest the importance of linking reading directly to action: her great innovation was to have students read a sentence on a slip of paper and then carry out the action or activity (Armstrong, 2003). Armstrong invites us to think of writing as actually a highly kinesthetic way of reading. There is a direct physical connection to words and their meaning when children learn to read meaningful sentences they have inscribed themselves with their own hands.

Armstrong (2003) suggests other ways to help students explore, understand, and express text meaning in physical ways that promote kinesthetic expression, such as charades, or role-playing the

material they have just read. This involves asking students to think through material in the text through their bodies instead of simply requiring them to sit still at their desks and do all the thinking invisibly.

Support for Movement-Based Curriculum

A movement-based curriculum uses movement to teach academics kinesthetically (Blaydes, 2004). Physical benefits alone could be sufficient reason for supporting physical education programs (Hanson, as cited by Priest, 1993) but educational policy has placed greater demands on accountability, drastically decreasing time for movement and physical activity to make way for more academia. However, no clear evidence indicates academic achievement will improve if physical education classes are cut.

Coe, Pivarnik, Womack, Reeves, and Malina (2006) studied the effect of physical education class enrollment and physical activity on academic achievement in sixth grade students. Standardized test scores were not significantly related to enrollment or physical activity levels. However, higher grades in academic core classes were associated with vigorous physical activity reported outside of class. The interesting thing to note, however, is that even though students enrolled in physical education class did not perform better academically than those who had an extra 55 minutes of classroom time, the decreased classroom time to do physical activity did not translate into lesser academic performance either. In fact, academic achievement improves even when the physical education reduces the time for academics.

In another study, a reduction of 240 minutes per week in class time for academics to enable increased physical activity led to consistently higher mathematics scores (Shephard et al., 1984). Additionally, Shephard (1996) concluded that although academic achievement may not improve because of physical activity programs, there is an improved rate of academic learning per unit of class time, which can help thwart concerns that time devoted to physical activity draws from academic advancement in other subjects.

Intense physical activity programs have positive effects on academic achievement, including increased concentration, improved mathematics, reading, and writing test scores; and reduced disruptive

behavior. Thoroughly reviewed longitudinal studies done in France, Australia, and Quebec have found academic performance is maintained or even enhanced when 14% to 26% of curricular time is allocated to physical activity, and the increase in academic performance is further enhanced when even more time is spent on physical activity (Shephard, 1997).

Quality physical education programs are important because they provide learning experiences that meet the developmental needs of youngsters, which help improve a child's mental alertness, physical well-being, academic performance, readiness to learn, and enthusiasm for learning (Bennett & Hanneken, 2003). Physical educators must include academic subjects in daily lessons and use strategies to involve the classroom teacher (Bennett & Hanneken) because it is also important for classroom teachers to incorporate movement and exercise into their pedagogical repertoire (Fahey & De Los Santos, 2002). Abraham (as cited by Bonnie's Fitware, n.d.) states a trend exists in many schools where more and more physical educators are integrating movement across the curriculum but classroom teachers have not integrated movement into their content areas. He suggests math teachers should have kids move in the same way physical education teachers have kids count.

The classroom teacher's promotion of, and involvement in, physical education can have a positive impact on student performance (Bennett & Hanneken, 2003). Additionally, Blakemore (2003), Sallis et al. (1999), and Shephard (1997) report findings that: (a) support quality physical education programs in schools, (b) determine that increased time in physical education does not have detrimental effects on students' academic achievement, and (c) recommend that further studies with randomized subjects be conducted. Findings from these studies provide compelling support for including movement and physical education in school curriculums throughout the nation.

CHAPTER 3

METHODOLOGY

This study is intended to examine the effects of movement on literacy achievement. In accordance with the literature that supports a movement-based curriculum to enhance academic learning and further suggests that specific sensory-motor movements are necessary foundational blocks which must be in place before content assimilation can occur, the present study implemented a sensory-motor program, based largely on the SMILE Lab ©, and evaluated its effect on the literacy skills of first grade learners.

Participants

The current study took place at an elementary school in a small community in northeast Tennessee during the 2006-2007 school year. The school at which the study was conducted had five first grade classrooms, averaging 18 students per class. The purpose of the study was introduced via a parent letter sent home in February with every first grade student after a brief classroom visit to each homeroom to explain the contents of the letter, tell about the lab activities, answer student questions, and invite student participation.

Recruitment Phase One

Because of gym size, the after-school sensory-motor lab was limited to 25 participants. Originally, all responses (which included an informed consent document) returned by the deadline would first be sorted by gender and then sorted into two equal groups:

1. Control group. Participants forming the control group would not attend the sensory-motor lab and would have no changes or interventions made to their school day.
2. Experimental group. Participants forming the experimental group would attend an after-school sensory-motor lab 3 days a week for 12 weeks.

However, based on an insufficient response rate (only 11 responses were received by the deadline), the study was postponed while modifications affecting the formation of the control and experimental groups were made to recruit more first grade volunteers. The delay drastically reduced the length of the study from 3 days a week for 12 weeks (36 sessions total) to 2 days a week for 4 weeks (8 sessions total).

Recruitment Phase Two

While these modifications were pending IRB approval, more consent forms trickled in. Still, the researcher did not foresee obtaining enough volunteers to randomly sort into two groups. A revised invitation and informed consent document were sent home with a cover letter explaining the changes made to the study. Those who had already submitted a consent form were given an opportunity to reconsider their participation in the study based on these changes and to return a revised informed consent document by the established deadline if they still wished to participate. This time, if less than 25 response forms were received, all interested students would be invited to participate in the sensory-motor lab. If more than 25 response forms were received, of those, 25 would be randomly selected to participate in the sensory-motor lab. This recruitment yielded 21 responses by the established deadline. Because fewer than 25 responses were received, all 21 volunteers were accepted to participate in the sensory-motor lab. The movement group consisted of 9 males and 12 females.

