Physical Activity Improving Executive Functioning Behaviors in Montessori Children Ages 3-12

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Physical Activity Improving Executive Functioning Behaviors

in Montessori Children Ages 3-12

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In fulfilment of final requirements for the MAED degree

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Abstract

Executive function refers to the intellectual processes necessary for goal-directed cognition and behavior, which develop across childhood and adolescence. This study focused on the effects of physical activity on concentration and focus, prior to academic lessons, in urban Montessori classrooms ages 3-12. This study was administered for six weeks utilizing a thematic calendar of physical activities. The tools used for data collection were: a pre-dialogue with teachers, pre and post-assessments, control tallies, on and off-task observation counts and a post-satisfaction survey. Movement interventions improved focus and concentration by an average of 27%. The data collected supported our hypothesis that purposeful movement activities increase executive functioning skill development. Action plan implications include providing professional development training on movement activities and transitions for teachers and further research on the ability to improve children’s initiative to choose lessons independently. Physical activity opportunities should be incorporated into classroom schedules, as positive associations have been found between classroom-based physical activity and indicators of cognitive skills and attitudes, academic behavior, and academic achievement (Centers for Disease Control and Prevention, 2016).

Keywords: Aerobic Exercise, Physical Activity, Executive Function, Cognition, Children, Concentration, Focus, Purposeful Movement, Montessori
Executive function is a developing skill set for children and a predictor for successful academic achievement. The term “executive function” refers to “cognitive processes that are required for the conscious, top-down control of action, thought, and emotions, and that are associated with neural systems involving the prefrontal cortex” (Muller & Kerns, 2015, p. 571). We intended to see if purposeful physical activity with teachers and students had an immediate connection on focus and concentrated attention on academic lessons. Would this movement implementation support the child in learning how to understand learning objectives and gain more knowledge with deeper focus? Acquiring executive functioning skills is important to aid in school readiness skill development for early childhood, as well as improving the school-aged child’s organizational ability, concentration, and self-discipline. By narrowing the study solely on developing longer periods of concentration skills, the researchers will attempted to link movement strategies and focused learning.

As children spend a large percentage of their day in school, it is pertinent that teachers address the issue of increased sedentary behaviors by planning intentional physical activity opportunities throughout the school day. The movement activity calendar, based on previous studies, included cognitively-engaging activities which noted a stronger impact on executive function development. Today, about one in three American kids and teens are overweight or obese, nearly triple the rate in 1963 (heart.org, 2016). Although the American Heart Association and the Center for Disease Control recommend children participate in at least 60 minutes of moderate to vigorous physical activity daily (heart.org, 2016), many preschool-aged children are moderate to vigorously active for only 20-25 minutes daily (Spurrier, 2008). Not only has it
been found that preschool children are not reaching recommended moderate to vigorous physical activity daily, they are also spending a large part of their waking time doing sedentary behaviors, such as watching television, using other screens, reading books and coloring (Maatta, Roos, Roos, 2016). Sedentary behavior is defined as any activity performed in a sitting or lying down position. These sedentary tendencies formed at an early age have been found to track later into life, predicting adulthood obesity (Maatta, 2016). Health and wellness are important for all human beings to learn and thrive effectively in daily life. Exploring and being physically active is imperative for young children to learn about themselves and the world around them.

Focus and concentrated attention support the child in learning how to understand knowledge. Dr. Maria Montessori based her philosophy on the belief that movement enhances learning. She wrote:

One of the most important practical aspects of our method has been to make the training of the muscles enter into the very life of the children so that it is intimately connected with their daily activities. Education in movement is thus fully incorporated into the education of the child’s personality. Everybody admits that a child must be constantly on the move (Montessori, 1909, p. 81).

Previous studies have found that movement has a direct correlation with the development of a child’s executive function. For example, the ability to direct one’s attention in a concentrated way fosters an array of positive developments. Also, these traits assist the school-aged child with organizational ability, concentration, and self-regulation (Diamond & Lee, 2011).

This study investigated the effects of movement on the executive function skill development with children in a Montessori environment. Academically successful children have
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the discipline to stay focused, the ability to see tasks through to completion and the self-control to absorb information. Therefore, developing concentration and focus at a young age allowed children to succeed in life-long learning.

literature review

this study utilized albert bandura's social cognitive theory of self-regulation. he defined self-regulation as the child's ability to learn independently, self-direct and think critically while learning (bandura, 1999). self-regulation is defined as the child's ability to achieve a goal, to emotionally regulate, strategically plan, manage time, persevere, and self-correct mistakes. self-regulation is important in the classroom when we consider that high levels of motivation and self-regulation are both associated with academic achievement independent of measured intelligence (blair & raver, 2015).

one example of an educational setting that has been empirically shown to improve executive function in children is the montessori based educational philosophy (lillard & else-quest, 2006). the montessori environment is designed to allow freedom of movement and choice which requires many executive functioning skills. as a child moves freely in the classroom, they have to use an approach that inhibits and helps them to resist distraction. the montessori environment provides the structure and materials to attain goals and problem solve. “the greatest sign of success for a teacher is to be able to say the children are now working as if i did not exist” (montessori, 1949, p. 283). a child's ability to use executive functioning is a strong indicator of success in both school and life.

several montessori activities are essentially walking meditation (diamond & lee, 2011). “walking on the line” is a focused, purposeful movement in the montessori classroom where great thought is put into each step, as the child walks in a careful, concentrated manner.
Another example would be the “pink tower,” where the child builds a tower of cubes, biggest to smallest, using cognitively engaging movement to complete a task.

