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The Impacts of Family STEM Events for Young Children on Parents' Perceptions in a Rural Remote School

Cheyenne Jeffers
University of Nebraska - Lincoln, cjeffers83@icloud.com

THE IMPACTS OF FAMILY STEM EVENTS FOR YOUNG CHILDREN ON PARENTS' PERCEPTIONS IN A RURAL REMOTE SCHOOL

by

Cheyenne Jeffers

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ABSTRACT

THE IMPACTS OF FAMILY STEM EVENTS FOR YOUNG CHILDREN ON PARENTS' PERCEPTIONS IN A RURAL REMOTE SCHOOL

Cheyenne Jeffers, M.A.

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Advisor: Amanda Thomas

STEM education is an interdisciplinary approach to creating learning experiences, preparing the children of today to become the workforce and global citizens of a digital tomorrow. Young children are natural explorers of their world, participating in STEM learning through real world experiences. Public and parental misconceptions are hurdles to implementing STEM learning with young children. Many believe young children are not capable of participating in STEM learning and should be taught foundational skills first. On the contrary, STEM learning should be a priority in the educational environment of young children, most beneficially combining efforts at home as well as at school. Parental engagement plays a critical role in the academic success of children. Encouraging family engagement by offering STEM events as a way for families to collaborate and explore STEM activities could offer a multifaceted motivation for educators. The positive impacts could include new parent perceptions and exposing remaining parent misconceptions, developing home connections and family engagement, and inspiring parent encouragement of STEM. Rural families are more likely to attend school events and are less likely to visit out of school educational attractions, for example zoos or aquariums. This study examined the impacts of family STEM events for young children on parents' perceptions in a rural remote school.

Keywords: STEM education events, early childhood STEM, STEM in rural schools, family STEM nights, parents' perceptions

DEDICATION

I dedicate my research to my loving and supportive husband, Cody, and my sweet and curious children, Chloe, Chaz, Cadie, and Cal. Thank you to my supportive community, who have shown their care and commitment to the education of their children.

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CHAPTER 1: INTRODUCTION

Problem Statement and Purpose

American education is being examined by educators and government officials, and many are calling for innovative reform. Improving and encouraging STEM education could create a pathway for successful innovations for America in STEM careers in the future. According to a press release, published by the United States Department of Education, $279 million were allocated to STEM discretionary grant funds. The U.S. Department of Education Secretary Betsy Devos's support for STEM education is evidenced by her saying:

> It's important that all students have access to a high-quality STEM education. These discretionary grant programs and this Administration's increased focus on STEM will help ensure our nation's students are exposed to STEM early in their lifelong education journeys and will have the tools needed for success in the 21st century economy (2018, para.2).

An integrated approach to teaching: science, technology, engineering, and math, coined STEM, is a current topic supported by government officials and a trending theme in education. The curious nature of young children makes them ideal candidates to explore and experiment in STEM learning activities. Adults in the lives of young children play a significant role in facilitating development. Actively engaging families should be a priority to benefit child development.

A globally competitive educational state is driving an examination of current educational practices and summoning for reform, focusing on K-12 education (Century,

2014). The children of today are facing an increasingly digitally driven world with complex global challenges. The current educational standards for students have changed blending STEM education concepts with science and technology goals. The Next Generations Science Standards (NGSS Lead States, 2013), the International Society for Technology in Education Standards (International Society for Technology in Education, 2016), and the Common Core State Standards for Mathematics' emphasis on mathematical practices or habits of mind (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010) reflect the STEM education movement. Weaving STEM experiences and education into the early childhood environment is a promising contribution to developing workers and citizens equipped for the world of tomorrow.

Engaging families in STEM events provides one way to support and engage young children in remote rural schools. Young children are greatly affected by the adults in their lives, both at home and at school. Fostering a fruitful partnership between home and school will encourage the development of young children. Young children that have a foundational knowledge base will be more academically successful later (Galindo & Sheldon, 2012).

Remote rural communities are more geographically isolated, offering less access to important out of school educational opportunities, but according to the National Center for Education Statistics, rural people are more likely to attend school activities (2007). This rural environment offers an opportunity to engage families to develop a knowledge base and interest for rural children, providing STEM experiences to an underserved population. STEM events are one way to provide out of school family STEM

experiences. It is the purpose of this study to investigate the question: What are the impacts of family STEM events for young children on parents' perceptions in a rural remote school?

Research Questions

1. What are the attitudes of rural parents as it relates to STEM learning for young children?
2. To what extent does parent participation in a rural school's STEM events reduce their STEM misconceptions?