The control group was randomly selected by the elementary school principal and consisted of 21 first grade students, 10 males and 11 females, who did not participate in the sensory-motor lab. In an effort to establish balanced representation between the movement and control groups, gender and homeroom teacher were the only basis for selection. The control group had no specific changes or interventions made to their normal school schedule. However, all first grade students received their weekly physical education class and followed their normal daily classroom routine and content curriculum for the duration of this study. The distribution between the control and movement groups was as follows (Table 1):

Table 1

Group Membership by Homeroom and Gender

Homeroom	<u>Control Group</u>			<u>Movement Group</u>		
	Boys	Girls	Total	Boys	Girls	Total
A	3	1	4	2	2	4
B	2	1	3	1	3	4
C	2	2	4	1	3	4
D	1	4	5	3	0	3
E	2	3	5	2	4	6
<u>Group Totals</u>	10	11	21	9	12	21

Method

A detailed sensory motor-lab was designed and implemented by the researcher and the elementary physical education teacher at the school where the study took place. The activities, which were set up as a series of centers in the gym, were designed to focus on three critical areas of movement: (a) balance, to assist with full body control, including the development of non-dominant hand and leg skills, (b) cross laterality, to activate nerve communication pathways between the two hemispheres of the cerebrum, and (c) visual perception, including eye-tracking activities which develop coordinated eye muscle movement essential for reading.

Materials

The following materials, all commonly used within various aspects of the physical education teacher's regular school program and available through most school supply catalogues, were used to implement the sensory motor activities in the gym:

1. Balance beams. Two balance beams were available during the lab. They measured 4 in. (10.2 cm) wide, 8 ft (2.44 m) long, and sat 6 in. (15.2 cm) from the floor.

2. Scooter boards. Two 18-in. (45.7 cm) flat square boards with wheels were used for scooting and spinning activities. Students would lie on their stomachs, kneel, or sit on the scooter boards and propel themselves with their hands in a figure-8 path around pylons, or spin in one spot (being careful of fingers).

3. Peacock feathers. Several long tail feathers (from real peacocks) were available for students to balance on various right and left body parts. The nib of the feather was placed on a specific body part while students focused on the "eye" of the feather to keep it balanced in a standing position.

4. Pool noodles. A slight variation to the peacock feather, 3-in. (7.6 cm) diameter pool noodles cut into 3-ft (0.91 m) lengths were used to balance on various body parts.

5. Scarves. Nylon juggling scarves in neon colors were used for tossing and catching activities. Students were encouraged to alternate right and left hands when throwing and catching.

6. Balloons. Nine-inch balloons were used for tapping and eye-tracking activities. A 16-in. (40.6 cm) inflatable beach ball was substituted for one student identified with latex allergies.

7. Crawling Tunnel. A collapsible crawling tunnel with an 18-in. (45.7 cm) diameter opening was set up on a floor mat to protect knees while students maneuvered through the 6-foot (1.83 m)-long tube.

8. Playground balls. Standard 8½ -in. (21.6 cm) rubber playground balls were used for bouncing and catching activities.

9. Incline mat. A 4 ft (1.22 m) x 6 ft (1.83 m) soft incline mat was used for forward and log rolls. Students started from the wedge end, measuring 2 ft (0.61 m) high, and rolled down the incline.

10. Vinyl floor mats. Five vinyl floor mats were made by the physical education teacher, four of which are original designs by Ralph Barrett, creator of the SMILE © Lab, and replicated with permission: (a) ABC Cross-over circles, (b) ABC Cross-over grid, (c) Hopscotch grid, and (d) Heel-to-Toe mat. The Midline Jumps mat was designed by the physical education teacher. Barrett encourages teachers to make and use his mats with materials on-hand, but for those who prefer mats can be purchased commercially. All mat designs were drawn with permanent marker on 5 ft (1.52 m) x 6 ft (1.83 m) pieces of vinyl material. A floor plan of the gym, approximately 2400 square feet (223 square meters) in size, showing placement of the materials during a sensory motor lab is shown in Figure 1. The vinyl floor mats are shown in Figure 2.