The Montessori classroom environment is designed to foster the development of the child’s executive functioning skills. Montessori’s prepared environment and teaching materials may allow students to experience struggles that will possibly lead to increased levels of self-esteem and self-control. In the Montessori classroom, children are given the opportunity to learn in a three-hour uninterrupted daily work cycle and work at their own pace on work that they are developmentally ready for and develop equilibrium, elasticity, adaptability, and obedience (Montessori, 1965). The Montessori classroom possesses the fundamental building blocks needed to develop these essential brain functions in young children, known as executive functioning skills.

**Executive Functioning**

Being able to pay attention, organize, and manage time are crucial skills in today’s world. “These three skills are only a few of the elements of executive function, an umbrella term referring to the cognitive processes that guide, direct, and manage thinking, emotional responses, and behavior” (Bagby, J., & Sulak, 2013, p.15). Executive functions are complex and interrelated. Additionally, attention, focus and working memory all impact one another. These characteristics of learning work together and assist in EF development, such as planning and problem solving. The development of executive control, especially the ability to focus and sustain attention, is key to other important developments (Lillard, 2017). For children to learn new things and manipulate information, working memory is essential. These higher brain processes are specific and allow us to plan, organize and complete tasks.
Aerobic Movement

Aerobic activity at a vigorous intensity level lead to several growth factors resulting in short and long-term changes in the structure and functioning of brain regions that are responsible for learning (De Bruijn, Hartman, Kostons, Visscher, & Bosker, 2018). Bremer (2018) found that there is some evidence that developing proficient movement skills at a young age may have a positive impact on physical activity, fitness and executive functioning in later childhood and adolescence. She stated that there was still a need for more research to better understand the relationship between movement and the overall development of self-regulation (Bremer & Cairnery, 2018). Cognitively engaging movement, such as skilled movement exercises, martial arts, and yoga had positive effects on developing executive function skills.

Cognitively Engaging Movement

In a study focused on cognitively engaging movement versus repetitive movement effects on executive function, Humphrey found that movement that engages the mind in specific skill development proved to increase executive function more than repetition (Humphreys, 2014). Combining movement and a cognitive task gave greater executive function development. Cognitively engaging exercise acted similarly to mental processes that use executive functions by requiring students to create, monitor, and modify specific tasks (Best, 2010).

Furthermore, physical activity at a young age may be imperative for the development of specific executive functions due to progressive changes in the brain (Best, Miller, & Jones, 2009). Overall, cognitively engaging physical activity has been defined as an activity that requires complex, controlled, and adaptive cognition and movement (Best, 2010). Group games requiring strategic behavior, and continuously changing task demands, such as a soccer game,
balance exercises, locomotor and object control skills are all exercises that require complex coordination.

**Yoga and Mindfulness**

One kind of individualized movement exercise is yoga. Yoga encompasses physical training, relaxation, and sensory awareness that help executive functions develop. Mindfulness is a quality of focused attention on the present. Mindfulness has been associated with well-being and happiness in adults, and there are many aspects of the Montessori curriculum that go hand-in-hand with this concept, and in turn produce positive outcomes for students (Lillard, 2011). Mindfulness activities are not just to make us happy, though. These activities have been shown to improve executive function as well. Mindfulness exercises include sitting meditation and activities to promote sensory awareness or awareness of others or the environment (Diamond & Lee, 2011).

**Interventions**

According to the Centers for Disease Control and Prevention, “Brief classroom physical activity breaks are associated with improved cognitive performance, classroom behavior, and educational outcomes among students” (Centers for Disease Control [CDC], 2014, p. 3). The Integrated Nutrition Education Program (INEP) is a way for children to learn about healthy eating in their classroom and to share what they learn with their families to form a home to school connection. Each lesson includes an interactive cooking activity that teaches children how to prepare and taste new fruits and vegetables. INEP is funded by SNAP-Ed and supported through partnerships with the University of Colorado and other various schools from around the state. The INEP program claims that incorporating brain boosts, which are short movement activities such as taking a short walk, singing songs with movement, or short energizers in the
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classroom will help children to refocus. Additionally, the INEP program says that Brain Boosts benefits include: regular activity, maintain a healthy weight, build confidence, and improve coordination, and improve brain function. Most importantly having fun being active builds lifelong healthy habits at a young age (The Integrated Nutrition Education Program, [INEP], 2018).