Methods Overview

The research in this study is a qualitative method, gathering data using parent interviews, photographs, and field notes, documenting and exploring the experiences of families at three Family STEM events.

Definition of Key Terms

STEM: For the context of this study, I define STEM as experiences, activities, and education that focuses on a hands-on approach to integrated two more subjects in the areas, of science, technology, engineering, or math.

RURAL REMOTE: National Center for Education Statistics (Geverdt, 2015), define rural remote as, "Census-defined rural territory that is more than 25 miles from an Urbanized Area and also more than 10 miles from an Urban Cluster" (p. 3).

CHAPTER 2: LITERATURE REVIEW

Overview

The impacts of family STEM events for young children on parents' perceptions in a rural remote school has not been widely researched. There is a dearth of research addressing this specific topic, particularly in the context of a rural remote area. There is, however, research on some elements within the topic. I examined the impacts of family involvement in achievement gains, the influences of STEM experiences in early childhood, public and parent perceptions about the capabilities of young children in STEM education, and the education and contexts of children and families in rural schools.

The Impact of Family Involvement on Achievement Gains

The positive effects of family involvement on student achievement is widely accepted and affirmed by multiple research studies. Galindo and Sheldon for example, found that the gains in math and reading achievement can be explained by family involvement in education (2012). The researchers also determined that schools encouraging family engagement and connections were more likely to have families more involved (2012). Parents of students in rural communities are more likely to attend school events than parents of students living in cities (National Center for Education Statistics, 2007).

One study observed and scored families at out of school science events, examining each family's interactions, dialogue, and inquiry during their participation in the science activities (Tuttle et al., 2017). The study found that the quality of family engagement was most interactive and beneficial when the activities facilitated parent-

child collaboration and the activity did not have a known conclusion. Many parents have interest in interacting with their children in science events but need support and guidance to most effectively engage in academic experiences with their children. Parent-child engagement was most interactive when the activities were non-restrictive, open-ended, and contained a mutual goal. Outside of school STEM connections have an important impact on children's STEM learning (Tuttle et al., 2017). The engaged families were exploring and tinkering with science with open-ended conclusions, allowing for creativity and encouraging habits of mind.

Multiple researchers agree that schools and programs endeavoring family outreach should consider multiple aspects of valuable family involvement. It is essential to first reach out to families and interest them in shared learning experiences. Schools that effectively encouraged family engagement, were more likely to have more family involvement (Galindo & Sheldon, 2012). It is also true that those opportunities for involvement should be purposeful and provide guidance to most effectively capitalize on the involvement. Positive effects can include constructive behavior modification, improved academic success, and a greater probability of college enrollment (Nugent, Kunz, Sheridan, Glover, & Knoche, 2017). Researchers at The Joan Ganz Cooney Center at Sesame Street Workshop (2017) stated, "Many parents and teachers experience anxiety, low self-confidence, and gendered assumptions about STEM topics, which can transfer to their children and students" (p.5). Taking full advantage of rural family participation could encourage parents to explore STEM learning experiences with their children and change the way they engage with their children in STEM activities.

Equipping parents with tools and guided inquiry could enrich the child's STEM experiences and advance the knowledge gained from the encounter.

STEM Experiences in Early Childhood

Researchers at The Joan Ganz Cooney Center at Sesame Street Workshop stated the importance of starting STEM education early with young children:

> In fact, just as the industrial revolution made it necessary for all children to learn to read, the technology revolution has made it critical for all children to understand STEM. To support the future of our nation, the seeds of STEM must be planted early, along with and in support of the seeds of literacy. Together these mutually enhancing, interwoven strands of learning will grow well-informed, critical citizens prepared for a digital tomorrow. (McClure et al., 2017, p. 4)

Children, from birth, are natural explorers, investigating the world around them. They are instinctively engaging in STEM experiences (McClure et al., 2017). Researchers at The Joan Ganz Cooney Center at Sesame Street attest waiting until young children are older to immerse them in intentional STEM learning is a missed opportunity. It is important for parents to understand that a young child is capable of engaging in meaningful STEM play and experiences. In real world experiences, children interact with their environment in an integrated approach. Research supports teaching STEM subjects, interlacing these subject areas often expands understanding and enables children to apply concepts in a natural, real world context (McClure et al., 2017).

