THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF EDUCATION

AN EXPLORATORY, QUALITATIVE STUDY OF PRESCHOOL TEACHERS’ KNOWLEDGE OF THE PA EARLY LEARNING STANDARDS FOR MATHEMATICS AND APPLICATION IN PRACTICE

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SPRING 2017

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Elementary and Early Childhood Education
with honors in Childhood and Early Adolescent Education

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ABSTRACT

In 2013, Pennsylvania competed for funding for schools. To ensure schools maintained this funding, they received new standards at the preschool level in order to prepare students for Kindergarten. Since these new standards were adopted, an overwhelming amount of pressure has been put on preschool teachers to ensure their students are meeting, if not exceeding these standards. A qualitative case study was conducted at the Sunshine Preschool to examine whether or not preschool teachers are being prepared with adequate knowledge of the PA Early Learning Standards for Mathematics and if the teachers were then enacting this knowledge of the standards into practice. The sample consisted of four preschool teachers with varying degrees of experience with children. We discovered that teachers with more knowledge of the PA Early Learning Standards for Mathematics did not implement richer mathematics instruction than teachers with less knowledge of the PA Early Learning Standards for Mathematics. We offer implications of these findings, as well as suggestions for improving future versions of this study.
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ACKNOWLEDGEMENTS

The completion of this honors thesis was made possible by the encouragement and constant guidance of various mentors and supporters. Words cannot express how grateful I am for all that you have done for me, as well as how inspired I am by each and every one of them.

I would like to begin by thanking Dr. Meg Burke, my thesis advisor and friend. I will never be able describe how grateful I am for her dedication to my success. She inspired to embark on this journey and never failed to motivate me when the writing process became difficult. Her honest, constructive criticism enabled me to continue to further myself as a writer, and for this I could not be more grateful. Each and every day, she challenges me to constantly improve my writing and furthers my confidence. It is because of her that I feel prepared to take on whatever adventure is next in my life.

Next, I would like to thank Jodie Styers, my thesis supervisor and friend. Regardless of what was happening in my academic life, I knew I could always count on her to be incredibly supportive. Throughout this entire journey, she has believed in me even when I may have doubted my abilities. Whenever seemed difficult, she was always there to assure me that everything was going to be alright. Her dedication to my success was always evident and for that I am incredibly blessed.

Thank you to Penn State Behrend for their abundant resources, as well as Dr. Dawn Blasko for assisting me as my honors advisor senior year. I have always been inspired to continue to dream big with my Penn State family behind me every step of the way. These past four years have given me friends who have not only supported me through this process, but friends whom I know will continue to be there for me in the years to come.

Finally, I would like to thank my family for always supporting me and encouraging me to follow my dreams. To my incredible parents, thank you for constantly making sacrifices to ensure I received the best education possible. Thank you for instilling the faith and values in me that have kept me motivated to further my academics all of these years. I appreciate your love and support more than I could ever say.
Chapter 1

Introduction

Statement of the problem

Ever-growing is the debate about the pros and cons of the Common Core State Standards and their effects on students. For instance, one major goal of the Common Core State Standards is to reduce the wide breadth of topics covered in each grade level to allow teachers more time to cover specific topics in depth (National Governors Association for Best Practices & Council of Chief State School Officers, 2010). This goal aims to help students gain a solid foundation in a certain number of concepts, starting in Kindergarten, before moving to the next grade level, where the students would be expected to build upon their previously learned knowledge. As a result, students enter kindergarten with teachers expecting them to have certain sets of knowledge already in place. In mathematics, new kindergartners are expected to know how to count to 100, name numbers, identify shapes, measurement, data, etc. at the start of the school year. In turn, this put pressure on preschools and early learning centers to ensure that 4 year-olds knew these concepts before moving on to Kindergarten.

In Pennsylvania (PA), the standards that were once meant for Kindergartners have been made into standards for preschools: the PA Early Learning Standards. The following study aims to examine preschool teachers knowledge of the PA Early Learning Standards for Mathematics and how the participants applied the standards in practice. A secondary aim is to examine is whether or not teachers in this study adequately prepare the students for Kindergarten.

Purpose of the Study

The purpose of this small, case study was to begin to investigate preschool teachers’ knowledge of the PA Early Learning Standards for Mathematics and how this knowledge impacted the implementation of the standards in practice. More specifically, we wanted to know whether or not
teachers with more knowledge of the PA Early Learning Standards of Mathematics implemented a richer mathematics instruction than teachers with less knowledge of the standards. Educational background as well as experience with preschool aged children were taken into account during analysis to determine if there is a link between any of these factors and the participants’ knowledge and implementation of the PA Early Learning Standards.

This study is important because children entering kindergarten are expected to have a strong grasp of number, counting, and basic arithmetic, thus, it is vital that teachers are adequately preparing preschool students with the proper foundations they will need to succeed in Kindergarten and beyond. Lastly, this study was conducted to raise awareness of the importance of ensuring our youth are adequately prepared for their future.

Research Questions

This study will answer the following research questions:

1. What do preschool teachers’ know of the PA Early Learning Standards for Mathematics?
2. Do preschool teachers implement the PA Early Learning Standards for Mathematics?
3. Do teachers with more knowledge of the PA Early Learning Standards for Mathematics implement richer mathematics instruction than teachers with less knowledge of the PA Early Learning Standards for Mathematics?

Definitions of Important Terms

Teacher knowledge. There is a commonly held belief across professions that one’s educational background as well as continuing education credits positively impacts one’s achievement in his or her career. In the field of education, this belief also rings true in the public eye. In this study, we defined teacher knowledge along the lines of the commonly held perception of knowledge. We defined “Teacher Knowledge” as academic education, practical teaching experience, and continuing education attendance. In this study, we utilized this working definition of “Teacher Knowledge” to determine what
types of experiences might have influenced a participant’s understanding of the PA Early Learning Standards.

Richness of tasks. “Rich: (adj.) having high value or quality” (Webster, 1953). Teachers provide students with rich tasks by doing more than simply giving them answers, or overwhelming them with information. Memorizing foundational theories without understanding and integrating them into meaningful practices on a daily basis with young children is no different than singing the ABC song without knowing what letters are for or why they are important (Mooney, 2015). According to Parks and Wagner (2015), a task would be defined as rich when it meets the following criteria:

- A student actually engages in the task itself.
- Manipulatives are carefully selected, used, and adapted to the specific activity.
- Builds on prior knowledge of the student(s) encountering the task.
- Confusions are anticipated and addressed adequately.
- Questioning is properly used to engage students and further their understanding.
- Students work collaboratively and exchange ideas with their peers.
- There is a focus on the process as opposed to the result of the task.
- Connections to other topics are made explicit.
- Students are immersed in the task as opposed to going through the motions.
- Allowing students to talk and work through their own thought processes.

Stein, Smith, Henningsen, & Silver (2000) stated that the teacher’s role in the facilitation of these tasks can either increase the richness of a task, keep the richness the same as it was intended by the author of the task, or decrease the richness upon implementation. His or her selection and implementation of tasks can push students further than utilizing a procedure without proper understanding, depending on how the teacher questions students, encourages discussions and argumentation, and guides the children to learning how to grapple with mathematics (Stein, Smith, Henningsen, & Silver, 2000). With the guidance
of the teacher, tasks that might otherwise be of low cognitive demand can become challenging and demand a lot from the students (Stein, Smith, Henningsen, & Silver, 2000).

Rich mathematics tasks engage students by challenging them, taking full advantage of their capabilities. This can be seen not only in lessons that are well-planned, thoroughly thought through, and backed in research, but can even be seen in the meaning making of everyday experiences. “Many of the richest lessons children learn at school and child care happen in the bathroom, at the lunch table, or when friends are arguing over the same toy” (Mooney, 2015, p. 22). The learning experiences that are most relatable to students’ lives, allowing them to make sense of the world, can be some of the most valuable, rich tasks. The ability to grasp these opportunities and provide engaging implementation of lessons can be impacted dramatically by teacher’s knowledge (Stein, Smith, Henningsen, & Silver, 2000).

**Organization of Thesis**

This honors thesis is organized into five chapters. The following paragraphs provide a brief description of chapters two through five.

In Chapter 2, we will discuss the historical timeline of the standards movement with regards to preschool standards and the importance of preschool teachers teaching practices and knowledge of mathematics. We will highlight the gaps of prior research and will make evident the importance of the following research study.

Chapter 3 outlines the methodology used in this study. This study used a qualitative, case study design (Yin, 2013). Purposeful and convenient sampling were used to select participants (Maxwell, 2005). The data from this study were collected from three sources: semi-structured interviews, card sort, and videotaped instructional tasks. There were four sources originally, but the short mathematics assessment was removed due to issues with participation. The data were analyzed following Yin’s (2013) guidelines for interpreting case study data. Lastly, Chapter 3 provides a detailed narrative of the study’s limitations.
In Chapter 4, we provide a detailed account of the study’s findings for each of the three research questions being investigated. We discuss that academic background did not necessarily equate to a strong knowledge of the PA Early Learning Standards for Mathematics. We also address the fact that the implementation of standards in practice was not cut and dry. Finally, we discovered that richness of mathematics instruction was not necessarily aligned with a strong working knowledge of the PA Early Learning Standards for Mathematics.

Chapter 5 provides a discussion about possible explanations for the findings. We also included implications for the Sunshine Preschool going forward based on the study results. Lastly, Chapter 5 provides future avenues for further research on this topic.
Chapter 2

Literature Review

Conventional wisdom states that the time period between a child’s birth until they step into a Kindergarten classroom is crucial to their long-term success and should not be taken for granted. The “Good Start, Grow Smart” initiative set forth by the United States (2002) addressed the importance of preparing children for success in schools by improving the interventions they receive prior to entering Kindergarten. Stipek (2006) agreed when she wrote, “Children from low-income families begin school, on average, over a year behind their middle-class peers in basic academic competencies” (p. 455). Additionally, she expressed the need for quality preschools as evidence showed they prepare children for increased academic success (and reduce retention rates) in grade schools (Stipek, 2006).

One way for policymakers and the public to ensure that all students start Kindergarten with an equal opportunity for success is through the implementation of Early Learning Standards (United States, 2002). “Early learning standards can be a way to address accountability and provide more information about appropriate expectations in the early years” (Gronlund, 2014, p. 1). Standards set specific goals for learning and create a cohesive method for assessing readiness of students all over the United States (Gronlund, 2014). One caveat to the success of standards is that they are most impactful when informed by developmentally appropriate practices (NAEYC, 2002; Stipek, 2006).

Little research has been conducted on preschool teachers’ knowledge of the early learning standards and what the teachers have learned about developmentally appropriate practices used to teach the standards in preschool (Lee & Ginsburg, 2007). Gronlund (2014) and Stipek (2006) expressed the growing fear that teachers will develop a method of teaching that is very systematic and one-size-fits-all instead of allowing children to learn through a self-directed manner, which is a proven best practice at the preschool level.
The Introduction of Standards in Preschools

Over the past few years, standards of what should be taught at each grade level have been receiving more and more attention. Research has shown both positive and negative results of standards implementation. Some researchers are adamantly against the standards, arguing that they take away from the individual student aspects of education (Hatch, 2002). Others stress the importance of the standards, as they enable everyone to be on the same page, challenging students to the level their abilities allow for, and enabling the setting of clear expectations for both students and teachers (Beck, Hart, & Kosnik, 2002; Lewis, 1995; Thompson, 2001; Vinovskis, 2009). The purpose of the standards for preschool was to provide teachers with smaller, more concise goals to be met by the end of the academic year. These new goals aimed to afford the teacher more time to focus on the concepts being taught and allow students opportunities to connect more deeply with the content.

In the 1960s, it was evident to both the public as well as government officials that poverty was placing children at a disadvantage when it came to education (Vinovskis, 2009). In 1965, the Elementary and Secondary Education Act of 1965 (ESEA) was passed in order to provide educational funds. Under Title 1 of the ESEA, funding was given to local educational agencies who provided services for students of low socioeconomic status (Dept of Ed). The funding of these services would enable equal opportunities for those who were economically troubled (Vinovskis, 2009). Using Title 1 funding, the state and local involvement in education was enhanced (Vinovskis, 2009).

In the 1980s, the Reagan administration became concerned with educational outcomes in the United States. “The educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people” (Sadovnik, Cookson, & Semel, 1994, p. 87). In 1983, the administration released *A Nation At Risk: The Imperative for Educational Reform* [A Nation at Risk]. This report made suggestions for increasing the educational success of American school children. Most importantly, *A Nation At Risk* called for states to voluntarily create state educational
standards as a means for ensuring that the American educational system prepared the future workforce adequately.

By the 1990s, educational standards were in place; however, their implementation was not required and there was much variety between the standards across states. As a result, many teachers ignored the standards (Lewis, 1995). Instead, the educational system relied on textbooks as the source of a common curriculum (Lewis, 1995). “Researchers on curriculum and instruction have long pointed out that there is a sameness to what is taught in American public schools, beginning with basal readers and reinforced throughout the years of schooling by other textbooks and standardized tests that guide teachers’ priorities” (Lewis, 1995, p. 1). Thus, state standards fell to the wayside, until the presidential race between George W. Bush and Al Gore in 2000.

In the 2000 presidential campaign, education was a hot topic (Vinovskis, 2009). Upon his election, President Bush reauthorization the 1965 ESEA act, now named the No Child Left Behind (NCLB) Act of 2002 (Vinovskis, 2009). No Child Left Behind attached standards to state testing and made teachers accountable for improving the standardized test scores of their students. First, the law was based on the premise that all students would reach 100% mastery of specific grade level standards by 2014. To track a school’s progress toward 100% mastery, schools were graded on an A-F rating based on their standardized test scores and improvement year to year. States and schools would receive federal funding based on Annual Yearly Progress toward 100% mastery of the standards. Second, NCLB mandated that standardized test scores for each teacher be published at the end of each academic year. Teachers could receive merit pay for increasing scores or could be reprimanded, or even fired, for little to no score improvement at the end of each school year. These two components of No Child Left Behind resulted in the construction of state standards and the creation of assessment tools (in the form of end-of-year standardized state tests).

Mandatory state standards resulted in a major political divide in the United States. There are people who argue that the standards will negatively affect students as well as teachers who encounter
them. For starters, opposers of the state standards movement were concerned that teachers’ foci on the outcome, end-of-year test scores, as opposed to increasing learning or basing instruction on student thinking (Hatch, 2002). Many felt that students were being taught how to take tests as opposed to being assessed on their understanding of different concepts. “When tests are allowed to become the be-all and end all, they deform, not reform, education” (Thompson, 2001, p. 359). The tests evoked unproductive anxiety and pressure on teachers as well students and caused many to feel that the education system was broken. Additionally, some felt that instead of the standards helping the growth of the individual, the standards aim to make every student perform identically (Hatch, 2002). Lastly, others argue that teachers would not be allowed to create fun, engaging, and relatable lessons. Instead teachers would have to focus on set curriculum to make sure that everyone learns exactly the same things (Hatch, 2002).

Supporters of mandatory state standards believed that both teachers and students would have explicit expectations for learning and that these would enhance educational experiences. For example, the standards were helpful in ensuring students were able to utilize the capabilities they have and were being challenging within their level of frustration rather than below their capabilities. Another reason people supported the state standards movements was that they felt that the clear expectations would allow teachers to prepare high quality lessons that aided students in their understanding (Beck, Hart, & Kosnik, 2002). “It [The Standards Movement] aims to hold high expectations and provide high levels of support for all students, teachers, and educational leaders” (Thompson, 2001, p. 358). More specifically, the new standards focused on broader, smaller goals with plans for how to achieve them, instead of being focused on an exhaustive list of topics to be covered at specific time (Beck, Hart, & Kosnik, 2002). In many cases, the state standards documents provided teachers with examples of educational tasks for students and examples of how students might approach a task for a particular standard.