Maeda and Randall (2003) focused on five-minute short activity breaks, working with one second-grade class in an elementary school with seven boys and twelve girls participating. The weekly routine, approximately an hour after lunch four days a week, consisted of restroom/water, physical activity, water, and then returning to the classroom for the math activity. Maeda and Randall found improvements in the behavior of the whole class after physical activity, and the teacher reported anecdotally that the students were able to get more done. However, on days when there was no physical activity, they were not often able to accomplish as much. More time was spent getting the class to settle down and maintain the children’s attention. The teacher also reported that the children enjoyed activities immensely (Randall & Maeda, 2003).

Overall, the literature suggested various ways to help improve focus and concentration and executive functioning. The purpose of this study was to determine the effects of cognitively engaging physical activity on preschool and upper elementary aged children in Montessori classrooms. This study intended to implement specific movement strategies to improve focus and concentration skills in children aged 3-12. Purposeful movement was incorporated inside the classroom during morning meetings and inside the gym.
This study intended to implement movement strategies with children to develop executive functioning skills. Acquiring executive functioning skills is important to aid in school readiness skill development for early childhood, as well as helping the school-aged child with organizational ability, concentration, and self-discipline. The researchers narrowed the study solely on developing longer periods of concentration and investigated to determine if the movement activities would produce an effect on learning. We introduced interventions with purposeful movement strategies and observed their effects on executive functioning skills and self-regulation with students aged 3-12 years old in primary and upper elementary Montessori classrooms.

**Participants and Setting**

The research was conducted in two different regions of the United States, Maryland and Colorado. This study included an Upper Elementary (4th -6th grade) classroom in a public Charter Montessori school in Maryland. The school was in an urban setting, with a total of 300 students, aged three years old to 8th grade. The upper elementary students used the Montessori philosophy and materials for their curriculum. Ethnicity in the upper elementary class used in the study included twenty-two total students (Asian 2, African American 4, Hispanic 1, Caucasian 15). There were 11 male students and 11 female students. Two students were special education students, and one student qualified for free and reduced meals. The primary classroom (3-5-year-olds) was in a Montessori inspired preschool in Denver, Colorado. The classroom included two first-year teachers. The school was in an urban setting, with 67 children ranging from three months to six years. Ethnicity in the primary class included seventeen total students.
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(African American 15, Hispanic/Latino 2). There were seven male students and ten female students. There was one special education student.

Qualitative and Quantitative Instruments

The Qualitative instruments used in this study were as follows:

- Pre-Dialogue – Gathered baseline information from the teachers using an introductory dialogue on current movement activities already implemented. This dialogue gave the researchers an idea of the teaching staff’s knowledge about executive functioning and its effects on learning.

- Organizational calendar - To keep track of lesson names and look ahead for the week.

- Check-In Conversation - At week one, week three, and week five of the intervention cycle, a check-in conversation with the teachers. Each teacher’s voice was important to the study, and additionally, the researchers could address any barriers that were challenging.

- Post-Satisfaction Assessment - This connected the teacher’s thoughts into the action plan with the study’s findings.

The Quantitative instruments used in this study were as follows:

- Pre and Post-Assessments – The teacher evaluated each child on executive functioning skills and their ability to self-regulate during the work cycle. The skills measured included: Had difficulty in choosing a work, organized materials for effective work, concentrated well, sustained work, wandered frequently and managed time.

- Control Observation Tally - A control observation count used a tally system for focus and concentration. This control observation tally occurred four times for one week. A control
observed in five-minute increments for 15 minutes with the number of students on-task and off-task. In both primary and elementary classrooms the researchers did these observations.

- Observation Tally - An observation count used a tally system for focus and concentration.

This observation count occurred two times a week for six weeks. This observation tally occurred in five-minute increments for 15 minutes with the number of students on-task and off-task.

**Procedure**

The participants in this study included 22 children varying in age from nine to twelve years old and 17 children aged three to five years old. With permission from their parents, the students in the class participated in whole group movement lessons which had a different theme each week of the six-week study period (Appendix A).

Before the study began, the researchers had a Pre-Dialogue interview with each teacher to ascertain the knowledge of executive functioning, Montessori training and years of teaching experience (Appendix B). During the intervention period, the teacher modeled and led a 15-minute purposeful movement activity each morning before the work cycle. The teachers used a movement calendar to plan each weekly activity. Week one of the study involved a yoga and mindfulness exercise each morning (Appendix C). Week two included Cardio Blast, where children did vigorous movements to raise their heart rate. Week three was titled Game Week. During this week the children participated in a game style exercise before the work cycle. Rockin’ Aerobics, the theme for the fourth week, used music with movement. Week five included a game called Charades, where the children acted out various themed topics each day.
The last week was a free choice, where the children chose their favorite physical activity from the previous lessons.