Public and Parent Perceptions of the Capabilities of Young Children in STEM

There are evident public misconceptions about the capabilities of young children participating in STEM education. According to McClure and colleagues (2017), parents

and the general public often believe STEM education should be taught after other subjects are learned first. Another public misconception is that STEM education is for older children and is important for students who are advanced in those subject areas, and that those subjects should first be taught in isolation. Gender stereotyping is also a public misconception, some believing that boys are naturally better at STEM subjects. It is important to provide parents and community members opportunities to disprove those misconceptions first hand. Early learning experiences and an early understanding of the world was associated with future science success. Alternatively, students that did not have the same foundational world understanding entering kindergarten struggled in science later (McClure, et al., 2017).

Parental perceptions are important in a child's education and future. Child self-efficacy and parental beliefs about their child's capabilities in STEM disciplines are related to the child's future successes in STEM areas (Yanowitz & Hahas-Vaughn, 2016). Parental beliefs about their child's math abilities are more indicative predictors of the child's perception of their math abilities than that child's previous math functioning (McClure, et al., 2017). The research of Yanowitz and Hahas-Vaughn and the research of McClure and colleagues support the importance of parental beliefs in a child's education.

It is a misconception that young children are not capable of learning STEM concepts, many instead believing that children should acquire foundational skills first. In fact, Clements (2016), found evidence that the inclusion of STEM education in early childhood, children aged birth through third grade, could bridge the gap of disadvantaged children and their deficient knowledge base entering kindergarten. By underestimating

the capabilities of young children, parents and educators are missing an opportunity for profound early growth and a foundation of future success (Clements, 2016).

Remote Rural School Children

Students in rural remote schools have less access to afterschool programs and out of school STEM learning experiences because of geographical access. Parents of students in rural schools were more likely to attend a school event than parents of students in cities (National Center for Education Statistics, 2007). Because of the isolation and limited access to STEM attractions and experiences compared to their urban counterparts, families in rural remote areas face unique challenges in creating and developing foundational STEM knowledge for their children. According to the report of the Status of Education in Rural America, families in rural schools are less likely than families in cities to take their children to STEM attractions that would provide STEM exposure and experiences, such attractions could include zoos, aquariums, children's museums, or other STEM related experiences (2007). These studies suggest that the strength of rural school parental involvement has the potential to both positively affect students' success and to aide in contradicting public and parent misconceptions about young children's capabilities in STEM learning.

Experiential knowledge is a strength for children from and living in rural areas. They are innately, due simply to their geographical environment, more immersed in nature and outdoor experiences such as feeding animals outside of a controlled environment, for example a zoo. Morales (2019), found rural children approach learning and hands-on educational experiences distinctly different than their urban and suburban peers. Rural children, specifically children from agrarian rural areas, have unique

strengths stemming from their environment and a foundational knowledge from being immersed in that setting. Morales' (2019) research found that agrarian rural children were more likely to explore hands-on educational experiences without direction and also connect relevant background knowledge and prior experiences to new information and understanding of scientific phenomena. Morales (2019) used data to assert the value of these agrarian rural strengths in the learning process.

Parents in rural communities were more likely to believe their children will obtain a high school diploma as their highest attainment of education and were more likely to have parents with a high school diploma as their highest attainment of education than their peers in cities and suburbs (National Center for Education Statistics, 2007). It is possible that educating parents on STEM careers and observing their children's capabilities or potential in STEM activities, could encourage parents to aspire for more for their children than a high school diploma as their highest level of education.

Summary

Rural communities could offer ideal conditions to impact STEM learning for children and parents' perceptions. Family involvement positively affects student achievement, and rural families are more likely to attend school events. Providing tools to enrich STEM play or activities, and guide children's inquiry equips parents to build STEM connections and learning outside of school time. Those outside of school time STEM activities build connections and benefit children's learning in STEM subjects in school. Quality and interactive family activities have the potential to provide parents with authentic experiences, exploring the capabilities of young children engaging in STEM related activities and education. Children in rural communities have a unique perspectives

and foundational skills due to their exposure to rural experiences such as farming and ranching. Inspiring parents to encourage children to pursue STEM experiences, education, and degrees could generate future innovations in agriculture as well as many other STEM related fields. Helping parents to make connections between the future of farm and ranch, and related STEM innovations. Introducing parents to the current advances in agricultural technology has the potential to stimulate parents' perceptions of the importance of STEM education for young children in our community.

CHAPTER 3: METHODS

Overview

To investigate the impacts of family STEM events for young children in a rural remote school, this study will utilize a qualitative research approach to analyze perceptions and collect interview data. Parent interviews were administered following each family STEM event. Parents of children with ages ranging from birth to third grade were asked for consent to interview them on their experiences at the STEM event. Following each of the three STEM events, occurring in February, March, and May, a set of parent interviews of four families' parents were selected at random from among the families that gave consent to interview.