Supporters of the mandatory state standards also argued that the standards did not require topics to be taught in one specific manner. Instead, the standards meant that all students would be able to learn the material because it would be presented in a variety of ways and teachers would be able to support the
learning of each standard (NCTM, 2014). “Teachers and students should not assume that the standards movement is for some and not for others. Reauthorization of the ESEA, for example, mandates that students who receive Title 1 services meet the same standards as those the state sets for all students” (Lewis, 1995, p. 1). While the standards challenged the students, the idea was that each standard would be presented at a level that capitalized on students’ capabilities rather than dictated by a textbook curriculum. Research evidence even showed that more challenging curriculum yielded positive results in Head Start programs (Sophian, 2004). This finding illustrated that young children can handle and accel with a more challenging expectations (Sophian, 2004). Lastly, the standards movement encouraged teacher collaboration and held both students and teachers accountable (Thompson, 2001). Evaluating teachers via standards made them more apt to: teach for understanding, focus on skill development and be diverse in their teaching (Beck, Hart, & Kosnik, 2002).

In 2009, President Obama addressed the issues that arose from the implementation of the No Child Left Behind law with a new educational policy called Race to the Top. Unlike No Child Left Behind, Race to the Top created a competition among states for federal funds. Some of the major components of Race to the Top included the idea that all participating states had to implement the new Common Core State Standards as their official state standards, and adopt one of the two assessment tools of the Common Core State Standards. These two ideas, along with others, attached federal funding directly to standardized test scores. This meant teachers were more accountable to increase the standardized test scores because school districts and states were competing for Race to the Top funding. It also meant that states were now required to implement the Common Core State Standards and utilize specific assessment tools, even though the states had previously spent money developing state-specific standards years before.

It is incredibly apparent that mathematics in preschool is vital for building initial foundations in order to prepare students for Kindergarten as well as future academic success. The question that still remains, however, is what is required of teachers to be knowledgeable to teach mathematics to young
children? Knowing the content itself is a starting point, however it is vital that teachers are also learning the best practices when it comes to actually teaching the content to young students (Parks & Wager, 2015). “Without an understanding of what and how to teach mathematics to young children, early childhood instruction will become too teacher-directed and emphasize rote practices and memorization of facts” (Parks & Wager, 2015, p. 125). This means teacher preparation programs must work to ensure preservice teachers are being prepared to not only understand the concepts they are teaching, but how to teach them in a manner children who have never heard of them before will understand (Parks & Wager, 2015). “In order to provide our best efforts for the children and families we work with, we need to bring both the documented research of the Early Childhood Education [ECE] field, as well as our own hypotheses, gleaned from observations and interactions to our daily work with them” (Mooney, 2015, p. 27). The problem is, despite what appears to be immense amounts of research in the fields of both mathematics and early childhood education, there is a significant lacking in research as to what teachers need to be taught in order to be prepared for teaching young children (Parks & Wager, 2015). Being responsible for aiding in children's understanding of their everyday encounters with mathematical concepts and knowing how to make this connections in a meaningful way is a necessity for early childhood mathematics educators (Parks & Wager, 2015).

Preschool Teachers’ Teaching Practices & Knowledge of Mathematics

Parks and Wager (2015) cite a lack of awareness of teacher educators in charge of the methods courses of preservice teachers as well as those who lead professional developments. Often times, methods instructors are mathematics educators who have not received proper training in the early childhood education, or early childhood educators not having received the proper mathematics background (Parks and Wager, 2015). “We need to understand how teacher educators’ backgrounds shape what and how methods courses are taught” (Parks & Wager, 2015, p. 126). Depending on their educational background, what they see as important to teach in their methods course may be different than teachers with a content
focus in another area. Thus teachers are not being taught the same ideas in their methods courses consistently across the board (Parks & Wager, 2015).

For the past fifteen years, many teachers have expressed/demonstrated a significant amount of difficulty making lessons informative and meaningful to students (Mooney, 2015). Not only are students learning from their teachers, but even teachers need to continue to learn and grow. “We cannot make our practices reflect theories that we have never learned” (Mooney, 2015, p. 27). Different procedures are necessary when it comes to teaching mathematics, however it is vital that the teacher understand the logic and reasoning behind it, and then be able to provide necessary examples to aid students in a similar understanding (Ball, Phelps, & Thames, 2008). Teachers need to teach in a manner that is of high quality (Beck, Hart, & Kosnik, 2002). Preschool students are learning primarily through play, thus it is vital that teachers are taught methods in which play can be used to teach various mathematical concepts. Teachers must aid students in making sense of the mathematics they are experiencing in their everyday lives (Starkey, Klein, & Wakeley, 2004). High-quality teacher interaction will significantly assist students in the growth of mathematics knowledge (Klibanoff, Levine, Huttenlocher, Vasilyeva, & Hedges, 2006). The best way to improve mathematics in early childhood is to better prepare teachers through means of further education and professional development (Lee & Ginsburg, 2009). The National Council for Teachers of Mathematics (NCTM) provides a framework of eight principles of effective teaching of mathematics. The following will discuss those most applicable to preschool mathematics.

One of the mathematics teaching practices, Implement Tasks that Promote Reasoning and Problem Solving (NCTM, 2014), encourages providing children with open-ended tasks as well as aiding them in reasoning through the given task. “Interesting items in the environment encourage children to find answers to their questions and solve problems across all curricular domains” (McLennan, 2014, p. 20). Utilizing this inquiry-based approach to learning mathematics is vital in preschool, as children are not always going to participate in whole group play. It is important that teachers learn how to approach and engage in discussions about various students’ tasks on the spot. These open-ended tasks will not always
have a specific answer, however they are beneficial because they teach students to focus on the manner by which they arrived at their answer as opposed to simply getting the answer itself (McLennan, 2014). “Effective mathematics teaching uses tasks as one way to motivate student learning and help students build new mathematical knowledge through problems solving” (NCTM, 2014, p. 17). These tasks do not have to be explicitly related to mathematics, rather it could be as simplistic as children sorting objects into bins when they are cleaning up before they go home for the day, or even making patterns of stars and clouds in a picture while creating an art project (McLennan, 2014).

The second relevant effective mathematics teaching practice is *Use and Connect Mathematical Representations* (NCTM, 2014). Teachers need to make mathematics concepts explicitly connect to their students’ lives (Lee & Ginsburg, 2009). For example, students could be asked to count the crayons they are using in order to develop a more concrete representation of numbers. Students could even be asked to sort between jump ropes and basketballs when going outside to play to notice a difference is physical attributes (McLennan, 2014). “When students learn to represent, discuss, and make connections among mathematical ideas in multiple forms, they demonstrate deeper mathematical understanding and enhanced problem-solving abilities” (NCTM, 2014, p. 24). This could be as simple as counting both large and small objects to see that seven objects are a representation of seven, regardless of what they are or how big they are (McLennan, 2014). Students are able to develop a richer understanding of the concept being taught when they take part in representing it in multiple ways.

The third mathematics teaching practice is *to Facilitate Meaning Mathematical Discourse* (NCTM, 2014) that is vital in preschool mathematics is the role of teachers as facilitators of mathematics discussions in the classroom. “Mathematical discourse includes the purposeful exchange of ideas through classroom discussion, as well as through other forms of verbal, visual, and written communication” (NCTM, 2014, p. 29). In preschool, much of what children learn, including mathematics, is learned through play. It is vital that early childhood educators of mathematics know how to intertwine play and mathematics, as well as having the ability to engage in mathematical conversations with a child. For
example, if a student is playing in the block area, being able to approach them and engage in a discussion about the different shapes of the blocks as well as the different properties that make up the shapes they are identifying. “One of the foundations of play-based learning is that the teacher is active in the play, asking questions and adding knowledge and insight” (McLennan, 2014, p. 21). This inquiry process allows both students and teachers to better understand the thoughts of students through purposeful questioning. “Purposeful questions allow teachers to discern what students know and help students make important mathematical connections” (NCTM, 2014, p. 35). By guiding a child’s play through discussion and purposeful questioning, they will become more confident in their mathematical abilities.

The last relevant effective mathematics teaching practice is *Build Procedural Fluency from Conceptual Understanding* (NCMT, 2014). Vital to the success of early childhood mathematics educators as well as students is the building of both procedural fluency and conceptual understanding. “The important goal is that, when teachers care about providing a quality experience for children, understanding the theories and growing with the theories of practice are necessary parts of their job” (Mooney, 2015, p. 28). While it is evident that certain routines, or procedures are helpful in solving problems, they should not be taught in isolation from the content behind the procedure. “Visuals can inspire even deeper, more connected learning” (McLennan, 2014, p. 21). For example, when teaching counting in preschool, it is vital to physically allow students to utilize tangible manipulatives when first learning the concept. Having them grab one manipulative, place it on the table and say “one,” and then placing the second manipulative on the table and saying, “two,” allows students to concretely see what one object looks like in isolation, then two being one more than one, and so on. “In moving to fluency, students also need opportunities to rehearse or practice strategies and procedures to solidify their knowledge” (NCTM, 2014, p. 45). Going off of the previous example, while it is important that students are able to count, it is even more vital that they grasp the abstract concept behind a number as well as opposed to rote memorization, procedural fluency without conceptual understanding.
It is pertinent to ensure students know more than just the memorized formula people usually use where applicable. Teachers need to understand and be able to explain the “why” of mathematics as opposed to “just knowing 2+2=4” (Lee & Ginsburg, 2009). Teachers must ensure students are understanding concepts, not just procedures, as this will allow them to make connections amongst various mathematical ideas as they become more advanced down the road. It is important to propose challenges to students, allowing them to experience difficulty in a manner that is beneficial to their understanding. By creating meaningful experiences, students are more likely to develop a deeper understanding of a concept after grappling with it for a while in a way that avoids frustration (NCTM, 2014).

Early childhood mathematics educators must be knowledgeable on the concept of equity. People often mistaken equity to be defined as saying students should all be taught the same way at the same time, when in fact this is not what it is asking of teachers. “Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students” (NCTM, 2014, p. 12). Teachers need to be sure to accommodate the needs of various students, and provide them with tasks that model high expectations. This includes providing open-ended tasks, making learning relatable to students’ lives, and encouraging students to generate their own strategies. In preschool, this can be seen through the use of a variety of manipulatives for concrete learners, to moving to the abstract concept without use of manipulatives. Early childhood educators must be educated to properly utilize the materials they are given.

It is pertinent that teachers of early childhood mathematics are well-versed with the curriculum being used. “A curriculum is the program used to help students meet the standards, including instructional materials, activities, tasks, units, lessons, and assessments” (NCTM, 2014, p. 70). It is important to clarify that the standards are the goals we are trying to accomplish; the curriculum is the manner in which we arrive at the standards. This can be described in a horizontal and a vertical manner. “From a horizontal perspective, teachers need an in-depth understanding of the mathematics and materials that they use to
teach a particular course or grade level” (NCTM, 2014, p. 70). It is imperative that teachers have a rich understanding of the concepts as well as the way in which these concepts build off of one another for the class they are teaching. Teachers are facilitators, not merely lecturers (Nisbet & Warren, 2000). “Without an understanding of what and how to teach mathematics to young children, early childhood instruction will become too teacher-directed and emphasize rote practices and memorization of facts” (Parks & Wagner, 2015, p. 125). While preschool mathematics may be seen as simple to those who have furthered their education, knowing the content is just scratching the surface as to what is needed to actually teach preschool mathematics (Ball, Phelps, & Thames, 2008).

**Conclusion**

In summary, starting in the early 1980s, the United States moved toward the creation of a national set of educational standards for the purpose of making the workforce more competitive with other nations around the world. Under the Bush and Obama administrations, the goal of national educational standards came very close to fruition. Additionally, assessments were developed to measure the effectiveness of the national standards. Teachers, in states that adopted the national standards, were tasked with helping all of their students reach mastery of the standards before the end of each academic year or face potentially losing their job or salary bonuses.

As a result, many teachers began focusing on their students attaining mastery level scores on the year-end standardized tests. This led to teachers and school districts placing immense pressure on teachers of the younger grade levels to make sure their students knew the content at a very high level before being promoted to the next grade. In turn, elementary schools began putting pressure on the state governments to mandate standards for the preschools, to ensure that kindergarten teachers had a fighting chance at having their students reach mastery of the standards by the end of the school year. States, such as Pennsylvania, created standards for preschools to follow as a way to increase preparation for the academic rigor of kindergarten. One drawback to the new preschool-level standards was that they
required more subject matter and pedagogical knowledge on the part of the teacher. Research has shown that such knowledge might not be fully developed in current preschool teachers or in the preparation programs for early childhood educators (Ball, Phelps, & Thames, 2008; Mooney, 2015; NCTM, 2014; Parks & Wagner, 2015).

The following study aims to address the gap in the early childhood education research on how a teacher’s knowledge, or lack of knowledge, of the PA Early Learning Standards for Mathematics impacts his or her ability to provide preschool children with rich mathematics instruction and, in turn, prepare, or not prepare, preschoolers for the rigor of kindergarten mathematics.

Another goal of the study is to increase awareness of how teacher preparation and continuing education can either positively or negatively impact the opportunities for preschoolers to learn rich mathematics. Specifically, the study purports that reflection on teaching pedagogy and continuing education will aid in improving the methods used to teach mathematics and help educators meet state standard requirements.

Lastly, the literature review conducted for the following study uncovered a need for research that examines the links between pre-service early childhood education programs, teacher knowledge of what they must teach in mathematics, knowledge of best practices in early childhood mathematics classroom, and comprehensive implementation of the preschool standards. The following research study aims to begin to fill the gap in analyzing teacher knowledge of the mathematics standards and how his or her knowledge affects their implementation of the standards in practice.
Chapter 3

Methods

Research Design

This was a qualitative case study (Yin, 2014) to obtain data on: 1) preschool teachers’ knowledge of the PA early learning standards in mathematics and their mathematics knowledge and 2) how a teacher’s knowledge of the PA early learning standards in Mathematics is applied in his or her teaching practice. A qualitative study is one in which, “the researcher is the primary instrument for data collection and data analysis” (Merriam, 2002). Engaging in a qualitative study allowed us to delve further into the reasoning behind teacher’s decision making during instruction and how the teachers planned to implement specific mathematics standards.

Merriam (2002) defined a case study as, “…an intensive description and analysis of a phenomenon or social unit such as an individual, group, institution, or community” (p. 1). Using a case study design and methodology in the following study allows the reader to gain an in depth look at how teachers in a particular preschool setting understood and used the PA Early Learning Standards. “Finally, the product of a qualitative inquiry is richly descriptive. Words and pictures rather than numbers are used to convey what the researcher has learned about a phenomenon” (Merriam, 2002, p. 1).

Sample

Participants were selected using convenient and purposeful sampling (Maxwell, 2005). Participants were recruited from Sunshine Preschool. The Sunshine Preschool is located in Northwestern Pennsylvania, relatively close to a university. The preschool is run by a private company that has facilities across the United States.

Setting. Sunshine Preschool sits on the edge of a large university. The rectangular, brick building has two playgrounds on the North side of the building. The parking lot is located on the East side of the
building. Clients walk up to the main entrance on the East side. They walk through a set of glass doors and to the right can see into the director’s office through a window, as well as a window on the left side of the entryway that looks into Large Muscle indoor playroom. Clients must ring the buzzer to gain access into the building. Once granted permission to enter, clients walk through a second set of glass doors and enter into the main lobby. On the right is the work area of the Assistant Director and the door into the Director’s office. Parents must log-in their child on a computer located in the assistant director’s area. Teachers are also required to sign-in and out via the computer. A visitor’s log is located near the sign-in computer. The main lobby is the only exit and entrance for anyone in the building. The other external doors in the building lead to the playgrounds.

The center has facility tends to a total of 81 students, or “clients” as they are known to the employees, at the time of this study. The facility first aims to serve the nearby university’s students and faculty, also known as clients. Secondly, the facility aims to serve the community, which consists primarily of children whose parents work at nearby businesses, local school districts, and alumni of the nearby university. The facility is incredibly diverse containing various ethnic and racial backgrounds. There are seventy caucasian students, 37 of which are male and 33 females. There are three African American students, two of which are male and one female. There are five Asian Pacific students, three of which are male and two females. There are three students, two who are male and one female, who identify as either Arabic, Indian, or Japanese, two of which are male and one female.

From the entry lobby, a person can walk either to the left (south) or the right (north) down a hallway that circles around the building. The hallway is decorated with bright colors and students’ artwork. The classrooms flank the north, west, and south sides of the building. On the north side of the building are the infant room and young toddler room. The west side houses the toddler room, the two-year-old room, and the PreKindergarten (PK) 1 room (the 3-year-olds). The PreKindergarten (PK) 2 room (4-year olds) and the large muscle room are on the south side of the building. The rooms flank the outer edges of the building. In the middle of the building are the faculty lounge (across from the young toddler
room), the conference room (across from the assistant director’s desk), and the restrooms (diagonal from the large muscle room).