After the physical activity each day, the researcher or teacher conducted the Observation Tally for 15 minutes to determine the number of students who are on task (Appendix E). For each five-minute interval, the total number of children observed being on or off task was recorded. After the implementation of the study, the researchers administered a Control Observation. The teachers marked a Control Observation Tally for four days in a row for one week to record the effects of no physical activity before the work cycle (Appendix E). On-task behavior was defined as being engaged in a lesson or working cooperatively with another student, as well as purposeful actions related to learning. When a student lost concentration and focus from a task or was socializing and disengaged from learning, it was identified as an off-task behavior.

The researchers evaluated each child’s development in a Pre-Assessment and Post-Assessment recorded before and after the study (Appendix F). These assessments incorporated a Likert rating scale ranging from strongly disagree, disagree, neutral, agree and strongly agree. The researchers reviewed the pre-assessment responses, identified common trends in concentration, focus, and self-regulation before the study began and throughout the six-week intervention, and finally, compared the pre-assessment results to the post-assessment results. A limitation of the study was that our control tally was conducted for four school days and our action research study was six weeks. The independent variable in our study was the purposeful movement activity before the work cycle. The dependent variables included focus and concentration, self-regulation, independent learning, ability to manage time and perseverance. A
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Post-Satisfaction Assessment was given to each teacher to record their opinion on the action research movement interventions (Appendix G).

Data Analysis/Results

Our overall goal for implementing purposeful physical activity before the work cycle was to develop students’ concentration, focus, and ability to self-regulate during the morning classwork. There were seven data collection tools the researcher used that had both quantitative and qualitative data. We used four tools to gather qualitative data for our study. The first collection of data was a Pre-Dialogue tool, which we used to gather baseline information from the teachers using an introductory dialogue on current movement activities already implemented (Appendix B). This baseline data gave us an understanding as to what the teacher’s knowledge of executive functioning was and why it was important to the study. Additionally, it gave the researchers information on how much the children were exercising throughout the day before the study began. An organizational calendar was used by teachers to keep track of lesson names and plan ahead for the week (Appendix C). This was a way for researchers to keep consistency between classrooms. Check-In Conversation results from week one, week three, and week five of the intervention cycle gave the teachers a voice to ensure that the movement activities flowed smoothly with the current routine (Appendix D). The researchers could address any barriers that were challenging.

There were four quantitative tools used in this study. The researchers used a Pre and Post-Assessment with a Likert scale in which the teachers evaluated each child on current executive functioning skills and their ability to self-regulate during the work cycle. In Figure 1, the behaviors measured included: organizes materials for effective work, concentrates well, sustains work, and manages time. These behaviors are considered desirable behaviors to allow
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Children to learn. They surveyed both primary and secondary classrooms. To analyze these behaviors with both classrooms, the researchers counted the responses for each characteristic evaluated as “agree” or “strongly agree”. The researchers added the primary and secondary classroom data sets together resulting in the total number for our results. In Figure 2, the behaviors measured included: has difficulty choosing work and wanders frequently. Both of these undesirable behaviors hinder children from completing a lesson and learning and were calculated the same way as the positive data sets. Figure 3 shows a bar graph from both classroom’s daily observations of on-task behavior with no physical activity before the work cycle. Figure 4 shows results from the observation count which used a tally system for focus and concentration after physical activity. This observation tally occurred two times a week for six weeks. The observation itself was marked in five-minute increments for 15 minutes with the number of students on-task and off-task recorded. We took the average of both days in each week to get a percentage score per week of students on-task after purposeful movement activity. We graphed each week throughout the six-week study period. The classrooms are shown next to each other in Figure 4. Figure 5 is a bar graph combining all children’s on-task behaviors for the entire six-week study. It also shows the percentage of children on-task without physical activity in one week. Our last data tool used was a Post-Satisfaction Survey (Appendix G). This survey tool shows the Likert scale for teachers to reflect on the past six-week study and answer questions marking strongly disagree, disagree, neutral, agree, or strongly agree. This tool also had three subjective open-ended questions, where researchers looked for patterns in teacher’s responses. This tool gave the researchers more information on action plans, next steps and reporting for future research.
Research Findings

The purpose of this Action Research study was to implement movement strategies with children to develop executive functioning skills in a Montessori classroom. Our action research asked, if children participate in movement exercises before their work time, will this help them develop longer periods of concentration and focus? We had the teachers report about each child and complete a pre-assessment to rate them on specific behavior traits on a Likert scale. Throughout the study, the teachers led a movement exercise before the children went to work and then observed them while working. They used an observational tally to notice how many children were on or off-task. At the end of the research period, the teachers completed a post-assessment on the same behavior traits.

The participants in this study included an Upper Elementary (4th-6th grade) classroom in a public Charter Montessori school in Maryland. The school was in an urban setting, with a total of 300 students, three years to eighth grade. Ethnicity in the upper elementary class used in the study included twenty-two total students (Asian 2, African American 4, Hispanic 1, Caucasian 15). There were 11 male students and 11 female students. The primary classroom (3-5-year-olds) was in a Montessori inspired preschool in Denver, Colorado. The classroom included two first-year teachers. The school is in an urban setting, with 67 children ranging from three to six years. Ethnicity in the primary class included seventeen total students (African American 15, Hispanic/Latino 2). There were seven male students and ten female students.