Context of the Study

This study was conducted in the context of a rural remote community in Southwest Nebraska. This agriculturally based community is the county seat with a population of 200 people. There is a population in the county that considers themselves as a part of the study community but live in rural areas outside of the village. The community and school are geographically isolated, positioned 259 miles from the closest metropolitan area. National Center for Education Statistics (Geverdt, 2015), define rural remote as, "Census-defined rural territory that is more than 25 miles from an Urbanized Area and also more than 10 miles from an Urban Cluster" (p. 3). As a result of the acute remoteness, there are a very limited number of out of school educational experiences for families to pursue. The school does experience a high attendance rate for school events and most years a 100% attendance for parent-teacher conferences. According to the Nebraska Department of Education Profile for the study school district for the 2017-2018

year, the school serves 115 students preschool through 12th grade. In comparison with the state averages, the study school has a high student population that are English Language Learners and considered to be high mobile. Over half of the student population in the study school qualify for free and reduced lunches, which is above the state average (Nebraska Department of Education, 2018). Refer to *Figure 1* below for a detailed comparison with Nebraska state averages. The study school qualifies as district wide for the Title I program that provides assistance for children in impoverished communities.

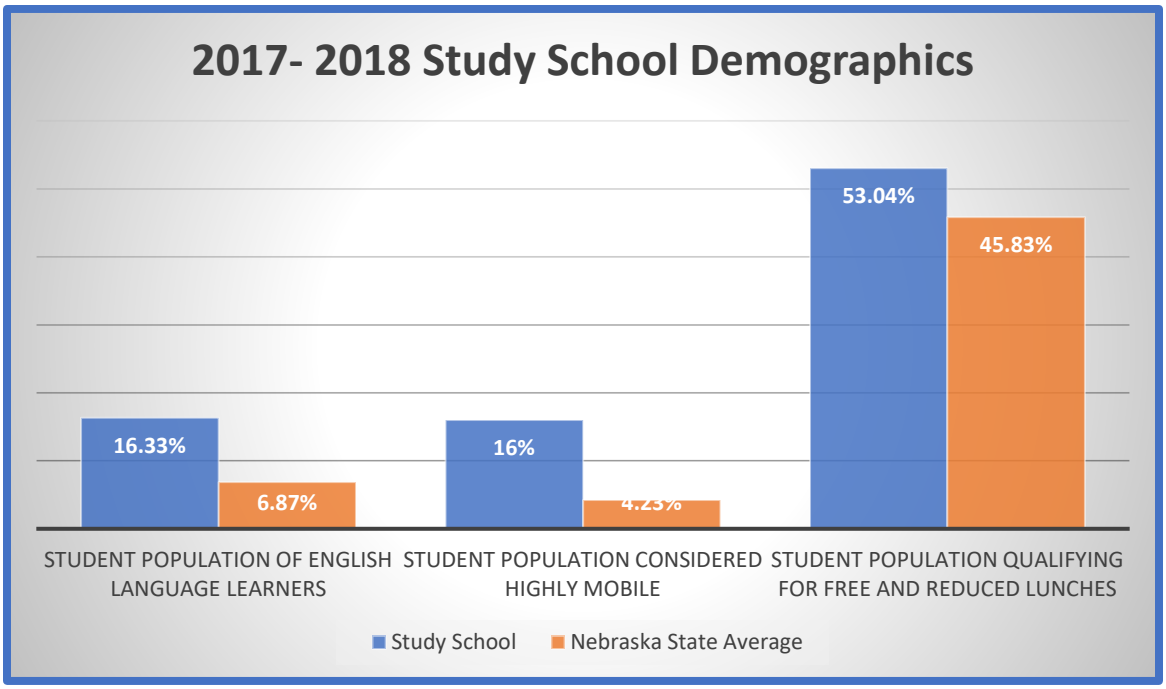

Figure 1. This chart displays and compares pertinent demographic statistics for the study school average (Nebraska Department of Education, 2018).

For this study, the researcher is also a classroom teacher at the study school. I have 10 years of teaching experience at the research site. I am a community members and a parent of children attending the study school and participating in the Family STEM events. My husband was born and raised in the community. We currently live outside of the community on my husband's multi-generational family farm.