The study took place in two classrooms at Sunshine Preschool: the PK 1 and PK 2 classrooms. The PK 1 classroom is a large room that has a kitchen and bathroom that adjoins with the PK 2 classroom. When someone enters the PK 1 classroom, there are cubbies and hooks for jackets on the right. To the left is the kitchen area with a fridge, sink, and counter space. In front of the counter are the tables where kids eat lunch or make crafts. The bathroom is just past the kitchen area. Past the cubbies is the dramatic play center. To the left of the dramatic play area are the math centers and blocks. There is a large open area in the middle of the room where everyone sits for meetings and group learning time. On the far left wall of the room is the science and technology center. The classroom has two computers and an area for science-related materials. The south and west side of the room are primarily windows that look out into the woods and the building next door. Students’ artwork hangs on the windows.

The PK 2 classroom is a large room that has a kitchen and bathroom that adjoins with the PK 1 classroom. When a person enters the PK 2 classroom, the cubbies are on the left. To the right is the kitchen area with a fridge, sink, and counter space. In front of the counter area, there are some tables where kids eat lunch and make crafts. Other tables are located in front of the bathroom entryway and one table is in the center of the room. The dramatic play area in PK 2 is past the cubbies to the left of the main classroom door. Beyond the dramatic play area is the east wall where the math center and blocks are housed. Next to the math center is the circle time area. At the intersection of the east and south walls is an easel used during calendar time. Continuing down the south wall are windows. The science area in the PK 2 classroom is located between the tables in front of the bathroom and the table in the middle of the room.

Sunshine Preschool employs 17 teachers and 4 substitute teachers. The company requires all teachers to have an Child Development Associate (CDA) credential or associate’s degree at minimum. The director at the Sunshine Preschool prefers her teachers to have at least a bachelor’s degree.
Each classroom has at least two classroom teachers. There were two classroom teachers in the PK 1 and PK 2 classrooms, at the time of this study. Both teachers are responsible for lesson planning, implementing activities, and taking care of the clients; however, one of the teachers is considered the lead teacher. The lead teacher is responsible for any incidents that occur during the school day and all of the logistical items that might need tending to during the school year.

The student to teacher ratio in each classroom differs dependent upon the age of the students. In the infant room, consisting of students from birth to 12 months, the teacher to student ratio is one to three. In the toddler room, consisting of students from 13 months to two years old, the teacher to student ratio is one to four. In the two year old room, consisting of students who are two years of age, the teacher to student ratio is one to five. In the PK1 room, consisting of students who are three years of age, the teacher to student ratio is one to nine. In the PK2 room, consisting of students who are four years of age, the teacher to students ratio is one to ten. At the time of this study, there were two teachers and 18 students in PK 1, and two teachers and 20 students in PK 2 (Personal Communication).

**Study sample.** A recruitment letter was sent to the director of the Sunshine Preschool requesting permission to conduct a study with the lead teachers in the Pre-Kindergarten (PK) classroom teachers who were 18 years or older. A follow up phone call was used to clarify any concerns that the director had about the study. The four PK teachers for this study were selected by the center director. The director’s selection of the study participants was a limitation because the participants might have felt coerced into participating and the teachers might have selected because the director felt they would present the center in the best light.

A small sample of participants was chosen for three reasons. First, the study is a case study examining teachers’ knowledge and implementation of the PA Early Learning Standards. A case study allows for the researcher to gain indepth knowledge on this phenomena. Second, there were only four teachers who fit the participant criteria set by the researcher prior to starting the study. Third, the researcher is currently pursuing a degree in Early Childhood Education. The small sample size allowed
for more flexibility for the researcher. After receiving approval, the researcher contacted all four of the teachers in the PK classrooms. The researcher reviewed the consent document with the participants and provided an explanation of the study. The researcher also stated that the subjects’ participation in the study was voluntary and that they were able to opt out at any time. Teachers signed the consent forms, indicating “yes, I want to participate.”

Four preschool teachers from the Sunshine Preschool participated in this study. Teacher A is a caucasian female who has been a teacher since 2011. She has worked at the Sunshine Preschool for one year and six months as one of the PK 1 teachers. Teacher A has a bachelor’s degree in Early Childhood Education as well as Special Education. In the past, she has participated a high school program that has allowed her to act as a teacher’s aid, as well as worked in regular education, emotional support, and autistic support classrooms.

Teacher B is a caucasian female who has been a teacher since 1998. She has worked at the Sunshine Preschool for one year and six months as one of the PK 2 teachers. Teacher B has an associate’s degree in Early Childhood Education. In the past, she has worked with students in both regular education and autism inclusion classrooms.

Teacher C is a caucasian female who has been a teacher since 2014. She has worked at the Sunshine Preschool for one year and six months as one of the PK 2 teachers, as well as one of the infant teachers. Teacher C has a bachelor’s degree in Early Childhood Education. In the past, she has worked primarily with preschool children, but also kindergarten second grade, and fourth grade students.

Teacher D is a caucasian female who has been a teacher since 2008. She has worked at the Sunshine Preschool for one year and six months as one of the PK 1 teachers, as well as one of the two-year-old teachers. Teacher D has a Child Development Associate (CDA). In the past, she has worked at the local YMCA as a preschool teacher.

**Data Collection Instruments**
Data will was collected from the following sources: 1) PA early learning standards cardsort, 2) interviews with each individual teacher, 3) short mathematics knowledge assessment for teachers, and 4) video of the mathematics lessons. The data will be analyzed using qualitative coding methods and basic statistical analyses.

**Cardsorts.** The card sort activity was developed by the researcher for the purpose of assessing the participants’ knowledge of the PA Early Learning Standards for Mathematics.

The researcher placed the four domains of the PA Early Learning Standards on the table in front of the participant. The four domains are: (1) Numbers and Operations, (2) Algebraic Concepts, (3) Geometry, and (4) Measurement, Data, and Probability. The specific standards were laid at random on the table. The participant was asked to read the standards and sort each standard under the category that best applied to the standard. The participants were asked to explain their reasoning while sorting the cards. At the end of the activity, the researcher asked the participants to summarize the overall process of the sorting.

The card sort took approximately 10-15 minutes. Two participants completed this activity. The activity was completed by participants, individually. One of these sessions took place in the faculty lounge at the Sunshine Preschool, the other took place in the classroom. The activity was audio and video recorded and later transcribed by the researcher. The researcher also took still pictures of the completed card sorts. The limitations of this activity will be discussed further in a later section.

The researcher returned to the Sunshine Preschool to complete the card sort activity with the other two participants. The activity was completed by participants, individually. One of these sessions took place in the classroom of the participant, the other took place in the conference room at the Early Learning Center. The activity was audio and video recorded and later transcribed by the researcher. The researcher also took still pictures of the completed card sorts. The limitations of this activity will be discussed further in a later section.
**Interviews.** Two interviews were conducted in this study: an opening interview and a follow-up interview. The opening interview was semi-structured. The purpose of this interview was to develop a more comprehensive idea of the individual participants, their educational background, and their unique teaching philosophies. Each participant was asked the same overarching questions. Follow-up questions varied based on the initial responses of the participants (Stake, 1979). The participants were asked: (1) Please describe your educational background, (2) Please describe your teaching philosophy in general, (3) Please describe any trainings or professional developments that you have attended since starting your teaching career, (4) Please describe how you feel about mathematics, (5) How many years have you been a teacher for, (6) How many years have you taught preschool, and (7) How many years have you taught at this institution.

The opening interviews lasted between 20 - 30 minutes. These interviews were supposed to be conducted with each teacher individually. When the researcher arrived at the location, the participants had already decided to participate in the interview as grade-level pairs. The limitations of this will be discussed in a later section.

The interviews were conducted in the faculty lounge at the Early Learning Center. This area allowed for private and open conversation amongst the participants and the researcher. All interviews were audio-recorded and transcribed by the researcher.

Follow up interviews were conducted 5 months later. The follow-up interview was semi-structured. The purpose of this interview was to review the data collected in the classroom, clarify the intentions of the filmed lessons, and discuss the fairly new implementation of the standards at the Early Learning Center. The participants were asked: (1) To reiterate the standard(s) being taught in the clip, (2) What the intended goal of the lesson was, (3) Their feelings about the new implementation of the standards in their facility, (4) What support they received upon implementation, (5) How their classroom or teaching has changed as a result of this change, and (6) How their planning is affected by this transition.
The follow-up interviews lasted between 20 - 30 minutes. The follow-up interviews were conducted with each teacher individually, except for 10 minutes of one interview when a second teacher joined the conversation without the researcher’s prior knowledge that this would happen. The limitations of this will be discussed in a later section.

All interviews were conducted in the faculty lounge at the Sunshine Preschool. This area allowed for private and open conversation amongst the participants and the researcher. All interviews were audio-recorded and transcribed by the researcher.

**Short Mathematics Assessments.** The short mathematics assessment was designed by the researcher under the guidance of a mathematics professor. The purpose of the assessment was to uncover a teacher’s conceptual understanding of specific mathematics topics relevant to preschool and elementary school mathematics. The assessment also was used to determine whether or not the teachers relied on procedural knowledge alone (rote memorization) or conceptual understanding, as well (Ball, 1990; Ball, Thames, & Phelps, 2008).

The assessment consisted of three different vignettes (see Appendix A). The vignettes addressed the mathematical concepts of number operations, geometry, and measurement. These relate back to three of the four domains of the PA Early Learning Standards: (1) Numbers and Operations, (2) Geometry, and (3) Measurement, Data, and Probability.

The first vignette investigated a teacher’s Knowledge of Content and Teaching (Ball, 1990; Ball, Thames, & Phelps, 1998). The task asked the teachers to describe how they would assist parents’ develop an understanding of how to support their children’s learning of subtraction at home.

The second vignette addressed the issue of Specific Content Knowledge and Horizon Knowledge (Ball, 1990; Ball, Thames, & Phelps, 1998). In this scenario, the teacher was asked to explain to a parent why there are so many different names for polygons and how these names were related.
The third vignette explored a teacher’s Common Content Knowledge (Ball, 1990; Ball, Thames, & Phelps, 1998). The teacher was asked to compare weights of three different animals and explain their thought process.

The short mathematics assessment was supposed to be conducted with the researcher present, but the director of the Early Learning Center expressed the teachers’ apprehension for this particular procedure. Therefore, the researcher decided to allow the teachers to take this assessment on their own. The data was collected by participants writing down, on paper, their responses to the vignettes. The researcher was personally handed the completed mathematics assessments. The limitations of this will be discussed in a later section.

**Video Observation.** The video observations were conducted by the lead preschool teachers in the classroom, using cameras and/or tripods provided by the researcher. One camera was given to the PK 1 classroom lead teachers and another was given to the PK2 classroom lead teachers. The teachers were asked to take turns filming one another’s instructional practices. The purpose of the video taping was to document the lead preschool teachers’ teaching and possible implementation of the PA Early Learning Standards.

Ten videos of math lessons were collected from the PK 1 teachers, in total. One PK1 teacher was videotaped during eight lessons and the other PK1 teacher was teaching in two lessons. These lessons were conducted in a small group setting. The average instructional time was three to four minutes.

Four videos of math lessons were collected from the PK 2 teachers, in total. There were two lessons from each PK 2 teacher. These lessons were conducted in a large group setting. The average instructional time was six to eight minutes.

Figure 1 summarizes the tasks that were filmed for this study and identifies which participant taught each task.

Figure 1. Summary of Filmed Tasks

<p>| Filmed Tasks |</p>
<table>
<thead>
<tr>
<th>PK 1 Classroom</th>
<th>Summary of Task</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>Two students had their own patterns they needed to complete.</td>
<td>A</td>
</tr>
<tr>
<td>Task 2</td>
<td>Students were asked to roll a ball on each side of the taped shapes on the floor and then identify the shape.</td>
<td>A</td>
</tr>
<tr>
<td>Task 3</td>
<td>A student used manipulatives they had to pick up and place into circles while counting.</td>
<td>A</td>
</tr>
<tr>
<td>Task 4</td>
<td>Students were asked to measure the height of their teacher using toy snakes.</td>
<td>A</td>
</tr>
<tr>
<td>Task 5</td>
<td>Students were completing puzzles with guidance from their teacher.</td>
<td>D</td>
</tr>
<tr>
<td>Task 6</td>
<td>Students were asked to sort objects based off of their color.</td>
<td>A</td>
</tr>
<tr>
<td>Task 7</td>
<td>Students were asked to have their train trace the &quot;track&quot; of a shape and then identify it.</td>
<td>A</td>
</tr>
<tr>
<td>Task 8</td>
<td>Students were making pictures and then it was noticed that one had sorted the different shaped foam stickers.</td>
<td>A</td>
</tr>
<tr>
<td>Task 9</td>
<td>The teacher used train tracks to measure students' heights.</td>
<td>A</td>
</tr>
<tr>
<td>Task 10</td>
<td>Students worked with one another and the teacher to sort small, medium, and large objects.</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PK 2 Classroom</th>
<th>Summary of Task</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>Student selects an numbered ice cream cone. Student must place the scoops of ice cream on top of the cone according to the number on the cone. This is repeated with a second student. The teacher then inquires with students about the differences in the two ice cream cones using words such as: more, less, shorter, taller, etc.</td>
<td>B</td>
</tr>
<tr>
<td>Task 2</td>
<td>Each day, attendance is taken. The teacher takes advantage of this learning opportunity by getting the students involved in counting the number of boys, number of girls, and total number of students. Then a discussion is had about more than, less than, greater than, etc.</td>
<td>C</td>
</tr>
<tr>
<td>Task 3</td>
<td>Students were engaged in a task that would introduce them to subtraction through experience. The teacher would ask a specific amount of students to &quot;get on the boat,&quot; then students would be asked to count how many total were on the boat. Then, the teacher would write the total on the board and ask a certain number of students to get off the boat. She would then write down the number she asked to get off the boat. Then she would ask the students to count the total number of students left on the boat. She would write an equation and discuss its components with students, using vocabulary such as take away, subtract, equal to, etc.</td>
<td>B</td>
</tr>
<tr>
<td>Task 4</td>
<td>A sort of game was played in which students rolled a die and then had to stack tiles according to the number on the die. Once every student had a turn to do this, the class counted how many tiles the class had in total.</td>
<td>C</td>
</tr>
</tbody>
</table>

All video taped lessons were transcribed by the researcher. The researcher selected small segments of the videos to present to the teachers during the follow-up interviews.
The limitations of the amount of video taped mathematics lessons and the uneven distribution across the four teachers will be discussed in a later section.

**Data Analysis Procedures**

The method the researcher chose to utilize in analyzing the data was pattern matching, more specifically rival independent variables as a pattern (Yin, 2013). Pattern matching is the process of looking at the findings obtained from a research study and comparing them to the original research questions (Yin, 2013). More specifically, rival independent variables as a pattern analyze data in order to disconfirm opposing outcomes (Yin, 2013).

The following paragraphs will explain in more detail how each research question of this study was analyzed. During the transcription process, the researcher used a notebook to contain any thoughts that came to mind. These notes, along with the transcriptions of the video observations as well as the film itself proved to be vital resources to the researcher. Throughout the entirety of the data analysis, the researcher continued to write these memos as a method of reflection and understanding.

**Research Question 1.** *What do preschool teachers’ know of the PA Early Learning Standards for Mathematics?*

The first research question is specifically looking at the teacher’s knowledge of the PA Early Learning Standards for Mathematics. The data most applicable to this question are the opening interviews and the card sorts. These data points enable the researcher to assess the teacher’s knowledge through questions and observation. The opening interviews allow the researcher to look at the educational backgrounds of each teacher as well as any mathematics or standards based professional developments they had attended. The card sort allows the researcher to view thought process of the teacher as they sort through the standards, assessing their reasoning as well as familiarity with the standards themselves.

To analyze the data for the first research question, the researcher printed out the transcriptions of the opening interviews, two copies per teacher. The researcher made two copies so that she could go
through the data twice. After the two readings, the researcher compared the notes and highlights she made on each copy to check her analyses for missing information and biases.