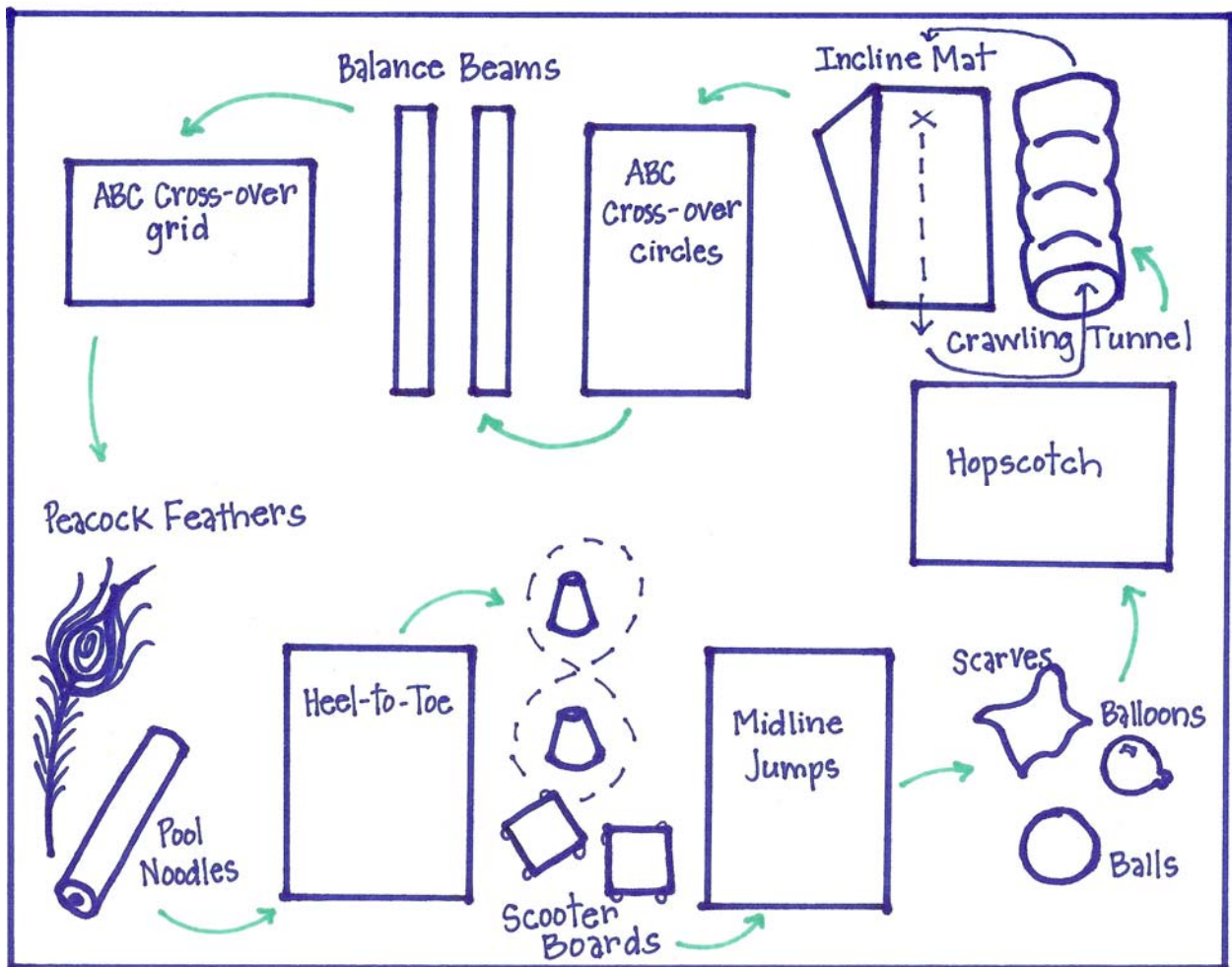
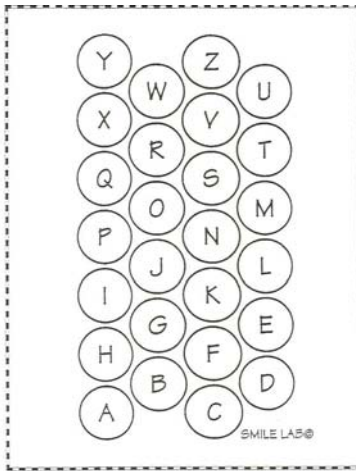
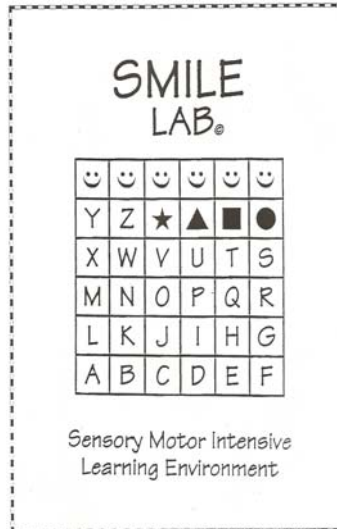


Figure 1. Floor Plan of Gym showing placement of Materials during Sensory Motor Lab

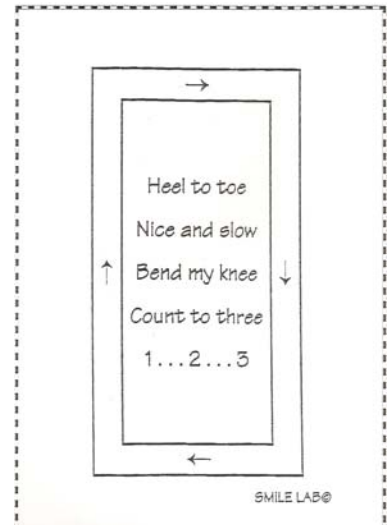
ABC Cross-over circles



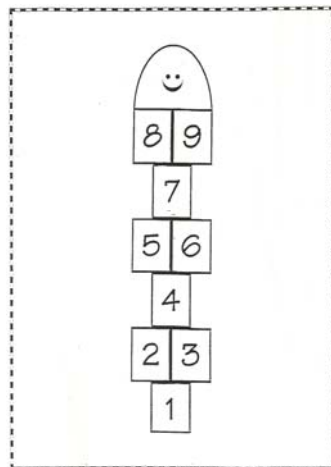
ABC Cross-over grid



Heel-to-Toe



Hopscotch



Midline Jumps

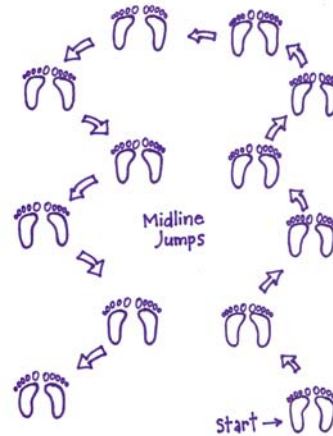


Figure 2. Sensory Motor Lab Vinyl Floor Mats. SMILE mats reprinted with permission (R. Barrett, personal communication, July 10, 2007). Midline Jumps mat reprinted with permission (J. Luppe, personal communication, July 9, 2007).

Program Design

Participants were paired up during each half-hour lab visit and completed a full circuit of centers, spending approximately 2 minutes at each activity station.

Week one. Students moved heel-to-toe forward and backward on the balance beam; balanced peacock feathers on their palms, fingers, and backs of their hands; tummy-crawled on scooter boards in a figure-8 pathway around pylons; and tossed scarves from hand-to-hand. Each vinyl floor mat was designed to improve balance and cross lateral movements. Emphasis was placed on controlled, focused, slow, and deliberate movements to help children gain a feeling of self-awareness and control. All five vinyl floor mats, as well as the incline mat and crawling tunnel, were used during each lab visit for the entire length of the study.

Week two. Students traversed the balance beam using cross-over side steps; balanced peacock feathers on facial body parts (nose, chin, forehead); used scooter boards under tummy to spin; and played "Scarf Explosion" by scooping and throwing a handful of scarves in the air then trying to catch as many as they could before they reached the floor. Incline and vinyl floor mats remained the same.

Week three. Students galloped across the balance beam; balanced peacock feathers on any body part; sat or kneeled on scooter boards and used hands to move across floor; and used rubber playground balls for two-handed bouncing and catching. Incline and vinyl floor mats remained the same.

Week four. Students used alternate high kicks forward across the beam; balanced pool noodles on the palms or backs of their hands, tummy crawled on scooter boards in a figure-8 pathway around pylons; and tapped balloons to keep them in the air, or tapped them in a pattern using different body parts to keep them in the air (e.g., finger, elbow, knee; finger, elbow, knee, etc.). Incline and vinyl floor mats remained the same.