Participants

The study participants were parents of families in the study community. The elementary school building contains preschool through fifth grade, and has a student population of 70 children. There was a sign-in sheet documenting the family members and children in attendance. Four families were randomly selected to interview after each of the three Family STEM events, for a total of 12 parent interviews, to explore and document their experiences and perceptions. The target audience of the events in February and May included families of children that were not early childhood aged, therefore, the families were able to participate in the event but were not eligible for the study. There were a total of 26 families that gave consent to participate in the study.

The first family STEM event took place in February and had a target audience of families with children aged preschool through sixth grade students, with an attendance of 45 students and family members in total. The February family STEM event was an integrated STEM event with an emphasis of engineering. Please refer to Appendix B for a more detailed description of the event and activities. Figure 2, on page 14, illustrates family members engaged in an engineering ice breaker activity. As with each of the three Family STEM events, four families were randomly selected for an interview. Parents were randomly selected from a pool of 11 consenting families for the February Family STEM event.

Figure 2. February family STEM event. This ice breaker activity aimed to have families collaborate to construct the tallest freestanding structure using only notecards and masking tape with an eight-minute time constraint.

The second Family STEM event was in March with a target audience of families with children from birth to third grade. This event was attended by a total of 87 children and family members. The March family STEM event was an integrated STEM event with a block party theme. Please refer to Appendix C for a more detailed description of the event and activities. Figure 3, on page 15, illustrates family members engaged in block play. All families participating in this Family STEM event were eligible for the study. Four families were randomly selected to be interviewed about their perceptions and experiences, from a pool of 23 consenting families.

Figure 3. The March family STEM event was a Block Party. Various forms of block play were enriched by interactive, guided inquiry by parents and facilitators.

The third Family STEM event was in May with a target audience of families with children in preschool through sixth grade, with an attendance of 93 children and family members. The May family STEM event was an integrated STEM event with an emphasis of technology. Please refer to Appendix D for a more detailed description of the event and activities. Figure 4, on page 16, shows family members exploring coding and robotics with Ozobots. Four families were randomly selected to be interviewed from a pool of 16 families.

Figure 4. The May family STEM event. In this picture, children and parents practiced coding with Ozobots with color coding markers and the Ozobot iPad applications. Children exploring in this photo range in ages from two years old to fourth grade.

Data Collection

Parent Interviews.

Four families were randomly selected following each of the three Family STEM events to participate in a parent interview, for a total of 12 parent interviews. The interviews were completely individual. Though both parents of each family were offered the interview, each interview conducted was with one of the family's parents and each case it was the mother of the family. Six interviews were completed face to face. Though there were 12 consenting interviews scheduled, one did not complete the interview. The interviews were about 15 to 20 minutes in length and included both closed and open ended questions. For a full list of questions see Appendix A. In five interviews, parents

were unable to schedule a time for interviews, in lieu of a face to face interviews the parents were given the interview questions and responded in written form.

Photographs and Videos.

Photographs and videos were gathered to capture families interacting and working at the Family STEM events. This data source was used as a secondary data source to illustrate the findings of this study.

Field Notes.

Field notes were composed by the researcher to describe and document the events and interactions of each Family STEM event. I wrote before each event to document the planning. Following each Family STEM event, I reflected and wrote for 45 minutes to document the happenings of the evening. There were valuable comments made at the STEM events made by parents that consented to the research, some of which were not chosen for the randomly selected parent interviews and some were interview participants. Field notes were used as a primary data source. The field notes were able to record and describe phenomena and researcher observations, not necessarily captured by the interviews or photographs.

Data Analysis

1. What are the attitudes of rural parents as it relates to STEM learning for young children?
2. To what extent does parent participation in a rural school's STEM events reduce their STEM misconceptions?

Parent interviews completed face to face were transcribed by the researcher. Parents that were unable to attend an interview face to face submitted written responses

to the parent interview questions. Interviews and researcher field notes were gathered and read several times for initial coding. The primary data sources of this study, the parent interviews and researcher field notes, were then openly coded line-by-line. The data were then analyzed using color coding to develop and categorize axial codes. Themes emerged across the axial codes. The photographs were used as a secondary data source to support and triangulate themes that emerged.

Summary

To examine the impacts of family STEM events for young children in a rural remote school, this study utilized a qualitative research approach to analyze perceptions and collect interview data. Eleven parent interviews were administered following each family STEM event, four in February, four in March, and four in May. Twenty-six sets of parents of children with ages ranging from birth to third grade gave consent to interview them on their experiences at the STEM event. Field notes were collected to document and record experiences and observations of the researcher at each event. Photos were taken to document interactions and encounters of the participants.