Baseline data were collected from teachers using a Pre-Dialogue questionnaire to discuss their prior knowledge of executive functioning (EF) and to present information on the topic. Along with assessing their prior knowledge on EF, the researchers collected information on
current movement activities already implemented into the classrooms, and how to fit the study into their daily schedules without disruption.

Based on interviews with the three participating teachers, the Montessori training of the teachers was drastically different ranging from no Montessori certifications and little understanding of Montessori philosophy, to 13 years of Montessori classroom experience. There was a relatively clear understanding of how executive functioning relates to learning. One of the new teachers commented that EF helped with forming memory, focus, self-regulation, and motivation. The elementary teacher commented that she knew without EF children cannot learn. Both classrooms seemed to enjoy similar activities such as yoga, games, dance, and team building. The researchers created themes for the weekly interventions. The teachers felt that this study would not interrupt the daily work cycle and implementing movement into morning circle time would be a welcome addition.

After week one, our check-in conversation with the teachers resulted in a request for an organizational tool, in a calendar format, to assist with planning and gathering materials. The researchers discussed weekly themes and designed the Movement Calendar (Appendix C). The teachers used the left-hand side to write in materials needed for each week and wrote what game or activity they played each day for documentation purposes. The check-in tool was designed for program improvement and the results of the teacher’s responses were integrated for quality improvement. The researchers used three kinds of data collection tools to measure EF in a six-week period. An assessment of each child was reported before and after the study period called Pre and Post-Assessment tools. First, the researchers used a Pre-Assessment with a Likert scale. They evaluated each child on current executive functioning skills and their ability to self-regulate during the work cycle. The skills measured included: has difficulty in choosing a work,
organizes materials for effective work, concentrates well, sustains work, wanders frequently and manages time. The researchers analyzed each question by adding the total number of children that scored positive responses as “agree” and “strongly agree”. The total number of children included both primary and elementary classrooms. Figures 1 and 2 show the relationship between the Pre-Assessment and Post-Assessment results according to desirable and undesirable behaviors.

**Figure 1**: Pre-Assessment and Post-Assessment: Positive Characteristics
The collection of data included a pre and post-assessment, using a Likert scale, conducted by the teacher on each child evaluating their executive functioning. This graph represents each EF “positive” characteristic for only “agree” and “strongly agree” responses in a combined value. The Pre-Assessment results showed that less than half of the total number of children in both age groups exhibited strong EF characteristics. After the implementation of purposeful movement before the work cycle, three of the “positive” EF behaviors increased in value. The category of concentrating well during lessons remained constant throughout the study. The two EF characteristics that had the most significant amount of positive change were organizing
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materials for effective work and managing time. It was surprising to the researchers that focus and concentration did not increase in value as other characteristics. Additionally, by the end of the research period, a majority of children were sustaining work and organizing their materials for effective work.

![Pre and Post-Assessment Baseline Data](image)

*This intervention was measured in six weeks*

**Figure 2**: Pre and Post-Assessment: Negative Characteristics
The collection of data included a pre and post-assessment, using a Likert scale, conducted by the teacher on each child evaluating their executive functioning. This graph represents each EF “negative” characteristic for only “agree” and “strongly agree” responses in a combined value.

Two of the questions on the Pre and Post-Assessment tool asked the teachers about an undesirable behavior during the work cycle. The one “undesirable” EF behavior that had a higher incidence in children being off-task, was “wandering frequently”. This increase could indicate that after a movement activity, or transition from circle time, children may have had difficulty in settling down and finding a lesson. Having difficulty choosing work decreased in frequency by the end of the six-week study resulting in more children being self-directed.
Figure 3: Control Tally No Physical Activity
This bar graph shows the percent of children on task in the first 15 minutes of the work cycle. There was no physical activity implemented before the work cycle. This observation tally was a control to observe EF behaviors in children prior to implementing this research study.

The Control Tally graph shows that more than half of the children in both primary and elementary classrooms were on-task for the first 15 minutes of the work cycle. The elementary classroom hovers in the 60% range with on-task EF characteristics. The primary classroom fluctuates between 30% to 73% on-task behaviors. This information was a foundational baseline for the researchers to know where the children were functioning before the study began.
This observation tally was calculated into a total percentage of on-task behavior each week for six weeks.

The researcher conducted an observation tally during the first 15 minutes of the work cycle after a physical activity was implemented at circle time. The researchers tallied the number of children on-task and off-task twice per week. This was converted into a percent of children on-task for the six-weeks. We logged the number of minutes children were on-task. We then converted those numbers into percentages so that we could analyze the percent of children on-task, and utilized weekly averages for our table.