The two copies were placed into separate manilla envelopes for each teacher. The researcher wrote the teacher’s ID on each envelope. The researcher also assigned a specific highlighter color to each teacher (teacher A - pink, teacher B - blue, teacher C - orange, and teacher D - yellow). She would use only that specific color to highlight any of the data pertaining to a particular participant. This color-coding helped the researcher keep the data organized and clear because she could immediately see which transcript belonged to which teacher based on the color of the highlighter used. The labeling and using separate folders for each teacher were done to keep all of the materials for each participant together and to help the researcher focus on one participant at a time.

The researcher used the following procedures to review each participant’s data set:

*Transcript analysis.* First, the researcher labeled each transcription for the opening interviews “Educational background and professional developments attended.” This label was placed there to ensure the focus was on only research question number 1. Starting with Teacher A, the researcher read through the two copies of Teacher A’s opening interview transcripts one at a time. The researcher focused on finding information about the teacher’s educational background as well as the professional developments she had attended. The evidence was highlighted according to Teacher A’s corresponding color. Additionally, the researcher wrote memos in the margins of the transcripts. These memos included thoughts that the researcher had when conducting the research and questions than arose when analyzing the data. When finished with the transcript, the researcher set the first copy of Teacher A’s opening interview back into its corresponding manilla envelope and put it to the side.

The researcher repeated the same process for each of the four participants. Immediately following the read through of the first copies of each participant's opening interview, the research completed the same process with the second copy of each participant’s opening interview. When both copies of each participant’s opening interview transcripts have been read through twice, the researcher reviewed all of
the copies. A chart was created for each participant to organize the opening interview transcript data. Each chart included the following pieces of information: (1) educational experience, (2) experience working with children, (3) preschool experience, (4) professional developments attended, and (4) years of teaching. Once the chart was completed for a participant, it was printed and then placed into the manila envelope for the individual participants. This process was completed for each of the four participants.

Next, the researcher created a chart titled, “Educational Experience”. She entered the data from each teacher into this new chart. The researcher was able to compare data on “Educational Experience” among the four teachers using this chart. A similar chart was created for each component of teacher knowledge, as well.

Lastly, the researcher created a chart called, “Analysis of Opening Interviews”, to help her synthesize the entire data set for Research Question 1.

*Card sort analysis.* The researcher printed two copies of the transcripts for each teacher. The researcher made two copies so that the researcher would not be influenced by previous findings when reading through the material multiple times. The two copies were placed in the previously designated, manilla envelope.

The researcher went through data in one folder as a whole before continuing on to the next data folder (Yin, 2013). This process helped the researcher to to focus on one teacher’s data set at a time. The researcher read one copy of the transcript twice. The researcher focused on how each teacher defined the four domains with information regarding the manner in which they define each of the four domains within the PA Early Learning Standards. The researcher highlighted keywords in the transcript, as she read through the data. The keywords were then recorded in a chart. This chart was used to analyze the words that the teachers used to define each domain.

Immediately following, this process was conducted across the teachers. Once all of the first copies were analyzed, the researcher repeated the process with the second copy of each transcript for each teacher.
To analyze the physical card sorting activity, the researcher created and printed an analytic rubric. The rubric listed each domain and the standards that fell under the specific domains. A rubric was printed for each teacher. The researcher compared the still photographs of each teacher’s card sort with the rubric to assess the accuracy of each participant’s placement of the standards under a domain.

Then, the researcher compared the transcript to the card sort photographs to analyze the reasoning behind the teacher’s positionings. The findings of these analyses were also recorded on each individual teacher’s rubric.

Lastly, the researcher created a chart that included all of the data from each teacher so that she could compare across the teachers.

**Research Question 2.** *Do preschool teachers implement the PA Early Learning Standards for Mathematics?*

The second research question examined whether or not the teachers utilized the standards during instruction, or if the standards were not guiding the teacher's' instruction. The data most applicable to this question were the video observations of the teacher’s instruction and the closing interviews. The video observations provided insight into how the teacher implemented the mathematics lessons. The closing interviews provided the researcher with knowledge of how the intended standard and objective of the lesson were implemented, if they were at all.

**Closing interview analysis.** The researcher printed out two copies of each individual teacher’s closing interview transcriptions. The researcher made two copies in order to be sure all important and relevant data was found in the transcripts during her multiple readings. The copies were placed into the folders that kept the data for each individual teacher. The transcripts were analyzed for evidence of the teacher’s intended goals of the lessons that were videotaped and for evidence that the teacher aligned the lesson with a specific standard or domain.

The researcher read and highlighted (with the color that corresponded with the specific teacher) the first copy of the closing interview transcript. This process was conducted with the first copy of closing
interviews for each teacher. Immediately following, the researcher repeated this process with the second copy of the closing interview transcripts.

**Lesson transcription analysis.** The researcher printed two copies of the transcriptions of each lesson taught by each participant. The transcripts were then placed into their corresponding manilla envelope. The researcher read and highlighted the first copy of each teacher’s transcript, looking for times in which the teacher was asking follow-up questions, engaging in discussion with students, utilizing manipulatives, etc (see Chapter 1: Richness of Tasks definition).

Next, the researcher watched the videos of instruction with the second copy of the lesson transcript in hand. The researcher wrote copious notes on the second copy of the transcript. The notes included information about what was happening in the lesson (i.e. discussions occurring, types of questions being asked by both teacher and students, as well as manipulatives being used).

Then, the researcher compared the her own notes written on the transcripts, the transcripts themselves, and the chart made from the closing interview transcripts to see if the intended goal of the task matched with what was being taught in the classroom. The researcher then utilized the PA Early Learning Standards checklist (see Appendix A) to investigate whether or not the intended domains were being implemented. The researcher began this process with Teacher A’s data. She compared the intended domain/s and goals for Task 1 with the PA Early Learning Standards checklist for that specific domain. The researcher went through each standard and the listed activities that went with the standard. She marked which activities were present, or not present, during the implementation of the task. When the analysis of each standard was completed, the researchers calculated the percentage of activities present for each task. A total of 85%, or higher, of the activities had to be present for the researcher to conclude that the standard was implemented. The researcher, then, recorded how many of the standards were implemented for each domain, if any, for Teacher A. This process was completed for each participant’s lesson transcript data.
Research Question 3. Do teachers with more knowledge of the PA Early Learning Standards for Mathematics implement richer mathematics instruction than teachers with less knowledge of the PA Early Learning Standards for Mathematics?

The third research question looked at the amount of standard knowledge the participants had and if the amount of knowledge affected the richness of their mathematics teaching. The data used to answer this question were: the card sorts, the opening interviews, the video observations of the participants instruction, and the closing interviews with each participant.

Opening Interview Analysis. The following procedure was used to analyze the data for each participant.

First, the researcher printed out two copies the transcriptions of the opening interviews per teacher. The two copies allowed the researcher to have one copy for the initial analysis and a fresh copy to read when looking for disconfirming evidence (Yin, 2013). The two copies for each teacher were placed in their respective separate manilla envelopes.

The researcher started with Teacher A’s data. She read the first copy of the interview, focusing on finding information about the teacher’s educational background and any professional developments they had attended. The evidence found was highlighted with Teacher A’s corresponding highlighter color. The researcher also wrote memos to record her analysis of the material.

Next, the researcher created a chart of Teacher A’s data. The chart included: (1) educational experience, (2) experience working with children, (3) preschool experience, (4) professional developments attended, and (4) years of teaching.

This process was completed for each participant in the study. Then, the researcher compiled all of the participants’ data in a chart titled, “Analysis of Opening Interviews.” This large chart allowed the researcher a space for comparing and contrasting the data and finding disconfirming evidence (Yin, 2013) for Research Question 2.
Card sort analysis. Next, the researcher studied the transcriptions of the card sort activity and the still photographs of the card sort for each teacher. The researcher printed out the transcriptions of the cardsorts, two copies per teacher. The two copies for each teacher were placed in their previously designated, separate manilla envelopes. The researcher created a rubric (see Appendix B) for analyzing the data based on the PA Early Learning Standards. The rubric listed each domain found in the PA Early Learning Standards and the corresponding standards for each domain.

Starting with Teacher A, the researcher highlighted evidence found in the transcript of the card sort that supported Teacher A’s reasoning for why standards were placed under particular domains of the PA Early Learning Standards. Next, the researcher synthesized the explanations into keywords.

Then, the researcher compared the still photograph of Teacher A’s card sort with the transcription from the activity. Each placement of the standards in the card sort was matched to the teacher’s explanation of placement, found in the transcript. The explanations and placements were combined into a chart and used for comparing across data sets.

This process was completed for all of the participants in the study. Then, the researcher went back to the second copies of the transcripts and completed the process again to find disconfirming evidence and to see if there were any pieces of evidence that were missed the first time through.

Limitations in the Methods

Despite careful thinking and planning, the researcher is aware of the inevitable limitations within this study. In the following section, the limitations of this study are explained along with the reasoning for these limitations, and how these limitations could be avoided if this study were replicated. Limitations will discussed in the following order: (1) Researcher, (2) PA Early Learning Standards cardsort, (3) interviews with each individual teacher, (4) short mathematics knowledge assessment for teachers, and (5) video of the mathematics lessons.

Researcher. The researcher brings limitations to the study that are not always evident without careful thought. The first limitation for the researcher was the location of the Sunshine Preschool. The
location of the center being studied was a limitation for the researcher when collecting data. The center’s location in northwestern Pennsylvania was a two hour drive from the researcher’s home in southwestern Pennsylvania. The videotaping of lessons were conducted during the summer months when the researcher was living in Southwestern Pennsylvania. This great distance made it hard for the researcher to be present consistently throughout the week that teachers were filming.

This limitation might have impacted the findings of the study because the researcher was not able to videotape the participants, herself. The teachers were left to decide when and what to videotape. It is possible that the teachers selected well-planned lessons to videotape, or lessons/content where they were more confident with the topic.

In future replications of this study, the researcher should arrange data collection times to be when she could be present at the videotaping. Further discussion of this limitation can be found later in the limitations section.

A second limitation was the researcher’s schedule. During the data collection process, the researcher was living in Southwestern Pennsylvania, taking summer school courses, and working Monday through Thursday each week. These responsibilities restricted the researcher’s time to conduct research at the Sunshine Preschool to Friday mornings and afternoons. This limitation might have impacted the study because had the researcher been available more days during the week or lived closer to the Sunshine Preschool, she could have been involved more in the data collection process. The study may also have been impacted by limiting the number of days the participants needed to be available for interviews, card sorts, etc.

In future replications of this study, it would be imperative for the researcher to be more available during the data collection process to ensure the fidelity of the data collected. The location of the Sunshine Preschool made frequent visits difficult, limiting interactions with the participants. It is vital that the researcher be able to visit the site of the research more than once a week. Flexibility is required to ensure all data needed is being collected, as well as assisting in the data collection process itself more.
A third limitation is the manner in which the researcher defines teacher knowledge. It is vital to consider the background of the researcher in order to understand their influence on the analysis process. The researcher feels the extent of teacher knowledge is dependent upon their educational background and the professional developments they have attended. According to the researcher, the educational background consists of information such as the schools they attended growing up, the people who taught them, the teacher preparation program they completed/attended, their experiences with children in a teaching position, and the research they have read or conducted.

In future implications of this study it is important that the researcher take a step back and process their own opinions and background. Recognizing and acknowledging how these thoughts and opinions may influence their study, the participants selected, their data collection processes, and their analysis of the data collected.

Cardsorts. There were three major limitations that occurred when conducting the card sorts: 1) the scheduling of time at the center, 2) the location in which the card sorts took place, and 3) the time period in which the card sorts were completed.

The scheduling of time at the center was a limitation. The researcher often encountered difficulty finding time to conduct and film the card sorts. In the summer months, Sunshine Preschool utilized flexible hours for the teachers. This flexibility caused the participants’ schedules to change weekly. Since, the researcher could film only on Fridays, there would many times when the schedules of the researcher and participants would not overlap. Additionally, a few times that the researcher arrived on a Friday to collect data, a participant would not be available for the researcher because of a staff shortage at Sunshine Preschool. Thus, the inconsistency of the summer scheduling meant that the participants were not always working on Fridays and this caused the card sort data collection to be rescheduled.

The scheduling conflicts and delayed data collection could have negatively impacted the card sort data. For example, the participants could have taken time to review or study the standards before the card sort, once they realized that the card sort was pushed back a week. Their studying may have resulted in
data that showed significantly more understanding than what would have shown without the extra study time.

In future replications of this study, it would be wise for the researcher to complete the card sorts the same day as the opening interviews. This way, it is causally structured as a part of the interview as opposed to being viewed as another activity to be completed by the teachers. At the least, it would be important to schedule all of the card sorts on the same day, with the least amount of “heads up” possible, to ensure it accurately assesses teacher knowledge as opposed to allowing participants additional time to review, learn, or introduce themselves to the PA Early Learning Standards.

Second, the location in which the card sort took place is a limitation for a few reasons. The card sorts were to take place in the faculty lounge at Sunshine Preschool. Teacher D’s card sort was completed in the classroom toward the end of the day, as there were not enough teachers to relieve her. The environment could have caused her to be unfocused or feel rushed because of the children being around her and in the room. Had she been in the faculty lounge, there would have been less distraction as well as privacy for further discussion. In future replications of this study, it would be beneficial to schedule a time in which the center knows they will have an abundance of teachers who can substitute into the room for the time needed for the card sort, as well as a backup time. This way, it is ensured that the card sort will occur under conditions that allow the teacher to be calm and in a quiet environment.

Teacher B’s card sort was completed in the faculty room. The researcher and the participant were able to leave the classroom briefly to conduct the card sort in the faculty room because there was another teacher that was able to step in during her absence. While she was able to complete the card sort in an environment free from noise and distraction of students, it was evident she felt rushed to return to her classroom. Had there been more time, the teacher may have taken more time to analyze the standards and sort them differently as well as provide more in depth explanations of her sorting processes. In future replications of this study, it would be beneficial to restate with the teacher that there is a solid block of time marked out for the card sort. This way, they know there is ample amount of time for them to take to
complete the card sort as well as discuss their thinking throughout the process. Ensuring they are in the room for a significant more time than needed will encourage them to discuss more, as they know they will be in the room with the researcher for that amount of time regardless while the substitute is taking care of their classroom, elevating the participant of their concerns.

Teacher B’s card sort was completed in the classroom during nap time. Many teachers were on their break, so the teacher needed to stay in the room. There was also a child that the teacher had to pay specific attention to during nap time, so she could not leave his side. While it was not apparent that she was speaking quickly or any less, the environment could have caused her to feel the need to talk less or quicker in order to keep a silent sleeping environment. In future replications of this study, the researcher should arrange for a more specific time with the facility as opposed to being told to come sometime in the afternoon. This ensures the participant can leave the classroom and complete the card sort in a quiet area that allows them to think as well as be extremely vocal about their thinking.

Teacher C’s card sort was completed in the conference room. This room was similar to the faculty lounge, as it was quiet and isolated. It was an environment free from distraction of noise, however it was small and incredibly cluttered. Teacher C was also just getting done with her lunch break, so she could have felt rushed to get back to her students, despite her position in the classroom being covered. In future replications of this study, the researcher could consider overestimating and setting a minimum time period the teacher will be given to complete the card sort. This will encourage the teacher to continue to look back at how they sorted the standards, further justifying their reasoning, because they know otherwise they will be sitting there doing absolutely nothing until the minimum time is up, allowing them to question themselves.

The time in which the card sorts were completed is a limitation for a few reasons. Each was completed on a different day due to days off as well as substitute teacher availability. The availability of the teachers need to match up with the availability of the center, which needed to match up with the researcher’s availability, and this was in the best case scenario. The card sorts were not all filmed on the
same date, meaning some teachers experienced the card sort prior to others, enabling the possibility for
the teachers who and completed the task to discuss with one another about what to expect or how to
prepare. Also over this time, the teachers could have developed more knowledge of the standards,
whether because of professional developments attended, their own research, or even simply because of
exposure in implementation. In future replications of this study, it is crucial to complete all of the card
sorts on the same day and in a timely manner. The closer the card sorts are to the beginning of the study,
the more accurate they will be in assessing knowledge prior to implementation. It might also be
interesting for the researcher to conduct this card sort again at the end of the study to assess how the
teacher’s knowledge was affected dependent upon the amount of implementation

**Interviews.** Two different types of interviews were conducted with the participants; an opening
interview and a follow-up interview. The five month time span between conducting the interviews, the
paired opening interviews, and the cross-over of two follow-up interviews are significant limitations in
this study.