CHAPTER 4: FINDINGS

Overview

The purpose of this study was to assess the impacts of family STEM events for young children on parents' perceptions in a rural remote school. A qualitative research method was applied compiling interviews, field notes, and photographs. This study seeks to provide clarity of two specific research questions. What are the attitudes of rural parents as it relates to STEM learning for young children? To what extent does parent participation in a rural school's STEM events reduce their STEM misconceptions? The first three chapters of this thesis presented an overview of the potential impacts of family involvement on achievement gains, STEM experiences in early childhood, public and parent perceptions of the capabilities of young children in STEM, and provided context for remote rural school children. This chapter will outline and present the themes and corresponding findings that surfaced from the primary data sources collected, the parent interviews and researcher field notes, and the secondary data source of photographs of the interactions and participation at the three family STEM events. Three themes emerged from the qualitative data compiled, new parent perceptions and possible remaining parent misconceptions, home connections and family engagement, and the extent of parent encouragement of STEM.

New Perceptions and Possible Remaining Misconceptions

After and while participating in the family STEM events, many parents conveyed changes in their thinking about STEM education, the age in which children should be exposed to STEM, the interest and capabilities of their child in STEM activities, and gained new insights in the way in which their child thinks. The interviews and field notes

did, however, expose remaining misconceptions and possible misconstructions still in place in parental perceptions.

Interviews and field notes were consistent with examples of parents expressing new discoveries and changes in their thinking of STEM education. One parent admitting in an interview, “I didn’t really ever think about it (STEM education) too much before last night.” One parent said before the family STEM event she wasn’t sure what STEM was, “I wasn’t sure. I thought mainly science.” Many parents were actively engaged learning about STEM related activities and ideas right alongside their children. A parent expressed her learning by saying, “I honestly didn’t know what STEM stood for and what it was. Being involved in STEM nights helped me understand what is behind it and what its really about.” In the May family STEM event, families were presented a video titled, “The Future of Work: Will Our Children Be Prepared?”. This video is a compilation of clips from the news media group Vice News (Be, 2019). This production showed technology’s role in the future of work and industry, many of the examples were in the agricultural industry. This presentation was relevant to the community because many families are financially sustained through agriculture related jobs. Accelerating technology is automating jobs that are procedural and algorithmic. Parents were having side table discussions and we discussed some ideas of the future as a group. One discussion talked about how it was “kind of depressing” seeing some of their careers changing and possibly becoming obsolete with emerging technology. The study community is agriculturally based and with new innovations in the related career fields, skills and education may need to reflect those changes. The family STEM event brought

clarity to both parents and children of what STEM related activities were, what it was to engage in them, and the relevance to the future.

A common public misconception was addressed in the parent interview question, when do you think should STEM education should start? Parents interviewed after participating in a family STEM event, had varying responses with regards to the specific age, but all interview responses denoted an age within the early childhood parameters of birth to third grade. The responses ranged from birth to first grade. Five interview participants said STEM education should start as early as possible, three participants said it should start as infants, two participants said it should begin at preschool, and one participant said it should start at first grade. The word cloud, *Figure 5* found on page 21, illustrates the parent responses. One parent interviewed stated:

> I didn't really correlate STEM with early childhood until last night and some conversations that were had about STEM confirmed that STEM and early childhood education go hand in hand. I now believe that encouraging STEM activities at a young age will increase not only physical growth but also the ability for my children to be inquisitive and explorers.

Parents were able to see their babies and young children as capable of interacting and learning from STEM related experiences.

Figure 5. This word cloud illustrates the parent responses when asked, when should early childhood education begin.

Parent participants interacting with their children said they were able to see new ways in which their child thinks. One parent said, “They both think very systematically, which helped them work their way through several activities.” Another parent stated, “Watching my child and the way she interacted showed me that she can think of many different solutions to solve a problem and doesn’t give up easily.” Parents were able to see the perseverance and problem-solving aptitudes of their children. “I realized how much solving they do on their own if we don’t interfere. They just need more time to process.” One parent commented in the interview that she learned, “that they did have a creative and imaginative side and used problem solving to build and construct things.” Parents spoke of their perceptions of their children changing, “I think it really encouraged me to see her differently, to see her in that light and that she enjoys learning in different ways.”