Additionally, Figure 4 shows the Observation Tally data with each week’s physical activity lesson theme. During week one, yoga exercises resulted in 90% of elementary children and 87% of the primary children on-task. Cardio Blast were quick bursts of activities that enhanced primary’s on-task behavior at 90%. While the elementary classroom’s on-task behavior dropped to 80%. Week three where cooperative games were played was fairly even with the results showing in the low 80 percent range. Week four had the highest percentage for the
elementary classroom with 92% children on-task. The primary classroom had their lowest on-task behavior at 78%. The next two weeks were a game of Charades and Free Choice for the children. These weeks showed similar results with approximately 90% of children on-task in the work cycle. The next graph, Figure 5, highlights the significant difference between having children participate in purposeful vigorous activity prior to learning.

![Primary and Elementary Classrooms On-Task Behavior](image)

**Figure 5: Total On-Task Behavior**
This bar graph combined all children’s on-task behaviors for the entire six-week study with physical activity. The on-task behaviors without physical activity were documented over a period of four days.

Figure 5 shows both primary and elementary classrooms had a combined 60 percent on-task focus with no prior physical activity before the work cycle. Throughout the control week with no physical activity, teachers observed children with varying behaviors including disrupting others, distractibility, and moving about the classroom without a purpose. At the end of the research study, a combined percentage score of 87 percent showed that physical activity implemented before the work cycle improved focus and concentration by 27 percent.
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A Post-Satisfaction Survey was used and combined quantitative and qualitative responses. A Likert scale was used as well as open-ended survey questions. Appendix G shows the Post-Satisfaction survey results for four teachers in the study. Two teachers agreed that purposeful movement impacted academic learning and improved EF development and one teacher was neutral. The teachers all want to continue to implement purposeful movement prior to lessons. The teachers want more time to plan and observe children. Two of the teachers would like additional resources and even further training. Two teachers felt they would recommend physical activity prior to the work cycle and one teacher remained neutral.

Conclusion

The purpose of this study was to investigate how we could increase executive functioning skills which are necessary for school readiness in children ages 3-12. These skills included organizational capability, concentration, managing time, initiative to choose work, and self-discipline. “Movement and cognition are closely entwined, and movement can enhance thinking and learning. The ability to direct one’s attention in a sustained and concentrated way fosters an array of positive developments and is itself trainable” (Lillard, 2017, p. 28). Our research study has shown that movement and cognition are closely interconnected. The question addressed in our research was: What effects will purposeful movement strategies in primary and upper elementary Montessori classrooms have on executive functioning skills?

Diamond and Lee’s research entitled “Interventions Shown to Aid Executive Function Development in Children 4-12 Years Old” found that movement is directly related to executive function skills. Repeated practice and diverse activities fostered success in creativity, flexibility, self-control, and discipline which are all indicators of executive functioning (2011). The data collected in this study supported the research question that purposeful movement activities could
increase executive functioning skill development. The teachers also supported the interventions of movement and saw improvements in behaviors related to executive functioning skills and will continue to incorporate physical activities and purposeful movement in their daily lesson plans. According to Maria Montessori, during work time children are given the opportunity to work independently on work that they are developmentally ready for in a prepared classroom. “For it is from the completed cycle of an activity, from methodical concentration, that the child develops equilibrium, elasticity, adaptability, and the resulting power to perform the higher actions, such as those termed acts of obedience” (Montessori, 1965, p. 105).

Five out of six of the executive functioning characteristics showed a positive behavior change. Data also indicated that children did not improve their ability to choose work. Observation and discussions with teachers revealed that some of the physical activities invigorated children to the point of distraction. Teaching staff felt that the benefits of the interventions outweigh the difficulty in calming down. Having planned transitions available to teachers could help with moving into a new activity.

Teaching experience could have played a role in the results of the data. There was a difference in classroom management skills, overseeing transitions, and presenting lessons. Comparing the Montessori trained teacher to the novice teachers, the Montessori teacher had a more authentically prepared environment than the novice teachers. We believe the Montessori training and the prepared environment helped promote physical movement, which in turn supports the development of executive functioning.
Recommendations

As teachers, we must infuse purposeful movement into all children’s daily routines to support and guide the development of executive functions and develop confident, lifelong learners. Based on the findings and conclusions of this study, the following recommendations are:

- Explore more possibilities in increasing the purposeful movement activities into daily classroom routines.
- Create a movement shelf where activities are available for children to use on an independent level if they feel distracted.
- Add short bursts of physical activity, when the children seem highly distracted, to redirect back to EF behaviors for optimal learning.
- Provide teachers with more observational time to view and record children’s progress and interests.
- Provide professional development training on implementation of purposeful movement into daily routines and transitions.
- Provide resources for teachers to prepare an authentic Montessori environment, which allows for natural and spontaneous movement opportunities throughout the day.
References


PHYSICAL ACTIVITY IMPROVING EXECUTIVE FUNCTIONING BEHAVIORS IN MONTESSORI CHILDREN AGES 3-12


January 7, 2019

Dear Parents,

I am a St. Catherine University student pursuing a Masters of Education. As a capstone to my program, I need to complete an Action Research project. I am going to study how physical activity and movement can help your child focus and concentrate more in the classroom. This helps your child prepare for lessons and further academic successes.