The five months time between the opening and follow-up interviews is a limitation for a variety
of reasons. During this five months, the participants may have learned a significant amount about the
standards than they had known at the time of the opening interview. There may have been professional
developments, either set up by the center or sought out by the participants, that the participants attended
to become more knowledgeable of the standards.

In future replications of this study, the researcher will set specific dates for each instrument and
communicate them to participants in advance of the study.

Another limitation of this study was that the opening interviews were conducted with pairs of
participants instead of individual participants. The intent of the researcher was to conduct all interviews
with each participant individually. The researcher arrived on the first day to conduct the opening
interviews with each individual participant, however, the participants were expecting to complete the
interviews in pairs because their director provided substitute teachers for each pair of classroom teachers and expected the participants back in their classrooms quickly.

The opening interviews were conducted twice. Once with the PK1 teachers and again with the PK2 teachers. Throughout each of these interviews, it seemed that both participants talked, but while transcribing, the researcher heard one participant in each interview significantly more than the other.

This is a limitation because one of the participants did not share as much as the others. She verbally agreed with the other participant in her interview, but she did not elaborate on her agreement or thoughts. It is possible that if this participant was interviewed independently she may have had slightly different response to the questions. The researcher was unable to completely triangulate the data from this participant because the open interview data were limited.

In future replications of this study, it would be important that the researcher interviewed each participant separately in order to get the specific ideas on teaching of each participant. It is important to isolate the responses of each teacher to ensure the information for each teacher is clear.

The interruption during Teacher A’s follow-up interview is a limitation for a few reasons. While conducting the follow up interview for Teacher A, Teacher B walked into the faculty lounge and provided her own thoughts on the questions about how the Sunshine Preschool was beginning to implement the standards this year.

There are two issues with Teacher B interrupting the interview with Teacher A and providing her own responses. First, this portion of Teacher A’s interview was no longer private and confidential. The public nature of the interview might have influenced how Teacher A responded to the question and how she might have felt during the remainder of the interview. The second issue was that Teacher A’s answers might have been influenced by Teacher B’s responses. It is possible that if Teacher B not walked in during the interview, each participant might have taken more time to explain her thinking as opposed to summarizing, generalizing, or agreeing with one another.
In future replications of this study, the researcher needs to make it clear to participants that the interviews will be completed individually. It would be good for the researcher to set specific times for the interviews and to explain to the other participants that the researcher will tell each participant when she is ready for their interview to be conducted.

**Short Mathematics Assessments.** Each teacher was asked to complete a short mathematics assessment. It was intended for the participants to take the mathematics assessment individually and in the presence of the researcher. In reality, the researcher acknowledged the anxiety of the participants to take the assessment in front of her and, as a result, she allowed the participants to take the short mathematics assessments home to be completed. The participants were instructed to complete the assessment independently and to call the researcher if they preferred to explain their answers aloud rather than write them down. Only two participants returned the assessment to the researcher by the end of the study. Allowing the participants to take the assessments home and only receiving half of the tests back are significant limitations in this study.

Giving the participants the short mathematics assessments to take with them was a significant limitation of this study. For instance, the teachers could have discussed the assessment with each other or anyone else they came in contact with while in possession of the assessment. As a result, the researcher cannot be sure the assessments were completed individually and therefore, unsure that the data gathered from the assessments reflects the knowledge of only the study participants.

The other major limitation was that only two assessments were returned to the researcher. The researcher collected math assessments from Teacher B and Teacher C, but not the other two subjects. This resulted in analysis of the two returned assessments and limited the results for Research Questions 2 and 3 for the participants who did not return the assessments.

In future replications of this study, the researcher would schedule times to conduct the mathematics assessment with individual participants. She might even conduct this assessment more like an interview than an assessment. Structuring the assessment as a conversation might ease the participants’
anxiety and provide the researcher with more data than what was gathered during this study. Or, the researcher would ensure that the participants were given an ample amount of time to read and think through their responses in a calm and quiet environment. The assurance of time will allow anxiety or nerves to lower, as the participants will have ample amount of time to think about the questions and their responses. Also to be done in future replications of this study, is for the researcher to provide a specific date for collecting the assessment, if it is decided the participants will take the short mathematics assessments home. The participants would be informed that they would be completing the assessment when the researcher returned, if the assessment was not ready to be turned in. This way, participants will be held accountable for finishing the assessment.

**Video Observation.** Each teacher was asked to film their mathematics instruction for no more than one hour per day for three weeks. The video observations were a source of limitations in this study. One limitation was the amount of instruction recorded by the participants. This was a limitation because the participants had difficulty filming each day of the week. The camera was a distraction to the children and the tripod was not “safe” around the children. Therefore the data collected did not capture the entire classroom or the entire area where mathematics was being taught.

Another limitation was that the teachers selected when and what they recorded. Even though the researcher instructed the participants record mathematics one hour per day for three weeks, the recordings did not reflect that this was what happened. This is a limitation because the data reflected edited versions of what was taught rather than a random sampling of the participants’ teaching. It is possible that the results for Research Question 3 were skewed because it is possible that the videos did not represent authentic teaching of each teacher, but instead days and lessons where the participants made sure to add in the standards and address specific standards throughout the lesson.

Also, the video observations were limited because not all of the participants were videotaped the same amount. Therefore, the researcher had an unequal amount of data about the participants’ teaching.
This difference in the amount of data is a limitation because it could impact the results that were found for each participant and the final conclusions of this study as a whole.

In future replications of this study, the researcher needs to personally videotape each teacher’s mathematics instruction. The researcher also needs to help the kids familiarize themselves with the camera so that it becomes less of a distraction over time.
Chapter 4

Results

Research Question 1

*What do preschool teachers’ know of the PA Early Learning Standards for Mathematics?*

The researcher found that half of the participants had a strong (<85%) working knowledge of the PA Early Learning Standards for Mathematics and half had an average (50% to 84%) level of knowledge of the PA Early Learning Standards.

To answer this question, the researcher investigated the knowledge each teacher had of the PA Early Learning Standards for Mathematics by conducting a card sort with each participant.

**General Descriptions of Participants’ Knowledge of PA Early Learning Standards**

**Cardsorts**

Each participant was asked to individually complete a card sort of the PA Early learning standards, in which they would sort the standards into one of the four domains they felt appropriate (see Figure 2).

Teacher A accurately placed eleven of the twelve standards in their appropriate domains, with an accuracy of 92%. She incorrectly placed, “Use mathematical processes when quantifying, comparing, representing, and modeling numbers,” a Numbers and Operations standard, in the Algebraic Concepts domain.

Teacher B correctly placed nine of the twelve standards in their appropriate domains, with an accuracy of 75%. She incorrectly placed, “Use mathematical processes when quantifying, comparing, representing, and modeling numbers,” a Numbers and Operations standard, in the Algebraic Concepts domain. She incorrectly placed, “Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from,” an Algebraic Concepts standard, in the Numbers and Operations domain. She incorrectly placed, “Classify objects and count the number of objects in each category,” a Measurement, Data, and Probability standard, in the Numbers and Operations domain.
Teacher C correctly placed eight of the twelve standards in their appropriate domains, with an accuracy of 67%. She incorrectly placed, “Count to tell the number of objects,” a Numbers and Operations standard, in the Algebraic Concepts domain. She incorrectly placed, “Compare numbers,” a Numbers and Operations standard, in the Measurement, Data, and Probability domain. She incorrectly placed, “Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from,” an Algebraic Concepts standard, in the Numbers and Operations domain. She incorrectly placed, “Classify objects and count the number of objects in each category,” a Measurement, Data, and Probability standard, in the Numbers and Operations domain.

Teacher D correctly placed eleven of the twelve standards in their appropriate domains, with an accuracy of 92%. She incorrectly placed, “Classify objects and count the number of objects in each category,” a Measurement, Data, and Probability standard, in the Numbers and Operations domain.

Figure 2. Cardsort Findings

<table>
<thead>
<tr>
<th>Cardsort Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher A</strong></td>
</tr>
<tr>
<td>Numbers and Operations</td>
</tr>
<tr>
<td>Know number names and the count sequence.</td>
</tr>
<tr>
<td>Count to tell the number of objects.</td>
</tr>
<tr>
<td>Compare numbers.</td>
</tr>
<tr>
<td>Use mathematical processes when quantifying, comparing, representing, and modeling numbers.</td>
</tr>
<tr>
<td>Algebraic Concepts</td>
</tr>
<tr>
<td>Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.</td>
</tr>
<tr>
<td>Use mathematical processes when representing relationships.</td>
</tr>
<tr>
<td>Geometry</td>
</tr>
<tr>
<td>Identify and describe shapes.</td>
</tr>
<tr>
<td>Analyze, compare, create, and compose shapes.</td>
</tr>
<tr>
<td>Use mathematical processes when drawing, constructing, modeling, and</td>
</tr>
</tbody>
</table>
Based on the results of the card sort activity, the researcher gathered information pertaining to the educational background and teaching experiences of each teacher in the study. She used the educational background and teaching experiences to further investigate the discrepancies among the participants’ knowledge of the PA Early Learning Standards for Mathematics.

**Participants’ Educational Background and Teaching Experience**

**Years Teaching**

Each participant was asked how many years they have been teaching. Teacher A has been a teacher for a little over a year (see Figure 3). Teacher B has been teaching for seventeen years. Teacher C has been teaching for three years. Teacher D has been teaching for eleven years.

**Preschool Experience**

Each participant was asked how many years of preschool experience they have had. Teacher A has had experience with preschool students for two years (see Figure 4). Teacher B has had experience with children for approximately thirteen years. Teacher C has had experience with preschool students for two years. Teacher D has had experience with preschool students for eleven years.
Preschool Experience

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher A</td>
<td>2 years</td>
</tr>
<tr>
<td>Teacher B</td>
<td>Approximately 13 years</td>
</tr>
<tr>
<td>Teacher C</td>
<td>2 years</td>
</tr>
<tr>
<td>Teacher D</td>
<td>11 years</td>
</tr>
</tbody>
</table>

Educational Background

Each participant was asked to describe their educational background (See Figure 5). All four of the participants attended a public high school. Teacher A received Bachelor’s degrees in both Early Childhood Education and Special Education over the course of four years. Teacher B went to college and received her Associate’s degree in Early Childhood Education. Teacher C received her Bachelor’s degree in Early Education. Teacher D went on to obtain her Child Development Associate Credential (CDA).

Educational Experience

<table>
<thead>
<tr>
<th>Degree Level</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Teacher C</th>
<th>Teacher D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highschool</td>
<td>Public</td>
<td>Public</td>
<td>Public</td>
<td>Public</td>
</tr>
<tr>
<td>CDA</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>Associate's</td>
<td>N/A</td>
<td>(1) Early Childhood Education</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Bachelor's</td>
<td>(1) Early Childhood Education (2) Special Education</td>
<td>N/A</td>
<td>(1) Early Education</td>
<td>N/A</td>
</tr>
<tr>
<td>Masters</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Experience Working with Children

Each participant was asked to describe her experiences working with children (See Figure 6). Teacher A has been working with children for eight years. In high school, she was a part of a program that enabled her to observe, working similarly to a teacher’s aid in various elementary classrooms. In college, she taught in seven different schools at a variety of grade levels, including two preschools, one kindergarten, two first grade and a second grade classroom. Teacher A has worked in regular education settings, emotional support rooms, and autistic support. Teacher B has been working with children for seventeen years. For four years, she worked in an autistic inclusion classroom with children between the ages of seven and ten years old. For the other thirteen years, she has worked primarily with preschool
students. Teacher B has also worked in regular education settings. Teacher C has worked primarily with preschool students, however, she has also had experience with children in kindergarten, second grade, and fourth grade. Teacher D has been working with children for eleven years. Until she working at the Sunshine Preschool, she worked in the preschool room at the YMCA.

Figure 6. Summary of Experience Working with Children

<table>
<thead>
<tr>
<th>Experience Working with Children</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher A</strong></td>
</tr>
<tr>
<td>1.) 8 years</td>
</tr>
<tr>
<td>2.) High school Elementary Observations Program</td>
</tr>
<tr>
<td>- Similar to a teacher's aid.</td>
</tr>
<tr>
<td>3.) College</td>
</tr>
<tr>
<td>- Taught in 7 different schools.</td>
</tr>
<tr>
<td>- Observational hours and projects in PK &amp; K.</td>
</tr>
<tr>
<td>4.) Experience in 2 PKs, 1 K, 2 first grades, a second grade.</td>
</tr>
<tr>
<td>5.) Regular education, emotional support, and autistic support.</td>
</tr>
<tr>
<td><strong>Teacher B</strong></td>
</tr>
<tr>
<td>1.) 17 years</td>
</tr>
<tr>
<td>2.) Primarily PK students</td>
</tr>
<tr>
<td>3.) Regular education</td>
</tr>
<tr>
<td>4.) Autistic inclusion education (ages 7-10 years)</td>
</tr>
<tr>
<td><strong>Teacher C</strong></td>
</tr>
<tr>
<td>1.) Primarily PK students</td>
</tr>
<tr>
<td>2.) Experience in PK, K, second grade, and fourth grade.</td>
</tr>
<tr>
<td><strong>Teacher D</strong></td>
</tr>
<tr>
<td>1.) 11 years</td>
</tr>
<tr>
<td>2.) YMCA preschool room</td>
</tr>
</tbody>
</table>

**Professional Development Events Attended**

Each participant was asked to describe the professional development event she had attended (see Figure 7). Teacher A found the reading professional development to be particularly impactful, as she learned about different things to do when reading a book to get children engaged. She stated that she benefits more from the professional development events that were based on teaching strategies as opposed to policies. She seeks out experiences in which she is being taught different skills and methods to use with children that are most beneficial to her students. Teacher A attends professional development events through the Sunshine Preschool once a month.

Teacher B specifically mentioned a block play as well as an Iters and Ecers professional development she participated in through the Sunshine Preschool. It showed her what she needed for her
classroom, ensuring everything was developmentally appropriate for each subject she teaches. Teacher B attends professional developments through the Sunshine Preschool once a month.

Teacher C also attended the block play and the Iters and Ecers professional development through the Sunshine Preschool. It showed her what she needed for her classroom, ensuring everything was developmentally appropriate for each subject she teaches. As far as mathematics professional developments are concerned, she took a college course that taught her about the “new version” of math. Teacher C attends professional developments through the Sunshine Preschool once a month.

Teacher D has attended the Sunshine Preschool’s new orientation and curriculum trainings. It showed her what she needed for her classroom, ensuring everything was developmentally appropriate for each subject she teaches. She specifically mentioned doing a lot of professional development about storytelling and rhymes. She seeks out experiences in which she is being taught different skills and methods to use with children that are most beneficial to her students. Teacher D attends professional development events through the Sunshine Preschool once a month.

Figure 7. Summary of Professional Development Events Attended

<table>
<thead>
<tr>
<th>Professional Development Events Attended</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher A</strong></td>
</tr>
<tr>
<td>1.) Sunshine PK new orientation</td>
</tr>
<tr>
<td>2.) Curriculum Trainings</td>
</tr>
<tr>
<td>3.) Birthday Trainings</td>
</tr>
<tr>
<td>4.) All the Kids Cares</td>
</tr>
<tr>
<td>5.) Health and Safety</td>
</tr>
<tr>
<td>6.) Literature</td>
</tr>
<tr>
<td>7.) Reading</td>
</tr>
<tr>
<td><strong>Teacher B</strong></td>
</tr>
<tr>
<td>1.) Block Play</td>
</tr>
<tr>
<td>2.) Iters and Ecers Course</td>
</tr>
<tr>
<td><strong>Teacher C</strong></td>
</tr>
<tr>
<td>1.) Block Play</td>
</tr>
<tr>
<td>2.) Iters and Ecers Course</td>
</tr>
<tr>
<td>3.) Math Methods (College)</td>
</tr>
<tr>
<td><strong>Teacher D</strong></td>
</tr>
<tr>
<td>1.) Sunshine PK new orientation</td>
</tr>
<tr>
<td>2.) Curriculum Trainings</td>
</tr>
<tr>
<td>3.) Birthday Trainings</td>
</tr>
<tr>
<td>4.) All the Kids Cares</td>
</tr>
<tr>
<td>5.) Health and Safety</td>
</tr>
<tr>
<td>6.) Literature</td>
</tr>
<tr>
<td>7.) Reading</td>
</tr>
<tr>
<td>8.) Storytelling</td>
</tr>
<tr>
<td>9.) Rhymes</td>
</tr>
<tr>
<td>10.) Block Play</td>
</tr>
</tbody>
</table>

Summary of Findings

We found that Teachers A and D accurately placed 92% of the PA Early Learning Standards. Teacher B correctly placed 75% of the PA Early Learning Standards. Teacher C correctly placed 67% of the PA Early Learning Standards.
Teacher B has an Associate’s degree in Early Childhood Education and has taught for 17 years, the most out of all of the participants. Teacher D has a CDA and has taught for 11 years. Teacher C has a Bachelor’s in Early Education and taught for three years, while Teacher A has a dual degree and certification in Early Childhood and Special Education and was in her first year of teaching.