The data of this study suggests that parents in the research community have gender stereotyping misconceptions. Examples of gender stereotyping misconceptions were found by the researcher in both primary sources of data, parent interviews and field

notes. Fathers were active and in some cases seizing the primary role in the interactions and family collaborations. As a teacher in the study community, I am often able to observe families at educational events such as Title I nights, back to school events, and parent-teacher conferences. It is typical for fathers not to attend or stand by in a wallflower role, the mothers of the family playing a more noticed and voiced involvement in the educational happenings of the child. Alternatively, at the family STEM events the fathers were in many cases the lead parental role. At the first family STEM event, three families had the father as the present parental attendant, the mothers stayed home. In many situations the mothers were taking a back seat and letting the fathers lead the family through building competitions and stations in particular. There were several comments made by mothers talking about how active the fathers were being. One mother saying how impressed she was with all the fathers jumping in and leading the kids through the activities. She then commented, “but I guess this is kind of a “Dad’s thing.” Another mother said, “I think this is the most dads I’ve ever seen at a school function.” Despite the active role of the fathers at the family STEM events, it is worth noting that in all of the parent interviews, the mothers of each family completed the interview. The interviews also gave reason to think that these gender stereotype misconceptions carry to the next generation, their children. One mother gave an interview about her thoughts of her family’s experiences of the last family STEM event. In her 18-minute interview, she did not once refer to her daughter. She answered all of the questions about her two sons that attended the event. Her daughter attended and engaged in the event right alongside her brothers but was not mentioned in the interview. These observations and comments suggest that parents in the community have remaining gender

stereotyping misconceptions, that men are more interested and more capable in STEM related activities than women.

Figure 6. Fathers attended the family STEM events and were actively engaged with children. This father and daughter are coding in "Coding with Awbie," an Osmo application with tactile coding tiles.

Home Connections and Family Engagement

The findings of this study suggest that participating in family STEM events may encourage families to engage in STEM related attractions, modify their play and activities at home, and the ways in which they engage with their children.

All parents interviewed noted that they did not frequent STEM experiences very often, but also expressed interest in attending. Two parents noted that the family STEM event was their first experience with STEM, one parent said they attended a STEM related activity once a year, four parents stated they did not attend often enough, two parents said a couple times a year, one said once every few years, and one parent noted that their family only went to STEM related attractions when they were hosted at the school. In response to interview question of how often does your family attend STEM related activities or attractions, one parent answered, "Not very often, it's just the access

to it. I think if we had access to STEM events, we would go to it. Proximity to those kinds of things and not knowing where to get involved in those activities." Not all parents interviewed gave a reason for their lack of attendance, but those that did give a reason all shared that their reason for not attending STEM attractions more often was the distance of the study community to STEM related events or activities. One parent commented "Unfortunately, we do not attend many STEM related activities or attractions. It is a personal goal of mine to change that." The number attendants of the family STEM events show there is substantial interest in the study community to attend STEM related attractions. "We should continue to do them! I think they are a really good way for us, as families to interact in our students' worlds."

Many parents expressed interest in bringing STEM activities in to their homes. One parent was encouraged to do more STEM related activities at home, "After the Block Party, I definitely want to try to do more STEM at home, even if we don't go to very many activities outside of the home." A keyword that emerged from interview data was purposeful. Parents commented that they hoped to be more purposeful. After seeing her daughter's interest in STEM a parent said:

> I think it (family STEM events) just encouraged me to be more purposeful in doing those kinds of activities with her… It encouraged me and I got to see that she was headed in that direction. Made me more purposeful in what we do together.

A different parent said she learned that, "Play is productive and purposeful." Another parent said, "Watching them in such a fun learning environment may have changed my perception of how I lead them when they want to be creative." Parents engaged in

activities that could be done at home with minimal supplies and preparation. One parent commented:

> The big takeaway that I took from last night's STEM event is that there are activities that can be done at home with not a lot of items to have to purchase. STEM is important for education at school, as well as at home.

Parents were pleased with how engaged their families were with one another. Many of the activities planned for each family STEM event were organized with the intentional goal of encouraging collaboration as a family. Families were given time after some activities to reflect on what could have made their design better and to brainstorm changes to their design or approach. Parents commented that they like that they were able to look back, "It helped my son to vocally process what was happening." Families were listening to each other and giving the children the opportunity to lead and share their thoughts. The parents were once again able to see their young children as capable, valuing their ideas and input. One family comprised of a father, a mother, a five-year-old, a three-year-old, and a two-year-old, worked through a challenge and commented afterward, "It got the whole family talking and everyone had a job to do."