Instrumentation

The literacy skills of the experimental and control groups were evaluated and compared using the Dynamic Indicators of Basic Early Literacy Skills (DIBELS), a set of standardized, individually administered measures of early literacy development. Benchmark assessments are administered in Fall, Winter, and Spring. The first grade measures include Phoneme Segmentation Fluency (PSF), Nonsense Word Fluency (NWF), Oral Reading Fluency (ORF), Retell Fluency (RF), and Word Use Fluency (WUF). They are short (1 minute) fluency measures designed to monitor the development of pre-reading and early reading skills. Each measure has been thoroughly researched and demonstrated to be reliable and valid indicators of early literacy development, intended to aid in the early identification of students who are not progressing as expected (DIBELS, 2006).

Phoneme Segmentation Fluency

Phoneme Segmentation Fluency (PSF) measures phonemic awareness and assesses students' ability to segment three- and four-phoneme words into their individual phonemes fluently. In an alphabetic writing system, the ability to hear and manipulate sounds in words is essential to learning to read. The PSF has been found to be a good predictor of later reading achievement. It is administered orally by the examiner who presents three- and four-phoneme words. The student must verbally produce the individual phonemes for each word. For example, if the examiner says "cat," the student will say "/c/ /a/ /t/" to receive three possible points for this particular word. The number of correct phonemes produced in 1 minute determines the final score (DIBELS, 2006).

The 2-week, alternate-form reliability for the PSF measure is .88, and the 1-month, alternate-form reliability is .79 in May of kindergarten. Concurrent criterion validity of PSF is .54 with the Woodcock-Johnson Psycho-Educational Battery readiness cluster score in spring of kindergarten. The predictive validity of spring-of-kindergarten PSF with (a) winter-of-first-grade DIBELS Nonsense Word Fluency is .62,

(b) spring-of-first-grade Woodcock-Johnson Psycho-Educational Battery total reading cluster score is .68, and (c) spring-of-first-grade CBM Oral Reading Fluency (ORF) is .62 (DIBELS, 2006).

Nonsense Word Fluency

Nonsense Word Fluency (NWF) measures the alphabetic principle, which includes alphabetic understanding (words are composed of letters that represent sounds) and phonological recording (letter-sound correspondence) to retrieve pronunciation of, or spell, unknown words. The NWF assesses letter-sound correspondence and the ability to blend individual sounds into words. Students are given a randomly ordered list of vowel-consonant and consonant-vowel-consonant nonsense words (e.g., sig, rav, ov) and asked to verbally produce either the individual sound of each letter or the whole nonsense word. For example, if the word is "jav," the student can respond "/j/ /a/ /v/" or "/jav/" to obtain a total of 3 correct sounds. The final score is the number of sounds produced correctly in 1 minute. Because the measure is fluency-based, students receive a higher score if they are phonologically recoding the word, and receive a lower score if they are providing sounds in isolation (DIBELS, 2006).

The 1-month, alternate-form reliability for NWF in January of first grade is .83. The concurrent criterion-validity of DIBELS NWF with the Woodcock-Johnson Psycho-Educational Battery-Revised readiness cluster score is .36 in January and .59 in February of first grade. The predictive validity of DIBELS NWF in January of first grade with (a) CBM ORF in May of first grade is .82, (b) CBM ORF in May of second grade is .60, and (c) Woodcock-Johnson Psycho-Educational Battery total reading cluster score is .66 (DIBELS, 2006).

Oral Reading Fluency

Oral Reading Fluency (ORF) is a test of accuracy and fluency with connected text and assesses the ability to translate letters-to-sounds-to-words fluently and effortlessly. Fluent readers possess automatic decoding processes requiring no conscious attention, thus enabling readers to focus attention on comprehension and meaning of text. The standardized set of passages and administration procedures are

designed to identify children who may need additional instructional support and to monitor progress toward instructional goals. The passages are calibrated for each grade level's reading goal level. Students read a passage aloud for 1 minute. Words omitted, substituted, and hesitations of more than 3 seconds are scored as errors. Words self-corrected within 3 seconds are scored as accurate. The number of correct words per minute read from the passage is the oral reading fluency rate (DIBELS, 2006).

Test-retest reliabilities for elementary students ranged from .92 to .97; alternate form reliability of different reading passages drawn from the same level ranged from .89 to .94. Criterion-related validity studied in eight separate studies in the 1980s reported coefficients ranging from .52 to .91 (DIBELS, 2006).

Retell Fluency

Retell Fluency (RTF) is intended to provide a comprehension check (the ability to extract meaning from text) for the ORF assessment. In general, oral reading fluency provides one of the best measures of reading competence, including comprehension, for children in first through third grades. The purpose of the RTF measure is to (a) prevent inadvertently learning or practicing a misrule, (b) identify children whose comprehension is not consistent with their fluency, and (c) provide explicit linkage to the core components in the National Reading Panel report, and (d) increase the face validity of the ORF (DIBELS, 2006).

Preliminary evidence indicates that the RTF measure correlates with oral reading fluency about .59. It appears children's retell scores may be typically about 50% of their oral reading fluency score, and that it is unusual for children reading more than 40 words per minute to have a retell score of 25% or less than their oral reading fluency score. A rough rule of thumb may be that, for children whose retell is about 50% of their oral reading fluency score, their oral reading fluency score provides good overall indication of their reading proficiency, including comprehension. But, for children who are reading over 40 words per minute and whose retell score is 25% or less of their oral reading fluency, their oral reading fluency score alone may not be providing a good indication of their overall reading proficiency. For example, a child reading 60 words correct in 1 minute would be expected to use about 30 words in his or her retell of the

passage. If the retell is about 30, then an oral reading fluency of 60 is providing good indication of his or her reading skills. If the retell is 15 or less, then there may be a comprehension concern that is not represented by the child's fluency (DIBELS, 2006).