With regards to professional development attendance, Teacher D has attended the most with 10. Teacher A attended seven professional development events, many of which overlapped with those attended by Teacher D. Teacher C recalled attending two professional development events and also discussed her math methods course as being of importance for her own math learning. Teacher B recalled attending the same two professional development events as Teacher C over the past year. Teacher B did not recall all of the sessions she had attended over the last 17 years.

Research Question 2

Do preschool teachers implement the PA Early Learning Standards for Mathematics?

We found that the answer to Research Question 2 was not cut and dry. There were times that the participants did implement the PA Early Learning Standards for Mathematics and there were times when the participants did not.

General Descriptions of Teacher Planning & Implementation of Tasks

In their classrooms, the participants worked together to plan and prepare mathematics lessons each week. The following data showcase each teacher’s intended goal for a particular mathematics task, the actual standard/domain taught, and the reason that the teacher selected a particular standard/domain for the task. The data also include any mathematically-aligned terminology that the teacher used when describing her goals for each task. The data are presented first in a chart and then expanded upon in narrative form, for each study participant.

Teacher A
During the closing interview, Teacher A identified the intended instructional goal and standard/domain being addressed during for each lesson filmed that she taught. Figure 8 shows the evidence gathered from Teacher A’s responses during her closing interview.

Figure 8. Intended Goals of Tasks for Teacher A

<table>
<thead>
<tr>
<th>Task</th>
<th>Descriptive Words</th>
<th>Overarching Goal of Lesson</th>
<th>Standard/Domain</th>
<th>Reasoning for standard/domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>Patterns, working on AB</td>
<td>Students will be able to complete and AB pattern.</td>
<td>(1) Numbers and Operations (2) Algebraic Concepts</td>
<td>(1) It's the ABA, the one two pattern. (2) Concepts- getting the patterns there.</td>
</tr>
<tr>
<td>Task 2</td>
<td>Shapes, fine motor, roll the ball, how many sides the shape had, difference between shapes</td>
<td>Students will be able to differentiate between different shapes.</td>
<td>(1) Geometry</td>
<td>(1) Students had to count the sides of shapes and identify which shape it was.</td>
</tr>
<tr>
<td>Task 3</td>
<td>Cardinality, one to one</td>
<td>Counting.</td>
<td>(1) Numbers and Operations</td>
<td>(1) The student was counting the objects and then putting them into circles.</td>
</tr>
<tr>
<td>Task 4</td>
<td>Non standard unit of measure, counting, predicting.</td>
<td>Measuring with non standard measures.</td>
<td>(1) Measurement, Data, and Probability (2) Numbers and Operations</td>
<td>(1) Measuring with snakes; data because of predicting how many snakes. (2) Counting how many snakes.</td>
</tr>
<tr>
<td>Task 5</td>
<td>Sorting, colors</td>
<td>Identify the differences between the colors.</td>
<td>(1) Numbers and Operations</td>
<td>(1) Sorting colors.</td>
</tr>
<tr>
<td>Task 6</td>
<td>Shapes, trains, tracks</td>
<td>Identify the shapes and their number of sides.</td>
<td>(1) Geometry</td>
<td>(1) Students were asked to have their train go around the track (the sides of the shapes) and then state how many sides there were and what shape it was.</td>
</tr>
<tr>
<td>Task 8</td>
<td>Shapes, art project, foam shapes</td>
<td>Originally the goal was just making art with the foam shapes. Teachers took advantage of the fact that the student sorted their foam shapes on their paper.</td>
<td>(1) Geometry</td>
<td>(1) Student was identifying shapes and their colors.</td>
</tr>
</tbody>
</table>
Teacher A taught 9 of the 10 tasks that were filmed in her classroom. Since she was not the lead teacher for Task 5, the row was blacked-out in the chart.

For Task 1, Teacher A stated the overarching goal of the task was to complete an AB pattern. She said the domains addressed by this activity were (1) Numbers and Operations and (2) Algebraic Concepts, “because of the ABA, one two pattern.”

During the implementation of Task 1, one out of the four standards under the Number and Operations domain was taught: Use mathematical processes when quantifying, comparing, representing, and modeling numbers. The participant demonstrated listening to the responses of her students, restating students’ responses in age-appropriate ways, addressing students’ misconceptions, modeling appropriate mathematical language when reasoning through a task, and utilizing think alouds. She also recognized the importance of using manipulatives to solve the task.

When it came to implementing the standards under the intended domain, Algebraic Concepts, none of the two standards were implemented in practice (PA Early Learning Standards, 2014).

For Task 2, Teacher A stated the overarching goal of the lesson was being able to differentiate between different shapes. She said the domain addressed by this activity was (1) Geometry because, “students had to count the sides of the shapes and identify which shape it was.”

During the implementation of Task 2, two out of the three standards under Geometry were implemented: (1) Identify and Describe Shapes and (2) Analyze, Compare, Create, and Compose Shapes. Teacher A used the names of each of the shapes explicitly and modeled her thinking about the different
properties of each shape. She also provided children with multiple opportunities to compare the different shapes during and after the task (PA Early Learning Standards, 2014).

For Task 3, Teacher A stated the overarching goal of the lesson was counting. She said the domain being addressed by this activity was (1) Numbers and Operations because, “the student was counting objects and then putting them into circles.”

During the implementation of Task 3, Teacher A met 2 of the 4 standards under the domain, Numbers and Operations: (1) Count to tell the number of objects and (2) Compare numbers. For standard 1, she provided carefully selected manipulates and modeled strategies for counting. For standard two, Teacher A provided opportunities for the student to count the objects at their own pace, multiple times if necessary and modeled the differences in the numbers.

For Task 4, Teacher A stated the overarching goal of the lesson was measuring with non-standard measures. She said the domains addressed by this activity were (1) Measurement, Data, and Probability and (2) Numbers and Operations because, “students were measuring with snakes, making predictions about the number of snakes to be used, and counting the number of snakes used.”

During the implementation phase, one out of the three standards in the Measurement and Data domain were implemented: (1) Describe and compare measureable attributes of length and weights of everyday objects. She modeled the use of measuring with non-standard items, ensures the availability of measuring tools in students’ everyday play, and asks questions about measurement with students.

Under the Numbers and Operations domain, three out of the four standards were implemented: (1) Count to tell the number of objects, (2) Compare numbers, and (3) Use mathematical processes when quantifying, comparing, representing, and modeling numbers. She provided manipulates and modeled different ways in which students can count, as well as made opportunities available to students for quantifying objects.
For Task 6, Teacher A stated the overarching goal of the lesson was to identify the differences between colors. She said the domain addressed by this activity was (1) Numbers and Operations because, “the students had to sort the different colors.”

None of the standards under the Numbers and Operations domain were actually implemented during instructional time. Task 6 did not actually met any of the PA Early Learning Standards for Mathematics. It is possible that this task met a preschool requirement that predated the PA Early Learning Standards.

For Task 7, Teacher A stated the overarching goal of the lesson was to identify shapes and their number of sides. She said the domain addressed by this activity was (1) Geometry because, “students were asked to have their train go around the “train track,” the sides of the shapes, and then state how many sides there were and what shape it was.”

During implementation of the Geometry domain, two out of the three standards were implemented: (1) Identify and describe shapes and (2) Analyze, compare create, and compose shapes. She used the names of each shapes, provided examples of the shapes taped on the floor for students to go over with their train, and modeled naming of the shapes. She created a task that allowed students to see the differences in a variety of shapes and made these shapes available to students following the introduction of the task.

For Task 8, Teacher A stated the overarching goal of the lesson was originally just making art with the foam shapes, but then a student sorted the foam shapes on their paper so they used it as a teachable moment. She said the domain addressed by this activity was (1) Geometry because, “the student was identifying shapes and their colors.”

Teacher A did not implement any of the standards during the implementation phase of Task 8. While Teacher A did provide a template of the shapes (one of five performance objectives under the Identify and Describe Shapes standard), this one performance objective did not comprehensively meet the criteria for any of the standards under the domain of Geometry.
For Task 9, Teacher A stated the overarching goal of the lesson was to distinguish between standard and non-standard measurement. She did not state which domain this activity addressed, therefore, the researcher did not know which domain was to be implemented during the lesson.

For Task 10, Teacher A stated the overarching goal of the lesson was to decipher between and sort small, medium, and large pictures of objects. She said the domain addressed by this activity was (1) Measurement, Data, and Probability because, “it’s a different kind of measurement.”

When it came to implementing the standards of the intended domain, Measurement, Data, and Probability, none of the three standards were implemented. Task 10 was representative of prerequisite knowledge for comparing length (i.e., putting pictures of objects in order by size).

Overall, Teacher A taught 9 mathematical tasks and ten of twelve PA Early Learning Standards for Mathematics, during the data collection phase of this study. She taught three of the four standards under Number and Operations. She taught one of the two standards under Algebraic Concepts. She taught all three of the standards under Geometry. She taught all three of the standards under Measurement, Data, and Probability.

**Teacher B**

During the closing interview, Teacher B was asked to identify the goal she had intended for each task filmed that she taught, as well as the standard or domain being addressed by the activity. Figure 9 shows the evidence gathered from Teacher B’s responses during her closing interview.

Figure 9. Intended Goals of Tasks Taught by Teacher B.

<table>
<thead>
<tr>
<th>Descriptive Words</th>
<th>Overarching Goal of Lesson</th>
<th>Standard/Domain</th>
<th>Reasoning for standard/domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 1</strong></td>
<td>Discriminate between letters and numbers, number recognition, counting, one to one correspondence, length, measurement, small, medium, large, adding, one to one correspondence,</td>
<td>Addition</td>
<td>(1) Numbers and Operations (2) Measurement, Data, and Probability</td>
</tr>
</tbody>
</table>
Teacher B taught 2 of the 4 tasks that were filmed in her classroom. Since she was not the lead teacher for Tasks 2 or 4, those rows were blacked-out in the chart.

For Task 1, Teacher B stated the overarching goal of the task was addition. She said the domains addressed by this activity were (1) Numbers and Operations and (2) Measurement, Data, and Probability because, “the task focused on number recognition, counting, and one to one correspondence.”

During the implementation phase, Teacher A met three out of the four standards were implemented, under the domain, Numbers and Operations: (1) Count to tell the number of objects, (2) Compare numbers, and (3) Use mathematical processes when quantifying, comparing, representing, and modeling numbers. She provided manipulatives for the students and modeled how they could assist students with counting. She used mathematically precise vocabulary throughout explanations and discussions, as well as when asking open-ended questions and facilitating mathematical discourse. She modeled reasoning and thought out loud so students could be one with her thought processes.

For Measurement, Data, and Probability, Teacher B met one out of the three standards, during the implementation phase: (1) Use mathematical processes when measuring, representing, organizing, and understanding data. She engaged children in the task and asked open-ended questions to gauge students understanding, as well as allow them to think through their processes. She modeled her thinking as well, out loud, to aid students in following her processes.

For Task 3, Teacher B stated the overarching goal of the lesson was subtraction. She did not state the domain being addressed by this activity, therefore, the researcher could not determine whether or not the intended domain was met during the implementation of Task 3.
Overall, Teacher B taught two mathematical tasks and met one of the twelve PA Early Learning Standards for Mathematics. She taught one of the three standards from the Measurement, Data, and Probability domain.

**Teacher C**

During the closing interview, Teacher C was asked to identify the goal she had intended for each lesson filmed that she taught, as well as the standard or domain being addressed by the activity. Figure 10 shows the evidence gathered from Teacher C’s responses during her closing interview.

Figure 10. Intended Goals for Tasks Teacher C Taught.

<table>
<thead>
<tr>
<th>Task</th>
<th>Descriptive Words</th>
<th>Overarching Goal of Lesson</th>
<th>Standard/Domain</th>
<th>Reasoning for standard/domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 2</td>
<td>Counting, being able to count each person, addition problem, classification, knowing the difference between boys and girls</td>
<td>Counting and Classification</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Task 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 4</td>
<td>Longer, taller</td>
<td>N/A</td>
<td>(1) Numbers and Operations (2) Measurement, Data, and Probability</td>
<td>(1) Finding the numbers. (2) Measuring which boat was bigger.</td>
</tr>
</tbody>
</table>

Teacher C taught 2 of the 4 tasks that were filmed in her classroom. Since she was not the lead teacher for Tasks 1 or 3, those rows were blacked-out in the chart.

For Task 2, Teacher C stated the overarching goal of the lesson was counting and classification. She did not identify the domain addressed by this activity, therefore, the researcher could not determine whether or not the intended domain was met during the implementation of Task 2.

For Task 4, Teacher C did not state the overarching goal of the lesson. She said the domains addressed by this activity were (1) Numbers and Operations and (2) Measurement, Data, and Probability because, “students were finding the numbers and measuring which boat was bigger.”
During the implementation phase of Task 4, three out of the four standards under the Numbers and Operation domain were implemented: (1) Count to tell the number of objects, (2) Compare numbers, and (3) Use mathematical processes when quantifying, representing, and modeling numbers. She provided manipulates for students and modeled their use in the counting task. She enabled to students to not only count, but also recount the objects in front of them. She taught using mathematical vocabulary, such as smaller, larger, greater than, less than, equal to, etc.

One out of the three standards under the Measurement, Data, and Probability domain were implemented for Task 4: (1) Use mathematical processes when measuring, representing, organizing, and understanding data. She created a task to engage her students and asked open-ended questions to further their thinking. She modeled the use of mathematical language and utilized thinking out loud to set an example for her students and share with them her processes. She set up the task in a way that allowed students to observe and hear the thought processes of their peers.

Overall, Teacher C taught 2 mathematical tasks for video recording and she met four of twelve total standards. She met three of the four standards for Numbers and Operations. She met one of the three standards under Measurement, Data, and Probability.

Teacher D

During the closing interview, Teacher D was asked to identify the goal she had intended for each lesson filmed that she taught, as well as the standard or domain being addressed by the activity. Figure 11 shows the evidence gathered from Teacher D’s responses during her closing interview.

Figure 11. Intended Goals for Tasks Teacher D Taught.
Teacher D taught 1 of the 10 tasks that were filmed in her classroom.

For Task 5, Teacher D did not state the overarching goal of the lesson. She said the domains addressed by this activity were (1) Measurement, Data, and Probability and (2) Geometry because “students were looking at the shapes and fitting them all together.”

When it came to implementing the standards of the intended domain, Measurement, Data, and Probability, none of the standards were implemented. When it came to implementing the standards of the intended domain, Geometry, none of the standards were implemented. The activity that was implemented for Task 5 was puzzles. While puzzles provide children with opportunities to talk about shapes and engage in problem solving, this type of conversation was not had during this task.

Overall, Teacher D taught 1 task during the data collection phase of this study. She did not implement any of the domains that she intended to teach during the recorded lesson.

**Summary of Findings**

In summary, out of all of the participants Teacher A implemented the standards most often, with nine out of the twelve PA Early Learning Standards being observed. Teacher C taught four of the twelve standards. Teacher B taught one of the twelve standards. Teacher D taught none of the standards.

**Research Question 3**

*Do teachers with more knowledge of the PA Early Learning Standards for Mathematics implement richer mathematics instruction than teachers with less knowledge of the PA Early Learning Standards for Mathematics?*
We found that having more knowledge of the PA Early Learning Standards did not necessarily mean that participants implemented richer mathematics instruction.

**General Descriptions of Participants’ Knowledge of Learning Standards**

**Teacher A**

Teacher A had a strong working knowledge of Algebraic Concepts, Geometry, and Measurement, Data, and Probability as indicated by her ability to sort the standards into the correct domain at a rate of 100%. Teacher A had a limited working knowledge of Numbers and Operations as shown by her 75% correct placement rate (See Figure 12).