In the coming weeks, I will be providing movement ideas as a regular part of their classroom activities. All students will participate as members of the class. In order to understand the outcomes, I plan to analyze the data obtained from the results. I will use an observation form and teacher assessments to see if the children are able to focus for longer periods of time after a quick brain break or movement activity. All strategies implemented, and assessments given are part of the daily educational practice.

The purpose of this letter is to notify you of this research and to allow you the opportunity to exclude your child’s Observation Count and Pre and Post Assessment on Executive Function from my study.

If you decide you want your child’s data to be in my study, you don’t need to do anything at this point.

If you decide you do NOT want your child’s data included in my study, please note that on this form below and return it by January 14, 2019. Note that your child will still participate in the activities, but his/her data will not be included in my analysis.

In order to help you make an informed decision, please note the following:

- I am working with a faculty member at St. Kate’s and a project coach to complete this particular project.
- Concentration, focus, and staying on task are key executive functioning skills that are important for academic success. Physical activity has been found to improve these skills for school readiness. There are no foreseeable risks involved in this study.
- I will be writing about the results that I get from this research. However, none of the writing that I do will include the name of this school, the names of any students, or any references that would make it possible to identify outcomes connected to a particular student. Other people will not know if your child is in my study.
- The final report of my study will be electronically available online at the St. Catherine University library. The goal of sharing my research study is to help other teachers who are also trying to improve their teaching.
- There is no penalty for not having your child’s data involved in the study, I will simply delete his or her responses from my data set. Your decision of whether or not to allow the use of your child’s data will have no impact on your relationship with the school or any of the teachers involved in the research.

You may keep a copy of this form for your records.

_________________________________________  __________________
Amanda Bodden  Date

OPT-OUT: Parents, in order to exclude your child’s data from the study, please sign and return by January 11, 2019.

I do NOT want my child’s data to be included in this study.

_________________________________________  __________________
Signature of Parent  Date
### Pre dialogue with teachers

<table>
<thead>
<tr>
<th>Question</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>How long have you been teaching?</td>
<td></td>
</tr>
<tr>
<td>What Montessori training do you have?</td>
<td></td>
</tr>
<tr>
<td>What do you know about executive functioning or how it relates to</td>
<td></td>
</tr>
<tr>
<td>learning?</td>
<td></td>
</tr>
<tr>
<td>Is it important to you that the children become normalized? And why?</td>
<td></td>
</tr>
<tr>
<td>What current forms of movement activities do you already do in your</td>
<td></td>
</tr>
<tr>
<td>classroom?</td>
<td></td>
</tr>
<tr>
<td>How do you see this project fitting into your current daily schedule?</td>
<td>Do you have a copy of your daily schedule?</td>
</tr>
<tr>
<td>What do you currently do to redirect children that are not focused?</td>
<td></td>
</tr>
<tr>
<td>Do you foresee any barriers?</td>
<td></td>
</tr>
<tr>
<td>What else do you think might make this more successful?</td>
<td></td>
</tr>
</tbody>
</table>

Thank you for your feedback and partnership in this research project

Missy Patten and Amanda Bodden © St. Catherine’s University
## Movement Calendar

<table>
<thead>
<tr>
<th>Supplies</th>
<th>Monday 1/14/19</th>
<th>Tuesday 1/15/19</th>
<th>Wednesday 1/16/19</th>
<th>Thursday 1/17/19</th>
<th>Friday 1/18/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yoga</td>
<td>Yoga</td>
<td>Yoga</td>
<td>Yoga (Observe)</td>
<td>Yoga (Observe)</td>
<td>Yoga</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplies</th>
<th>Monday 1/21/19</th>
<th>Tuesday 1/22/19</th>
<th>Wednesday 1/23/19</th>
<th>Thursday 1/24/19</th>
<th>Friday 1/25/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLK No School</td>
<td>Yoga</td>
<td>Yoga</td>
<td>Yoga (Observe)</td>
<td>Yoga (Observe)</td>
<td>Yoga</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplies</th>
<th>Monday 1/28/19</th>
<th>Tuesday 1/29/19</th>
<th>Wednesday 1/30/19</th>
<th>Thursday 1/31/19</th>
<th>Friday 2/1/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game</td>
<td>Game</td>
<td>Game</td>
<td>Game (Observe)</td>
<td>Game (Observe)</td>
<td>Game</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplies</th>
<th>Monday 2/4/19</th>
<th>Tuesday 2/5/19</th>
<th>Wednesday 2/6/19</th>
<th>Thursday 2/7/19</th>
<th>Friday 2/8/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockin Aerobics</td>
<td>Rockin Aerobics</td>
<td>Rockin Aerobics</td>
<td>Rockin Aerobics</td>
<td>Rockin Aerobics</td>
<td>Rockin Aerobics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplies</th>
<th>Monday 2/11/19</th>
<th>Tuesday 2/12/19</th>
<th>Wednesday 2/13/19</th>
<th>Thursday 2/14/19</th>
<th>Friday 2/15/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charades Animals</td>
<td>Charades</td>
<td>Charades</td>
<td>Charades</td>
<td>Charades</td>
<td>Charades</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplies</th>
<th>Monday 2/18/19</th>
<th>Tuesday 2/19/19</th>
<th>Wednesday 2/20/19</th>
<th>Thursday 2/21/19</th>
<th>Friday 2/22/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>President's Day</td>
<td>Choice</td>
<td>Choice</td>
<td>Choice (Observe)</td>
<td>Choice (Observe)</td>
<td>Choice</td>
</tr>
</tbody>
</table>
Check In Conversation