Word Use Fluency

Word Use Fluency (WUF) measures oral vocabulary and assesses the ability to understand and use words correctly in a sentence. This measure is intended for most children from fall of kindergarten through third grade. A benchmark goal is not provided for WUF because additional research is needed to establish its linkage to other big ideas of literacy (phonological awareness, alphabetic principle, and accuracy and fluency with connected text). Tentatively, students in the lowest 20% of a school district using local norms should be considered at risk for poor language and reading outcomes, and those between the 20th and 40th percentiles should be considered at some risk (DIBELS, 2006).

Data Collection

Step One

In February a parent letter was sent home with every first grade student to introduce the study, explain its purpose, and invite any interested students to sign up for the after-school sensory-motor lab. Because of gym size, participant space was limited to 25.

Step Two

Volunteers and their parents were strongly encouraged to attend one of two training/informational meetings where each participant was introduced to the sensory-motor activities and the center rotation sequence. Both the training and the operation of each sensory-motor lab was overseen by the researcher and the physical education teacher to ensure that all activities were performed correctly and all stations were visited during each half-hour session. Emphasis was placed on two crucial concepts: (a) the slower and more deliberate the movement, the more effective it is, and (b) the tighter the movement, the more centrally located it is in the brain.

Step Three

Pre- and posttesting of every first grade student was administered by each homeroom teacher or literacy staff member during normal class time using the DIBELS one-on-one assessment tool. The following first grade fluency measures were collected in December and April: phoneme segmentation fluency, nonsense word fluency, oral reading fluency, and word use fluency. The retell fluency subtest was administered in April; therefore, only posttest scores were collected for this measure.

Step Four

Volunteer participants attended the after-school sensory motor lab on Tuesdays and Thursdays for 4 weeks. After a short snack and water break prior to the start of each half hour session, students gathered in a circle on the gym floor to talk about the activities, the importance of moving slowly and deliberately, and how these movements helped the brain think and learn. Students were randomly paired for each session and rotated among 10 movement activities, spending approximately 2 minutes at each. Music was played during the half hour session, and a drum was used to signal when to rotate. At the conclusion of the movement session, students gathered once again in a circle on the floor to discuss progress and plans for the next session. Because this was an after-school program, transportation had to be provided by parents.

Step Five

The results of the pre- and posttest first grade DIBELS measures were compiled in order to conduct different statistical analyses. Administration of the April benchmark assessments for first grade began during the final week of the sensory-motor lab; therefore, some members of the movement group were tested before the study had concluded. Also, it is relevant to note that although the importance of attendance was stressed, unavoidable absences occurred during the duration of the already shortened study. Of the 21 participants, 6 missed one lab, 2 missed 2 labs, and 1 missed 3 labs. Only 12 maintained perfect attendance during the 4-week study and were present for a total of 8 sessions.

Data Analysis

Multivariate Analysis of Variance

In cases where there is more than one dependent variable, a multivariate analysis of variance (MANOVA) is needed to identify whether changes in the independent variables have a significant effect on the dependent variables. This analysis can protect against Type I errors that might occur if multiple analyses of variance (ANOVA's) were conducted independently. The current study uses a 2 x 2 x 2 mixed factorial MANOVA to analyze group, gender, and test time effects among data collected from 5 measures of the first grade DIBELS subtests. The analysis seeks to identify the interactions among the independent variables and the association between dependent variables, if any. All statistical analyses were conducted using the Statistical Program for the Social Sciences (SPSS) version 14.0 for Windows with the significance level set at .05.

Assumptions for this design, including normal distribution of the dependent variables, homogeneity of variances, and random selection were considered. Data were analyzed by 7 *F* tests: three main effects, one 3-way interaction, and three 2-way interactions (Table 2) to determine whether or not there was an overall difference between the levels of the independent variables (group, gender, and test time) relative to the dependent variables (five DIBELS subtests) taken as a whole.

Univariate Analysis of Variance

Total scores on the DIBELS measure are a composite of the scores from its five subtests, making it linearly dependent with those tests. This produces singularity among the dependent variables, violating one of the assumptions for the MANOVA analysis. Therefore, total DIBELS scores were explored in a separate univariate analysis of variance. Here, the significance level is adjusted for the number of comparisons made; one degree of freedom is lost for each dependent variable that is added. As a follow-up, Tukey's HSD was used to perform post hoc comparisons of significant interactions.

Table 2

Source Table for the 2 x 2 x 2 Mixed Factorial Design

<u>Source Table</u>		
Main Effects	Gender	F
	Group	F
	Test Time	F
Interactions	Group by Gender	F
	Group by Test Time	F
	Gender by Test Time	F
	Group by Gender by Test Time	F

Finally, the Roy-Bargman stepdown analysis was included to solve the problem of correlated dependent variables by holding the contribution of each related dependent variable constant while examining the contributions of the independent variables (R.L. Leonard, personal communication, June 5, 2007). Results of the data analyses are presented in Chapter 4.

CHAPTER 4

RESULTS

The research questions and hypotheses presented in Chapter 1 are addressed in this chapter, which includes the findings from the study. The purpose of this study was to examine the effects of movement on first grade literacy skills. A 2 x 2 x 2 mixed factorial multivariate analysis of variance (MANOVA) was performed on five literacy subtests of the first grade DIBELS measure. The independent variables included group, gender, and test time. The results of the study are presented under each of the following research questions.

Research Question #1

Would the addition of a sensory-motor program which targets balance, cross laterality, and visual-perception activities have a positive impact on first grade literacy skills? The MANOVA analysis consisted of five dependent variables: Phoneme Segmentation Fluency (PSF), Nonsense Word Fluency (NWF), Word Use Fluency (WUF), Oral Reading Fluency (ORF), and Retell Fluency (RF). December and April scores were examined in each subtest measure except RF where only the posttest scores were collected. Both the Box's M and Levene's test of equality established the error variance of the dependent variables to be equal across groups.

Multivariate Tests

The mixed factorial design looked for a main effect for each level of the independent variable (movement, gender, and test time), and an interaction effect for each possible combination of variables. Using Pillai's Trace criterion for comparison, the combined independent variables were not found to be significantly related to the combined dependent variables. However, some overall aspects of the descriptive statistics generated from this analysis are worth noting. Tables 3-6 illustrate a means comparison of standard scores and deviations between the control and movement groups for the PSF, NWF, WUF, and

ORF subtests. One member of the movement group is excluded from these reports because of missing pretest data.