**Teacher B**

Teacher B had a strong working knowledge of Geometry as indicated by her correct placement rate of 100%. She had an average working knowledge of Numbers and Operations as indicated by her correct placement rate of 75%. Teacher B got a 66.7% correct placement of standards in Measurement, Data, and Probability and 50% correct under Algebraic Concepts (See Figure 12).

**Teacher C**

Teacher C had a strong working knowledge of Geometry as indicated by her correct placement rate of 100%. Her next highest score was a 66.7% correct placement of standards in Measurement, Data, and Probability. She correctly placed 50% of the standards under Algebraic Concepts and Number and Operations (See Figure 12).

**Teacher D**

Teacher D had a strong working knowledge of Algebraic Concepts, Geometry, and Number and Operations as indicated by a 100% correct placement rate. She correctly placed 66.7% of the standards under Measurement, Data, and Probability (See Figure 12).

**General Descriptions of Task Richness for Each Participant**

**Teacher A**
For Task 1, Teacher A exhibited four of the nine areas of richness (as defined in Chapter 1), making her task the task 44.4% rich. She engaged students in the task, as well as carefully selected, used, and adapted manipulatives. The task built upon the students prior knowledge and questioning was used in a manner that engaged students and furthered their understanding.

For Task 2, Teacher A exhibited three of the nine areas of richness, making the task 33.3% rich. She carefully selected, used, and adapted manipulates as well as built upon students’ prior knowledge. The task encouraged students to focus on the process they were going through as opposed to the result.

For Task 3, Teacher A exhibited two of the nine areas of richness, making her task 22.2% rich. She carefully selected, used, and adapted manipulates as well as ensured the focus to be on the process students were going through, as opposed to the result.

For Task 4, Teacher A exhibited three of the nine areas of richness, making the task 33.3 % rich. She engaged the students in the task, as well as carefully selected, used, and adapted manipulatives. The task built upon students’ prior knowledge.

For Task 6, Teacher A exhibited six of the nine areas of richness, making the task 66.7% rich. She engaged students in the task, as well as carefully selected, used, and adapted manipulatives. The task built upon students’ prior knowledge. She used questioning to engage students and further their understanding. Students worked in a collaborative manner, exchanging ideas with their peers. The task allowed students to talk and work through their own thought processes.

For Task 7, Teacher A exhibited two of the nine areas of richness, making the task 22.2% rich. She engaged students in the task, as well as carefully selected, used, and adapted manipulatives.

For Task 8, Teacher A exhibited two of the nine areas of richness, making the task 22.2 rich. She engaged the students in the task, as well as directed the focus to the processes as opposed to the results.

For Task 9, Teacher A exhibited three of the nine areas of richness, making the task 33.3% rich. She carefully selected, used, and adapted manipulatives as well as built upon students’ prior knowledge. She used questioning to engage students and further their understanding.
For Task 10, Teacher A exhibited two of the nine areas of richness, making the task 22.2% rich. She carefully selected, used, and adapted manipulatives. She used questioning to engage students and further their understanding.

**Teacher B**

For Task 1, Teacher B exhibited seven of the nine areas of richness, making the task 77.7% rich. She engaged students in the task and carefully selected, used, and adapted manipulatives. The task built upon students’ prior knowledge. Confusions of students were anticipated and addressed adequately. She used questioning to engage students and further their understanding. She ensured the focus was on the process students were going through as opposed to the result. The task allowed students to talk and work through their own thought processes.

For Task 3, Teacher B exhibited six of the nine areas of richness, making the task 66.7% rich. She engaged students in the task and carefully selected, used, and adapted manipulatives. The task built upon students’ prior knowledge. She used questioning to engage students and further their understanding. She ensured the focus was on the process students were going through as opposed to the result.

**Teacher C**

For Task 2, Teacher C exhibited six of the nine areas of richness, making the task 66.7% rich. She engaged students in the task and carefully selected, used, and adapted manipulatives. The task built upon students’ prior knowledge. Confusions of students were anticipated and addressed adequately. She used questioning to engage students and further their understanding. Students worked in a collaborative manner, exchanging ideas with their peers.

For Task 4, Teacher C exhibited six of the nine areas of richness, making the task 66.7% rich. She engaged students in the task and carefully selected, used, and adapted manipulates. The task built upon students’ prior knowledge. She used questioning to engage students and further their understanding. Students worked in a collaborative manner, exchanging ideas with their peers. She ensured the focus was on the process students were going through as opposed to the result.
Teacher D

For Task 5, Teacher D exhibited two of the nine areas of richness, making the task 22.2% rich. She used questioning to engage students and further their understanding. She ensured the focus was on the process students were going through as opposed to the result.

Comparing Knowledge of Standards with Richness of Instruction

Figure 12 displays the data of each participant’s knowledge of the PA Early Learning standards, the number of tasks each participant taught, and the average richness [rich is classified as < 95%, average is classified as 50% - 84%] of the tasks taught by each participant.

Figure 12. Summary of Research Question 3 Results

<table>
<thead>
<tr>
<th>Research Question 3</th>
<th>Percent of Standards Correct</th>
<th>Number of Tasks Taught</th>
<th>Average Richness Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher A</td>
<td>92.00%</td>
<td>9</td>
<td>33.00%</td>
</tr>
<tr>
<td>Teacher B</td>
<td>75.00%</td>
<td>2</td>
<td>72.20%</td>
</tr>
<tr>
<td>Teacher C</td>
<td>67.00%</td>
<td>2</td>
<td>66.70%</td>
</tr>
<tr>
<td>Teacher D</td>
<td>92.00%</td>
<td>1</td>
<td>22.20%</td>
</tr>
</tbody>
</table>

Teacher A correctly placed 92% of the PA Early Learning Standards for Mathematics under their respective domains. The average richness score of the nine tasks she taught was 33%. Teacher B correctly placed 75% of the PA Early Learning Standards for Mathematics under their respective domains. The average richness score of the two tasks she taught was 72.20%. Teacher C placed 67% of the PA Early Learning Standards for Mathematics under their respective domains. The average richness score of the two tasks she taught was 66.70%. Teacher D correctly placed 92% of the PA Early Learning Standards for Mathematics under their respective domains. The average richness score of the two tasks she taught was 22.2%.

In the next chapter, we will discuss the findings in depth and the possible implications of the findings.
Chapter 5

Discussion and Conclusion

Research Question 1. *What do preschool teachers’ know of the PA Early Learning Standards for Mathematics?*

We found that there was a range of knowledge among participants regarding the PA Early Learning Standards for Mathematics. Teachers A and D displayed the most amount of working knowledge of the standards during the card sort activity. Teachers B and C demonstrated a limited working knowledge of the Early Learning Standards during the card sort activity. These were very interesting findings in lieu of the vast educational and experiential backgrounds of the participants.

When comparing the educational background of the teachers with their working knowledge of the standards, we found that Teacher A had the most academic knowledge of teaching based on her dual bachelor’s degrees in Early Childhood Education and Special Education. Teacher D, on the other hand, holds a CDA. Teachers B and C had an Associate’s and a Bachelor’s in Early Childhood Education, respectively. Based on this comparison, we found that academic knowledge was not necessarily indicative of how much knowledge the participants had of the Early Learning Standards.

We looked at experience working with children as the net possible explanation for the knowledge discrepancies and found that all four participants had fairly equivalent experience with regards to age-levels and grades with which they have worked. Teacher B, however, had the most amount of years experience, while Teacher A and C had less years working with children. Again, these results were not necessarily indicative of why Teachers A and D displayed the most amount of working knowledge of the standards and Teachers B and C did not.

When looking specifically at the number of years teaching in general and the number of years teaching preschool ages specifically, Teachers B and D were the most experienced of the participants.
Again, these findings did not necessarily indicate a reason for why Teachers A and D held the most amount of knowledge of the PA Early Learning Standards because Teachers A and D had such drastic differences in their years teaching.

The most interesting comparison came when contrasting the teachers knowledge with the number and types of professional development events they have attended as in-service preschool teachers. Both Teachers A and D have attended the most amount of professional developments with Teacher A attending seven events and Teacher D attending ten. Teachers B and C, however, reported attending two and three, respectively. While this data is limited, it is possible that attendance at Continuing Education Professional Developments might have the greatest impact on a teacher’s working knowledge of the new PA Early Learning Standards. There needs to be much more research on this possibility, but based on the data in this study, the teachers who attended more professional developments demonstrate more working knowledge of the PA Early Learning Standards for Mathematics. Additionally, it is possible that the types of professional development events attended also had an impact on the participants’ working knowledge of the Early Learning Standards, but this will need to be investigated in subsequent studies.

**Research Question 2. Do preschool teachers implement the PA Early Learning Standards for Mathematics?**

We found that the implementation of the PA Early Learning Standards for Mathematics varied greatly among the participants in this study. Teacher A provided her students with the most amount of standards-related tasks. Teacher D provided her students with the least amount of standards-related tasks, while Teachers B and C provided a very limited number of standards-related tasks in a rich manner.

These findings were restricted by the number of videotaped mathematics lessons per participant. In lieu of this limited data, conclusions beyond basic frequency tallies were unable to be drawn for Research Question 2.
Research Question 3. Do teachers with more knowledge of the PA Early Learning Standards for Mathematics implement richer mathematics instruction than teachers with less knowledge of the PA Early Learning Standards for Mathematics?

We found that teachers with more knowledge of the PA Early Learning Standards for Mathematics did not implement richer mathematics instruction than teachers with less knowledge of the PA Early Learning Standards for Mathematics. In fact, we found the teachers with the most amount of knowledge had a third or less of the criteria for richness present in their teaching, while the two teachers with the least amount of knowledge of the PA Early Learning Standards had more than two-thirds of the criteria for richness present in their teaching.

One striking finding from the data was that Teachers A and D had correctly placed 92% of the standards during the card sort, but when evaluated for providing rich mathematics instruction, Teacher A scored 33% and Teacher D scored 22%. On the other hand, Teachers B and C correctly placed 75% and 67% of the standards, respectively, and scored 72.2% and 66.7% when evaluated for providing rich mathematics instruction, respectively.

While this finding is limited due to the small number of tasks taught by Teachers B, C, and D, Teacher A’s data were based on nine different tasks, which is a relatively large number compared to the one or two tasks taught by the other participants. Additionally, Teacher A was very forthcoming with her thoughts on mathematics and teaching, in general, during the opening interview. Shockingly, even though Teacher A knew the standards and the standards were clearly implemented in her teaching (see Research Question 2), she scored well below the anticipated threshold for task richness. It is possible that Teacher A knew the most about the standards document because she had recently studied the PA Early Learning Standards in her teacher preparation program. A question that remains unanswered is whether or not her preparation included an in-depth examination of how to teach the standards in practice rather than just looking at the face value of each standard. The answer to this question might explain why her richness
score was much lower than her implementation or knowledge scores. It is also possible that her lack of richness could be explained as a function of her limited teaching experience.

Teacher D, while producing only one video-taped task for examination, also had a very high working knowledge of the PA Early Learning Standards, but when asked about the intended goals for her teaching, she was unable to provide the domain/standards to be taught. Teacher D’s richness score was the lowest score of richness of all of the participants. In many ways, the low richness score of Teacher D could possibly have been anticipated based on the fact that she could not identify what domain or standard she aimed to teach in that particular lesson.

Teacher B demonstrated an average knowledge of the PA Early Learning Standards for Mathematics, but scored the highest of all the participants when evaluated for providing rich mathematics instruction. Teacher C had the least amount of knowledge of the standards, but had the second highest richness score. One limitation of this finding is that both Teachers B and C presented two videotaped tasks a piece. It is possible that their videos demonstrated rich mathematics instruction because they self-selected the most planned out tasks with regards to teaching the standards.

Even with the limitations, these findings raise the question as to if a strong working knowledge of the PA Early Learning Standards is indicative of a teacher’s ability to provide rich mathematics instruction. In the case of the Sunshine Preschool, it was apparent that having knowledge of the standards did not mean that students were provided with instruction that provided opportunities for deep mathematical experiences. One might think that the differences in professional development attendance played a role in the degree of richness provided during instruction, but Teachers B and C disproved this theory because they attended the least amount of professional development events, while having the richest teaching episodes. However, it is possible that the two professional development events attended by Teachers B and C addressed high quality teaching strategies, while the professional developments attended by Teacher A and D did not.
Another possible explanation might be that Teachers B and C sought out additional information about how to adequately teach the standards to their students. Teacher A might have thought she was providing rich instruction but did not understand that there were multiple performance objectives for each standard that supported in-depth exploration of the mathematics concepts rather than just the one sentence that identified each standard. Teacher D might have been anxious about being videotaped and, therefore, tried to complete the taping as quickly as possible.

A final possible explanation might be that the more experience a teacher had teaching at the preschool level, the more likely they were to provide rich mathematics instruction. This was true for Teacher B, however, Teacher D disproved this possibility. Teacher D had an abundance of years teaching preschool, but her richness score was the lowest of all of the participants.

**Implications.**

There were two major implications of this study. First, the Sunshine Preschool might benefit from professional development events or trainings that are geared toward rich teaching strategies and developmentally-appropriate mathematics activities that would further students’ understanding of various mathematics concepts. While further research is needed to determine the complete effects of professional development on the participants in this case study, it was evident that the professional development attendance may have provided some of the participants with pedagogical knowledge that may have been beneficial in implementing rich teaching strategies.

The second implication was that basing hiring on a potential teacher’s level of education might not automatically lead to students will receiving rich mathematics instruction. Based on the findings of this study, it is possible that teachers with more academic knowledge might know the standards but not how to implement them with the depth and rigor needed for kindergarten or further education. Therefore, the Sunshine Preschool administration might want to include a practical component to their hiring process, such as having applicants evaluate student’s mathematics work and provide suggestions of how they might structure a subsequent lesson based on the student's’ work or have applicants provide a
teaching demonstration. A practical component to the interview process might allow administrators to develop a more comprehensive understanding of the teaching practices of the interviewee with regards to rigor and richness.

**Future Research.**

In the future, the first thing we would do is repeat this study, after having fixed as many of the limitations as possible, with a preschool comparable to the Sunshine Preschool. For instance, we will establish a more strict timeline for collecting the data for the study. We will also provide clearer expectations to the participants regarding the necessity of adhering to the strict guidelines for individual interviews, video recordings, and assessment data collection, to ensure all necessary data is collected. Additionally, participants will be asked to provide the researcher with copies of their lesson plans, as well as a list of the materials students used during the lessons. As for the data on professional development the researcher will obtain records of the participants’ attendance to clearly see how many professional development events were attended over the years the participant taught, the type of professional development events attended, and, if possible, what the content was learned during the professional developments.

Another follow up study will compare the results of this study with similar data collected from other preschools owned by the parent company of the Sunshine Preschool. This study will address whether or not the findings from the Sunshine Preschool are an anomaly or if there is something similar happening across schools within the company. Also, replicating this study at other sites of the company that owns the Sunshine Preschool will allow us to analyze and compare the results to get a better idea of any possible improvements that could be beneficial to the company as a whole, or to individual sites.

A third follow up study will be a comparison case study between the Sunshine Preschool and other preschools in the state. Specifically, that study could examine questions such as: 1) Are other preschools implementing the PA Early Learning Standards for Mathematics? And 2) Are the students being provided with rich mathematics instruction that will adequately prepare them for Kindergarten and
future academic success? It might be intriguing to see the similarities and/or differences between the Sunshine Preschool and other types of preschools, whether public, private, or parochial and what that means for current preschool teachers and mathematics teaching.

Finally, on a grander scale, we will replicate this study across state lines. First, we will compare preschool standards across states to see if they are similar or different to those in Pennsylvania. Second, we will replicate this study using a sampling of preschools that are comparable to the Sunshine Preschool from across the nation. Thirdly, we will compare the preparation of preschool teachers across states to see if the results from this study mimic results from other states. We will assess the standards they have, the preparation given to the teachers about their standards, and how the teachers go about implementing rich mathematics instruction in their practices. This might be very telling about how current and future preschool teachers prepare for the task of teaching mathematics to their students.