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS THE TIME COMMITMENT WORKING WITH YOUR CURRICULUM?</td>
<td></td>
</tr>
<tr>
<td>ARE CHILDREN ENJOYING THE ACTIVITIES?</td>
<td></td>
</tr>
<tr>
<td>HOW CAN WE IMPROVE OR CHANGE THESE INTERVENTIONS?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E

Observation Tally and Control Tally

**On and Off Task Observation count**

<table>
<thead>
<tr>
<th>Date:</th>
<th>Movement activity:</th>
<th>5 minutes</th>
<th>10 minutes</th>
<th>15 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>line, recess, transition, brain break, vigorous activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On task</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off task</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Observations:**

Thank you for your feedback and partnership in this research project

Missy Patten and Amanda Bodden © St. Catherine’s University
Appendix F

Pre and Post Assessment

**Pre - Assessment**

<table>
<thead>
<tr>
<th>Child (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Has difficulty in choosing a work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizes materials for effective work</td>
</tr>
<tr>
<td>Concentrates well</td>
</tr>
<tr>
<td>Sustains work</td>
</tr>
<tr>
<td>Wanders frequently</td>
</tr>
<tr>
<td>Manages time</td>
</tr>
</tbody>
</table>

**Post - Assessment**

<table>
<thead>
<tr>
<th>Child (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Has difficulty in choosing a work</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Sustains work</td>
</tr>
<tr>
<td>Wanders frequently</td>
</tr>
<tr>
<td>Manages time</td>
</tr>
</tbody>
</table>

Thank you for your feedback and partnership in this research project

Missy Patten and Amanda Bodden - St. Catherine University
### Post-Satisfaction Assessment

<table>
<thead>
<tr>
<th>Question</th>
<th>Primary 1</th>
<th>Primary 2</th>
<th>Elementary</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do you think this intervention worked?</td>
<td>Agree</td>
<td>Neutral</td>
<td>Agree</td>
</tr>
<tr>
<td>Did your students improve their executive functioning?</td>
<td>Agree</td>
<td>Neutral</td>
<td>Agree</td>
</tr>
<tr>
<td>How likely are you to sustain these movement exercises?</td>
<td>Agree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Would you recommend movement activities to other teachers?</td>
<td>Strongly Agree</td>
<td>Neutral</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

### Post-Satisfaction Assessment Quotes from Teachers

<table>
<thead>
<tr>
<th>Question</th>
<th>Quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>What areas would you improve or change?</td>
<td>“I would like to have a more prescribed plan to implement day by day to help with preparation in advance for accountability in the study.”</td>
</tr>
<tr>
<td></td>
<td>“The students enjoyed all the activities, but I felt some were more distracting than focusing. It got their heart rates up but they had difficulty calming down.”</td>
</tr>
<tr>
<td></td>
<td>“I would like to have more time to plan.”</td>
</tr>
<tr>
<td>What additional support do you need to continue movement activities in your classroom?</td>
<td>Nothing additional, just more practice.”</td>
</tr>
<tr>
<td></td>
<td>“We have the materials to continue with activities. It would be helpful to get additional ideas.”</td>
</tr>
<tr>
<td></td>
<td>“We need more space in the classroom to do activities.”</td>
</tr>
<tr>
<td>Did you see any other behavioral changes during these movement activities? (Social-Emotional, cognitive and/or overall physical development and health) these movement exercises?</td>
<td>At times, the interventions helped the kids get more focused, though sometimes they got more hyped up to a point of being disruptive. Overall, lots of great ideas to work with, just takes time to find activities that yield more desirable outcomes.”</td>
</tr>
<tr>
<td></td>
<td>“Balance, time management, and choosing work.”</td>
</tr>
<tr>
<td></td>
<td>“I observed children interacting more cooperatively and laughing and smiling.”</td>
</tr>
</tbody>
</table>
PHYSICAL ACTIVITY IMPROVING EXECUTIVE FUNCTIONING BEHAVIORS IN MONTESSORI CHILDREN AGES 3-12