Table 3

Means Comparison and Standard Deviations for Phoneme Segmentation Fluency Subtest

Group	N	Mean Scores (SD)		Mean Difference
		December	April	
Control	21	53.86 (10.66)	55.67 (8.33)	1.81
Movement	20	47.30 (9.18)	50.30 (8.65)	3.0
Total	41	50.66 (10.38)	53.05 (8.81)	2.39

Table 4

Means Comparison and Standard Deviations for Nonsense Word Fluency Subtest

Group	N	Mean Scores (SD)		Mean Difference
		December	April	
Control	21	56.57 (14.11)	66.67 (28.16)	10.1
Movement	20	58.20 (13.62)	66.30 (26.14)	8.1
Total	41	57.37 (13.72)	66.49 (26.86)	9.12

Table 5

Means Comparison and Standard Deviations for Word Use Fluency Subtest

Group	N	Mean Scores (SD)		Mean Difference
		December	April	
Control	21	49.10 (14.65)	48.33 (7.79)	- 0.77
Movement	20	46.70 (12.93)	49.15 (7.73)	2.45
Total	41	47.93 (13.72)	48.73 (7.68)	0.8

Table 6

Means Comparison and Standard Deviations for Oral Reading Fluency Subtest

Group	N	Mean Scores (SD)		Mean Difference
		December	April	
Control	21	47.52 (33.04)	70.00 (37.80)	22.48
Movement	20	53.65 (34.85)	73.60 (36.35)	19.95
Total	41	50.51 (33.65)	71.76 (36.68)	21.25

Tables 3-6 show the movement group experienced gains in each subtest measure between pre- and posttesting. When compared to the control group, the movement group produced a greater mean gain on both the PSF and WUF measures. Only one mean score decline between pre- and posttesting was noted by the control group on the WUF measure (Table 5). Descriptive data for the RF subtest are reported separately (Table 7) because only posttest mean scores were available for a between-groups comparison. All movement group members are included in the RF measure.

Table 7

Posttest Means Comparison Between Groups and Standard Deviations for Retell Fluency Subtest

Group	N	Mean Scores (SD)		Mean Difference Between Groups
		December	April	
Control	21		37.33 (16.17)	
Movement	21		38.29 (15.57)	
Total	42		37.81 (15.69)	0.96

Table 7 shows only posttest means and standard deviations for the RF subtest measure. A means comparison between groups shows a difference of 0.96 with the movement group having the greater mean score.

Main Effect of Test Time

A univariate *F*-test on test time was performed on each DIBELS subtest to check the assumption that students will show progress over time through natural maturation and additional time in school. In this case, improvement is expected of first grade students between pre- and posttest scores, regardless of participation in either the control or movement group. The analysis revealed that the main effect of test time

was significant for both ORF, $F(1, 37) = 101.43, p = .00$, and NWF, $F(1, 37) = 5.08, p = .03$. There were no significant effects for test time on the PSF or WUF measures. Table 8 provides the F values and significance levels for all four dependent variables.

Table 8

Univariate Fs for the Main Effect of Test Time

Source	Measure	<i>df</i>	Mean Square	<i>F</i>	Sig.
Test Time	PSF	1.00	100.25	1.51	.23
	NWF	1.00	1677.48	5.09	.03
	WUF	1.00	22.24	0.25	.62
	ORF	1.00	8923.82	101.43	.00
Error	PSF	37.00	66.43		
	NWF	37.00	330.33		
	WUF	37.00	89.27		
	ORF	37.00	87.98		

First grade students across both groups in this study did not appear to make significant expected improvement over time on either the PSF or WUF measures. However, it is interesting to note the standard deviation on the WUF (Table 5) narrowed between pre- and posttesting (December $SD = 13.72$, April $SD = 7.68$) indicating a tighter range of student ability as the year progressed. A similar result was not found for the PSF (Table 3) measure (December $SD = 10.38$, April $SD = 8.81$).

Research Question #2

Is there a significant difference in gains between the experimental group's pre- and posttest DIBELS scores on any of the subtests as compared to the control group? Again, using Pillai's Trace criterion for comparison, the combined independent variables were not found to be significantly related to the combined dependent variables. However, a univariate *F*-test measuring group effect was used to address question two and null hypotheses one through four:

Ho1. There is no statistically significant difference in DIBELS PSF pre- and post-subtest scores between the experimental and control groups.

Ho2. There is no statistically significant difference in DIBELS NWF pre- and post-subtest scores between the experimental and control groups.

Ho3. There is no statistically significant difference in DIBELS WUF pre- and post-subtest scores between the experimental and control groups.

Ho4. There is no statistically significant difference in DIBELS ORF pre- and post-subtest scores between the experimental and control groups. The results of this analysis are shown in Table 9.

Main Effect of Group

A univariate *F*-test performed on group effect revealed a statistically significant finding on the PSF measure, $F(1, 37) = 6.57, p = .015$. There were no statistically significant effects for group on the NWF, WUF, or ORF measures. Table 9 provides *F* values and significance levels for all four dependent variables.

Table 9

Univariate Fs for the Main Effect of Group

Source	Measure	<i>df</i>	Mean Square	<i>F</i>	Sig.
Group	PSF	1.00	733.62	6.57	.02
	NWF	1.00	.18	.00	.99
	WUF	1.00	30.78	169.15	.67
	ORF	1.00	12.95	.00	.94
Error	PSF	37.00	111.62		
	NWF	37.00	624.34		
	WUF	37.00	169.15		
	ORF	37.00	2163.56		

Comparison of means for each group (Table 3) showed that the movement group experienced a 6% gain on the PSF measure, twice as high as the control group's 3% gain. Therefore, null hypothesis 1 is rejected. Because the analysis yielded no statistically significant findings among the remaining subtest measures, null hypotheses 2-4 are retained.

Research Question #3

Did gender affect performance on any DIBELS post-subtest scores? Using Pillai's Trace Criterion for comparison, the multivariate analysis of the main effects of gender on the combined dependent variables revealed no statistically significant findings. However, a univariate *F*-test measuring the main effects of gender, as well as a univariate *F*-test measuring a 2-way interaction between group and gender, was used to address question three and null hypotheses five through nine:

Ho5. There is no significant interaction between gender and performance on the DIBELS PSF post-subtest scores.