Conclusion

In this study, we investigated teachers’ knowledge of the PA Early Learning Standards, whether or not they implemented the standards in practice, and if teachers with more knowledge of the PA Early Learning Standards for Mathematics implemented richer mathematics instruction than teachers with less knowledge of the PA Early Learning Standards for Mathematics. This study is important because children entering kindergarten are expected to know more than ever before, thus, it is vital that teachers are adequately preparing preschool students with the proper foundations they will need to succeed in Kindergarten and beyond.

This study was conducted to raise awareness of the importance of ensuring preschool students being taught aligned to the PA Early Learning Standards for Mathematics are adequately prepared for not only Kindergarten, but their academic future as a whole. We found that academic background did not necessarily equate to a strong knowledge of the PA Early Learning Standards for Mathematics. It was also found that the implementation of PA Early Learning Standards for mathematics in practice was not
cut and dry. Finally, we found that richness of mathematics instruction was not necessarily aligned with a strong working knowledge of the PA Early Learning Standards for Mathematics.

Having fixed the limitations, the researcher plans to replicate this study in other preschools owned by the same company as the Sunshine Preschool. This will allow us to open the doors to future studies aiding in discovering if it is possible that what we found at the Sunshine Preschool is indicative of the rest of the preschools owned by this company, or if the Sunshine Preschool is an anomaly. From there, it would be interesting to compare the company who own the Sunshine Preschool to other types of preschools to see how each of the companies might benefit one another, and possible courses of action to take to ensure preschool students are receiving rich mathematics instruction.
Appendix A

PA Early Learning Standards

<table>
<thead>
<tr>
<th>Domain</th>
<th>Big Idea</th>
<th>Essential Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Numbers and Operations</strong></td>
<td>Mathematical relationships among numbers can be represented, compared, and communicated.</td>
<td>How is mathematics used to quantify, compare, represent, and model numbers?</td>
</tr>
<tr>
<td><strong>Algebraic Concepts</strong></td>
<td>Mathematical relationships can be represented as expressions, equations, and inequalities in mathematical situations.</td>
<td>How are relationships represented mathematically?</td>
</tr>
<tr>
<td><strong>Geometry</strong></td>
<td>Geometric relationships can be described, analyzed, and classified based on spatial reasoning and/or visualization.</td>
<td>How are spatial relationships, including shape and dimension, used to draw, construct, model, and represent real situations or solve problems? How can the application of the attributes of geometric shapes support mathematical reasoning and problem solving?</td>
</tr>
<tr>
<td><strong>Data, Measurement, and Probability</strong></td>
<td>Measurement attributes can be quantified and estimated using customary and non-customary units of measure.</td>
<td>What does &quot;what&quot; we measure influence &quot;how&quot; we measure? How can data be organized and represented to provide insight into the relationship between quantities?</td>
</tr>
</tbody>
</table>
Appendix B

Rubric

<table>
<thead>
<tr>
<th>Standard</th>
<th>Possible Activities:</th>
<th>X</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Numbers and Operations</strong></td>
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<tr>
<td><strong>Know number names and the count sequence.</strong></td>
<td>• Teach children counting songs, rhymes, and chants.</td>
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<tr>
<td></td>
<td>• Provide and read books, poems, chants with numbers, and number concepts.</td>
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<td></td>
<td>• Use number words and numerals, including zero, in everyday situations.</td>
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<td>• Provide experiences with numbers through daily routines such as attendance and calendar.</td>
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<td></td>
<td>• Provide opportunities for writing numerals and representing numbers.</td>
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<tr>
<td></td>
<td>• Play number recognition games.</td>
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<tr>
<td><strong>Count to tell the number of objects.</strong></td>
<td>• Provide manipulatives. (e.g., counting bears, magnetic numbers, lacing numbers)</td>
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<td></td>
<td>• Model strategies to help children keep track of what they are counting.</td>
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<td></td>
<td>• Provide daily opportunities for children to count and recount objects.</td>
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<td></td>
<td>• Ask children to pass out utensils, napkins, cups at meals and snacks to reinforce one-to-one correspondence.</td>
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<tr>
<td><strong>Compare numbers.</strong></td>
<td>• Model counting and comparing of objects in daily experiences.</td>
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<td></td>
<td>• Explicitly teach mathematical vocabulary. (e.g., “more than,” “less than,” “equal to”)</td>
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<td></td>
<td>• Provide opportunities for quantifying sets of objects.</td>
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<tr>
<td><strong>Use mathematical processes when quantifying, comparing, representing, and modeling numbers.</strong></td>
<td>• Notice children engaged in numerical play and describe what they are doing.</td>
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<td></td>
<td>• Ask open-ended questions to encourage children to talk about their thinking. (e.g., How do you know there are six blocks?)</td>
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<td></td>
<td>• Listen carefully to children’s responses, and restate their responses using clear, age-appropriate, mathematical language.</td>
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</tr>
<tr>
<td></td>
<td>• Listen carefully to children’s responses to identify and clarify misconceptions.</td>
<td></td>
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<tr>
<td></td>
<td>• Model reasoning language. (e.g., “If that is right, then ...” “That can’t be because if it were, then ...”)</td>
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<tr>
<td></td>
<td>• Provide many opportunities for children to talk and listen to their peers.</td>
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<td></td>
<td>• Model reasoning by thinking-out-loud.</td>
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<td></td>
<td>• Explicitly call attention to a child’s think-aloud to engage peers</td>
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<td></td>
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<tr>
<td><strong>Algebraic Concepts</strong></td>
<td><strong>Geometry</strong></td>
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<td>------------------------</td>
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<tr>
<td><strong>Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.</strong></td>
<td><strong>Identify and describe shapes.</strong></td>
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<tr>
<td>• Model using appropriate math vocabulary when adding objects to a set.</td>
<td>• Explicitly use the names of geometric shapes.</td>
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<td></td>
</tr>
<tr>
<td>• Model using appropriate math vocabulary when taking away objects from a set.</td>
<td>• Take children on a shape walk looking for geometric shapes in the environment.</td>
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<tr>
<td>• Use manipulatives to demonstrate joining and separating sets.</td>
<td>• Provide books about geometric shapes.</td>
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<tr>
<td>• Tell stories about joining and separating sets.</td>
<td>• Provide shape templates, puzzles, attribute blocks, parquetry and pattern blocks in learning centers.</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Use mathematical processes when representing relationships.</strong></th>
<th><strong>Analyze, compare, create, and compose shapes.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Notice children engaged in mathematical play and describe what they are doing.</td>
<td>• Provide experiences for children to compare attributes of various geometrical shapes.</td>
</tr>
<tr>
<td>• Ask open-ended questions to encourage children to talk about their thinking. (e.g., “Tell me how you joined your piles of objects to make a bigger pile.” “I wonder what would happen if you ate some of those gummy bears?”)</td>
<td>• Provide shape templates, puzzles, attribute blocks, parquetry and pattern blocks in learning centers.</td>
</tr>
<tr>
<td>• Listen carefully to children’s responses, and restate their responses using clear, age-appropriate, mathematical language.</td>
<td>• Provide opportunities to make shapes with play dough, geoboards, Popsicle sticks, and pattern blocks.</td>
</tr>
<tr>
<td>• Listen carefully to children’s responses to identify and clarify misconceptions.</td>
<td>• Model naming shapes as two-dimensional (lying in a plane, “flat”) or three-dimensional (solid).</td>
</tr>
<tr>
<td>• Model reasoning language. (e.g., “If that is right, then ...” “That can’t be because if it were, then ...”)</td>
<td>• Model reasoning by thinking-out-loud.</td>
</tr>
<tr>
<td>• Provide many opportunities for children to talk and listen to their peers.</td>
<td>• Explicitly call attention to a child’s think-aloud to engage peers in the process.</td>
</tr>
<tr>
<td>• Acknowledge children’s use of fingers, concrete objects, or symbols to represent quantity.</td>
<td>• Acknowledge children’s use of fingers, concrete objects, or symbols to represent quantity.</td>
</tr>
<tr>
<td>Use mathematical processes when drawing, constructing, modeling, and representing shapes.</td>
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</tbody>
</table>
| • Notice children engaged in geometric play and describe what they are doing.  
• Foster geometric awareness. (e.g., encourage children to sketch their block creation before taking it down)  
• Ask open-ended questions to encourage children to talk about their thinking. (e.g., “I wonder if we could make a square out of our pile of triangles?”)  
• Listen carefully to children’s responses, and restate their responses using clear, age-appropriate, mathematical language.  
• Listen carefully to children’s responses to identify and clarify misconceptions.  
• Model reasoning language. (e.g., “If that is right, then ...” “That can’t be because if it were, then ...”)  
• Provide many opportunities for children to talk and listen to their peers.  
• Explicitly call attention to a child’s think-aloud to engage peers in the process. |
| Measurement, Data, and Probability |
| Describe and compare measurable attributes of length and weights of everyday objects. |
| • Show children how to measure with non-standard items.  
• Provide measuring tools (e.g., rulers, scales, measuring cups) for children to explore and use in their play.  
• Explicitly discuss and model use of standard measuring tools, using measurement vocabulary.  
• Engage children in cooking experiences.  
• Ask questions about measurement. (e.g., “How tall are you?” “How much does that weigh?” “How many footsteps to the door?”) |
| Classify objects and count the number of objects in each category. |
| • Provide materials to practice sorting and classifying.  
• Model sorting and classifying.  
• Use verbal prompts. (e.g., “Let’s put all the red crayons in this cup.”)  
• Label storage containers with visual prompts to encourage sorting and classifying.  
• Sing, recite fingerplays, and read books that explore different categories. (e.g., colors, shapes, animals)  
• Ask children about groups. (e.g., “Why do these things belong together?”)  
• Collect objects to use for data collection.  
• Model organization of data for graphing purposes.  
• Model, using mathematical vocabulary, comparing data on graphs and charts. (e.g., more, equal, less, not equal)  
• Make comparisons part of daily routine. (e.g., “Do more people walk or ride to school?”) |
| Use mathematical processes when |
| • Notice children engaged in measurement activities and describe what they are doing. |
| measuring; representing, organizing, and understanding data. | • Engage children in opportunities to measure, represent, organize, and understand data.  
• Ask open-ended questions to encourage children to talk about their thinking. (e.g., “I wonder how we could discover which type of weather we get the most of this month?”)  
• Listen carefully to children’s responses, and restate their responses using clear, age-appropriate, mathematical language.  
• Listen carefully to children’s responses to identify and clarify misconceptions.  
• Model reasoning language. (e.g., “If that is right, then …” “That can’t be because if it were, then …”)  
• Provide many opportunities for children to talk and listen to their peers.  
• Model reasoning by thinking-out-loud.  
• Explicitly call attention to a child’s think-aloud to engage peers in the process. |
BIBLIOGRAPHY


Principles to actions: Ensuring mathematical success for all by the National Council of Teachers of Mathematics (2014).


ACADEMIC VITA

Stephanie Ruggiero

EDUCATION

Bachelor of Science, (2013 - present)
The Pennsylvania State Erie, The Behrend College
• Major: Childhood and Early Adolescent Education
• Minor: Psychology
• Honors: Dean’s List (6 semesters), Behrend Excellence Award, Behrend Honors, Class of 1922 Memorial Scholarship, Council of Fellows Leadership Scholarship, Irvin Kochel Award, Ladies Aid Scholarship, Provost Award, Ready to Succeed Scholarship, Schreyer’s Honors Scholar, William Murphy Scholarship

RELEVANT WORK EXPERIENCE

Student Teaching, Rolling Ridge Elementary School, Spring 2017
• Planned and implemented daily lesson plans for Kindergarten, progressing to full day planning and teaching after a few weeks
• Showed disciplinary abilities by maintaining behaviors in the classroom
• Adapted lessons for a variety of learners

Discipline and Inquiry Block, Penn State Behrend, Fall 2016
• Mathematics, Science, Special Education, and Social Studies methods courses
• Observed, planned, and taught lessons in a first grade classroom as well as a third grade classroom
• Maintained disciplinary control of the classroom in both of the above placements

Language and Literacy Education Block, Penn State Behrend, Spring 2016
• Literacy, Art, and Music methods courses
• Observed, planned, and implemented a variety of lessons in each of the subjects mentioned above

Counselor, YMCA Day Camp, Summer 2016
• Planned and implemented activities for children of a variety of age and grade levels

Tutor, Family, Summer 2016
• Worked with a third grade student who was going into fourth grade with various concepts in both mathematics and reading

Lion Scout, Penn State Erie-Admissions, 2015-present
• Gives weekly tours to potential and accepted students along with their families
• Greeter at open houses and accepted students days
• Sat on student panels for potential and accepted students along with their families

**Student Activities Student Consultant,** *Penn State Erie-Smith Chapel,* 2015-2016
• Worked as a secretary answering phones and assisting those who entered the chapel on campus
• Edited the monthly service newsletter

**Volunteer,** *Holy Trinity Catholic School,* Fall 2014 - present
• Welcomed in to assist teachers of grades PREK-3

**Babysitter,** *Various Families,* 2007 – present
• Interacted with children until it was time for them to go to bed
• Took care of two sisters five days a week from 8am-4pm in the summers
• Provided crafts and reading as daily activities

**ACTIVITIES**

**Member,** *Omicron Delta Kappa National Leadership Honor Society,* 2015 – present

**Founding Member,** *Behrend Students Against Violence Everywhere*
**President,** 2014 – 2015
• Raise awareness about sexual assault and domestic violence
• Photographed and edited public service announcements for the campus
• Created an agenda and headed weekly meetings of the organization

**Vice President,** 2015 – present
• Assist in the correspondence of outside resources
• Leading in the planning of a larger event in the Spring for all campus

**Member,** *Campus Crusade for Christ (CRU),* 2014 – present

**Member,** *Gamma Sigma Sigma National Service Sorority,* March 2014 – present

**Dare To Cut Your Hair Chair,** 2014 – 2015
• Planned fundraising event at Millcreek Mall for the American Cancer Society
• Contacted various companies for donations
• Contacted hairstylist for haircuts and hair donations for Locks of Love
• Organized volunteer jobs for 25 women

**Service Vice President,** 2014 – 2016
• Organize service projects for the 44 members to complete
• Communicate with various organizations to find their needs
• Keep record of individual service hours of the 44 members
• Submit a report to nationals after each semester, fall and spring
• Lead a committee that assists in ideas for service projects
• Present service opportunities to the executive board and members each week
• Correspond with the 44 members to ensure correct service hour recording

**Member,** *Lambda Sigma National Honors Society for Sophomores,* 2014 – 2015
Secretary, Fall 2014
• Created agenda for bi weekly meetings
• Recorded minutes at biweekly meetings for both general and executive board
• Corresponded with 48 members
• Kept record of absences and excuses from biweekly meetings

President, Spring 2015
• Created agenda for bi weekly meetings
• Facilitated biweekly meetings for both general and executive board
• Organized various events
• Led the induction ceremony for new members

Member, Random Acts of Kindness (RAK), 2014 – present

VOLUNTEER EXPERIENCE

Volunteer, Second Harvest Food Bank, 2015 – present
• Assisted with sorting and packaging food for those in need

Volunteer, ServErie, Spring 2015
• Assisted in the cleaning of Wayne Elementary

Volunteer, Beads for Needs, 2014 – present

Volunteer, Expanding Social Opportunities, 2014 – present
• Work dances for special needs adults
• Make cards given out as favors for dances

Volunteer, Good Samaritan Project, Fall 2014
• Bought school supplies to fit into shoeboxes for children in need

Volunteer, Project Linus, Fall 2014 – present
• Made tie blankets for children in the hospital for long stays

Volunteer, Shining Star Program, Fall 2014 – present
• Gather presents for children on their wishlist for Christmas

Volunteer, Vacation Bible School, 2014 – 2015

Volunteer, Welcome Week, 2014 – present
Guide, 2014
• Moved the Freshman into the dormitories
• Helped Freshmen find their way around campus and to events planned for them

Captain, 2015
• Co-led a team of guides
• Greeted each car as they came into our dormitory on move in day
• Moved the Freshman into the dormitories
• Helped Freshmen find their way around campus and to events planned for them

Volunteer, Catholic Heart Work Camp, 2011 – 2014
• Prince Frederick, MD: Helped special needs adults with various activities and outdoor work
• Seaside Heights, NJ: Helped Hurricane Sandy victims
• Farmington, MI: Helped special needs adults learn their colors and painted
• Mishawaka, IN: Assisted an elderly woman by building a patio and painting