Ho6. There is no significant interaction between gender and performance on the DIBELS NWF post-subtest scores.

Ho7. There is no significant interaction between gender and performance on the DIBELS WUF post-subtest scores.

Ho8. There is no significant interaction between gender and performance on the DIBELS ORF post-subtest scores.

Ho9. There is no significant interaction between gender and performance on the DIBELS RF post-subtest scores.

Main Effect of Gender

A univariate F -test performed on the main effect of gender revealed a statistically significant finding on the RF measure, $F(1, 37) = 7.12, p = .01$. There were no statistically significant effects for gender on the PSF, NWF, WUF, or ORF measures. Table 10 provides F values and significance levels for all five dependent variables.

Table 10

Univariate Fs for the Main Effect of Gender

Source	Measure	<i>df</i>	Mean Square	<i>F</i>	Sig.
Gender	PSF	1.00	5.36	.05	.83
	NWF	1.00	.10	.00	.99
	WUF	1.00	144.03	.85	.36
	ORF	1.00	6453.42	2.98	.09
	RF	1.00	1452.26	7.12	.01
Error	PSF	37.00	111.62		
	NWF	37.00	624.34		
	WUF	37.00	169.15		
	ORF	37.00	2163.56		
	RF	37.00	203.97		

Following analysis of the significant main effect, Roy-Bargman stepdown analysis was conducted to evaluate the contribution of gender to the variance observed in the dependent variables when the variance accounted for by the other dependent variables is held constant. Analysis indicated that there is an effect on ORF scores due to gender, $F(1, 37) = 5.32, p = .03$.

Interaction Effects

Interaction effects were explored for the various combinations of the independent variables with no statistically significant findings emerging from multivariate tests when the dependent variables were combined. However, a univariate *F*-test measuring a 2-way interaction between group and gender yielded two statistically significant findings: ORF $F(1, 37) = 4.38, p = .04$, and RF $F(1, 37) = 4.39, p = .04$.

Because this analysis only reveals the presence or absence of a significant interaction, a follow-up analysis using Tukey's HSD was necessary to pinpoint the specific group and gender details within each of these measures. Table 11 provides *F* values and significance levels for all five dependent variables.

Table 11

Univariate Fs for Group and Gender Interaction

Source	Measure	<i>df</i>	Mean Square	<i>F</i>	Sig.
Gender by Group	PSF	1.00	3.19	.03	.87
	NWF	1.00	698.78	1.12	.30
	WUF	1.00	79.00	.47	.50
	ORF	1.00	9471.78	4.38	.04
	RF	1.00	894.46	4.39	.04
Error	PSF	37.00	111.62		
	NWF	37.00	624.34		
	WUF	37.00	169.15		
	ORF	37.00	2163.56		
	RF	37.00	203.97		

Tukey's post hoc comparison revealed that the significant interaction in both the ORF and RF measures was due to high scores for females in the movement group and low scores for males in the movement group. This yielded a significant difference in means between the males and females in the movement group (ORF, $MD = 38.62$, and RF, $MD = 21.11$), as compared to males and females in the control group (ORF, $MD = 3.82$, and RF, $MD = 2.50$). Table 12 illustrates the details of this interaction:

Table 12

Tukey's Post Hoc Comparison of Means for Group and Gender Interaction

<u>Oral Reading Fluency</u>		Mean Scores (<i>SD</i>)		Mean Difference
Group		Male	Female	
Control		72.00	68.18	3.82
	<i>n</i> = 10 males, 11 females	(26.18)	(47.26)	
Movement		51.30	89.92	38.62
	<i>n</i> = 9 males, 12 females	(27.10)	(33.00)	

<u>Retell Fluency</u>		Mean Scores (<i>SD</i>)		Mean Difference
Group		Male	Female	
Control		36.00	38.55	2.55
	<i>n</i> = 10 males, 11 females	(12.32)	(19.57)	
Movement		26.22	47.33	21.11
	<i>n</i> = 9 males, 12 females	(7.28)	(13.92)	

Scores for the females in the movement group were significantly higher than scores for the females in the control group. Conversely, scores for the males in the movement group were significantly lower than scores for the males in the control group. Based on the results of the univariate *F*-test and post hoc analyses, null hypotheses 8 and 9 are rejected. Because no significant interactions were reported among the PSF, NWF, and WUF measures, null hypotheses 5-7 are retained.

Chapter 5 presents an interpretation of these results along with recommendations for further research.

CHAPTER 5

DISCUSSION

Summary

The purpose of this study was to extend the knowledge of the relationship between movement and cognition by examining the impact of a sensory-motor program on the literacy skills of first grade learners. An after-school sensory-motor lab that targeted balance, cross laterality, and visual perception activities was offered to interested first grade participants. Literacy skills were evaluated and compared using five subtest measures from the DIBELS assessment: Phoneme Segmentation Fluency, Nonsense Word Fluency, Word Use Fluency, Oral Reading Fluency, and Retell Fluency. A 2 x 2 x 2 mixed factorial MANOVA was used to analyze group, gender, and test time effects on the multiple dependent variables.

Findings

Three research questions guided this study:

Would the addition of a sensory motor program that targets balance, cross laterality, and visual perception activities have a positive impact on first grade literacy skills? Multivariate tests of significance across all four of the subtest measures where pre- and posttest scores had been collected revealed no statistically significant findings to connect movement with literacy performance. It is assumed that a level of progress will be made with maturation and the passing of time, and this was found to be true with the ORF (accuracy and fluency with connected text) and NWF (letter-sound correspondence and blending) measures, but not the PSF (phonemic awareness) or WUF (oral vocabulary and word use) measures. This might prompt the school district where this study took place to look again at these latter two test measures for their effectiveness. Despite this finding, the experimental group made positive gains in all four subtest areas. Because the length of the study was considerably shortened to eight sessions, it is highly doubtful this progress can be attributed to the implementation of a sensory-motor lab but rather the students' maturation over time between pre- and posttest measures.

Is there a significant difference in gains between the experimental group's pre- and posttest DIBELS scores on any of the subtests as compared to the control group? One statistically significant finding was reported on the PSF measure where the movement group experienced a 6% increase in gains, twice as high as the control group's gains. Though this significant leap was made by the movement group on the PSF, it failed to impact the overall progress of first grade learners across both groups on the PSF when test time effect was measured.

Did gender affect performance on any DIBELS post-subtest scores? A significant interaction between group and gender was found in both the ORF (accuracy and fluency with connected text) and RF (ability to extract meaning from text for the ORF assessment) measures. Follow-up analysis indicated a significant variation of mean differences between the males and females in the movement group as compared to males and females in the control group. Scores for the females in the movement group were significantly higher than scores for the females in the control group. Conversely, scores for the males in the movement group were significantly lower than scores for the males in the control group. Based on these findings, it appears that participation in a sensory-motor lab negatively impacted males and positively impacted females in both ORF and RF measures.

Limitations

Delays in recruiting enough volunteer participants to form the movement group was the greatest detriment to this study and any findings that might have been significant. The duration of the study was drastically reduced from 3 days a week for 12 weeks (36 sessions) to 2 days a week for 4 weeks (8 sessions). The sensory-motor lab was conducted after school rather than built in to the school day which could have impacted the recruitment of interested students because of time conflicts with family schedules and other after-school activities. Additionally, parent transportation was required and, therefore, excluded any students who relied on bus or other after-school pick-up services. The shortened study duration was confounded further by attendance issues. Out of 21 participants, 12 attended all eight labs, six missed one

lab, two missed two labs, and one missed three labs. Of the nine male volunteers, only four attended all eight sessions. One missed three sessions, two missed two sessions, and two missed one session. Low male numbers and attendance difficulties could have contributed to the males scoring significantly lower than the females in the movement group, thus impacting the results of the test of interaction between group and gender.

Conclusions

Because insufficient time was given to the movement program, any statistically relevant findings pertinent to this study are inconclusive. As Paglin (2000) claims, it could be that physical activity is good for brain development, but the effect is general rather than specific. It is still unclear as to the specific types and amounts of experience necessary to stimulate the formation of particular neural connections, and clearly this study wasn't long enough to yield supporting evidence. Research is available that favors a positive relationship between academic achievement and physical activity and further suggests that specific sensory-motor movements are necessary foundational blocks which must be in place before content assimilation can occur. Conversely, educators must remain open to and curious about this growing field of information yet take care to separate science from speculation.

Implications

Traditionally, educational methods and practices have treated the brain as a passive repository and relied heavily on students listening, reading, and practicing skills in isolation (Kruse, 1998). Having insight into how the mind works gives educators a better understanding of how to diversify the curriculum to meet individual needs. If a teacher's goal is to create an environment where all students can learn and thrive, then the educational community must recognize the importance of applying cognitive and neuroscience research and theory in the learning process (Prigge, 2002). Movement is one of the underlying components of brain-based learning. Perhaps the findings of future movement studies will not only substantiate the

research that has already been done but convince educators that making time for movement appeals to a child's bodily-kinesthetic nature and can prime the brain for an optimal learning experience.

Recommendations

As a result of this study the following recommendations are offered:

1. Further movement studies targeting sensory-motor activities should be conducted to expand the relationship between movement and cognition at different grade levels.
2. Research should be conducted for a longer duration and with more frequency than the current study to yield conclusive results.
3. Consider conducting research in the fall semester of a given school year to allow time for content assimilation and to track learners for a longer period of time.
4. Longitudinal studies should be conducted to compare achievement of learners who did and did not participate in a sensory-movement program.
5. Studies should be built into the school day to eliminate schedule, transportation, and time constraints and to draw a larger sample.
6. Research should be conducted examining the effects of movement on mathematical skills.

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APPENDICES

APPENDIX A

PERMISSION FROM THE SUPERINTENDENT



Dory Creech
Director of Comprehensive School Improvement and Accountability
p: 423.378.2125 f: 423.378.2120
email: dcreech@k12k.com

December 8, 2006

Dear Mrs. Kathy Luppe,

Kingsport City Schools is pleased to approve your research project for your graduate thesis. We understand the project will be after school hours, last for approximately 10 weeks and only involve students with written parental consent. We will permit the use of DIBELS test scores for your research. We will require that student confidentiality be maintained throughout the study. I would be interested in reading your research upon completion. Thank you for your interest in Kingsport City Schools.

Sincerely,

A handwritten signature in cursive script that reads "Dory Creech".

Dory Creech
Director of Comprehensive School Improvement and Accountability
Kingsport City Schools

APPENDIX B

PERMISSION FROM THE PRINCIPAL

Andrew Johnson School

1001 Ormond Drive
KINGSPORT, TENNESSEE 37664
Phone (423) 378-2300 • FAX (423) 378-2310

MRS. LENORE KILGORE
Principal

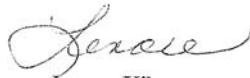
MR. STACY EDWARDS
Assistant Principal

December 11, 2006

Whom It May Concern,

Andrew Johnson Elementary School is pleased and excited to participate in a research project with Mrs. Kathy Luppe. Our understanding is that this project will be after school hours and last approximately 6 to 10 weeks. Parental consent will be secured before the study begins and student confidentiality will be maintained at all times. We request that all research findings be shared with the faculty and staff of our school.

Sincerely;



Lenore Kilgore

VITA

KATHY S. LUPPE

Personal Data:

Date of Birth: July 6, 1966
Place of Birth: Livermore, California
Marital Status: Married

Education:

Livermore High School, Livermore, California
California State University, Chico; 1988
Bachelor of Arts, Journalism
California State University, Chico; 1990
Elementary Teaching Credential
East Tennessee State University, Johnson City, TN
Master of Arts in Early Childhood Education,
August 2007

Professional Experience:

Elementary Teacher, Napa Valley Unified School District, CA,
grades 5 and Kindergarten, 1990-1994
Elementary Teacher, Kingsport City Schools, Kingsport, TN,
grades 1, and multiage 2-3, 1994-1999
Kindergarten Teacher, St. Paul's Day School and Kindergarten
Kingsport, TN, 2005-present