Each night parents were given tools of inquiry including guiding questions for parents to ask differentiated according to their own child's developmental level. Each event had its unique probing method based on the activities. One event included posters at each station with STEM subject objectives that could be accomplished and ways to enrich the play through inquiry, another event had specific questions to pose as the children were working through the activity, and another event utilized a ring of developmental questions parents carried around to scaffold their children into deeper

understandings of what they were doing. Each family STEM event also began with a short parent education presentation that was approximately ten minutes. After hearing the presentation and given tools for inquiry, parents were actively engaged in the activities and utilized the inquiry resources provided. A parent expressed:

> I feel like as parents with STEM stuff we need to be asking questions throughout the processes. So my kids are always building stuff but do I ever really sit down and ask the questions, why did you do it this way, how could you do it better? Or how might you improve it or do it next time? You know, I'm not very intentional with that and so I think the STEM night is just a good reminder that we could always be doing better at putting those questions in there to further their thinking in STEM activities, whether they are in school or not.

These data suggest if parents are given education and resources, they will be encouraged to use them when engaging with their children. Providing parents with opportunities to learn in authentic, facilitated STEM activities give them occasions to practice ways to enrich their family's learning experiences in the future.

The Extent of Parent Encouragement of STEM

According to the data collected in this study, parents in the study community would encourage STEM careers, believe their children are interested in STEM, and believe STEM education is important in their child's education.

All parents in the interview said they would like to see their child pursue a STEM career. After participating in the family STEM events one parent expressed, "He enjoys different aspects of STEM and I would love to see him having a career he loves, so I would absolutely like for him to pursue a STEM career." One activity during the

February family STEM event was to meet an engineer living in the study community. He spoke to the parents and kids about the engineering opportunities while living in the study area. A parent comment from the interview was:

> We see all the career opportunities that are available, especially for the kids growing up here. They are good jobs. They are well paying jobs. You can do a lot of really cool things and especially on the engineering side of it.

While all parents answered they would like their child to pursue a STEM career many interviewed also noted that they wanted their child to be happy, like this parent, "Yes, absolutely! I think that would be amazing! But I also want her to just be happy and passionate about what she does." By the answers given in the interviews, all parents would like to see their children pursue STEM careers but some also indicated an emphasis on their child's happiness and choice in career. When asked if she would like her child to pursue a STEM career, one parent illustrated her understanding of the diverse applications of children developing STEM related skills, "Sure, it just depends on what they are passionate about but I think that it (STEM) can be incorporated in any profession."

When posed with the question, do you believe your child is interested in STEM activities, all of the interview participants indicated that they did believe their child was interested in STEM activities. One parent said her perceptions of her children's interest changed:

> Specifically, the two younger ones, I never thought of them as being engineer-minded but they saw success and then they were excited about it and now they are excited about STEM. I think it opened their eyes to what STEM was.

Another interviewed parent said that attending the STEM events reaffirmed her belief that her child was interested in STEM activities and engaging with her child showed her more about how her child thinks, “She likes figuring out how things work, how to build something, and using her hands. I think it reaffirmed and showed me more, just how much she enjoys those activities and comes alive!”

After attending the family STEM events, parents in this study revealed that they think STEM instruction is important to their child’s education. All of the parents in this study indicated that they believe STEM instruction is important, one parent said:

> I think STEM instruction is very important in education. The careers that are available are changing at such a rapid pace, we have to build minds that are able to problem solve and adapt quickly. STEM instruction will only help my child to succeed in the future.

Another parent said, “We can start educating them on what this (STEM) could turn in to and be down the road. Encouraging them down a career path with their interest.” One parent was particularly moved by the video, “The Future of Work: Will Our Children Be Prepared?” showing the engineering technologies that are already in place that are changing the work environment and work force (Be, 2019). She expressed, “Just seeing the video at the last STEM activity, just seeing where our culture is heading. It is really important for them to be involved in STEM…Then our kids can be actively involved in where our culture is headed.”

Summary

The intention of this research study was to evaluate the impacts of family STEM events for young children on parents’ perception in a rural remote school. The research

method was a qualitative approach gathering data using parent interviews, researcher field notes, and photographs to document the interactions and happenings of each event. This research pursues clarity of two particular research questions. What are the attitudes of rural parents as it relates to STEM learning for young children? To what extent does parent participation in a rural school's STEM events reduce their STEM misconceptions? The first three chapters of this thesis exhibited a summary of the potential impacts of family involvement on achievement gains, STEM experiences in early childhood, public and parental perceptions of the capabilities of young children in STEM, provided context for rural remote school children, and outline the methods used to collect data for this study. Chapter four, the findings of the study, presented the themes and findings that emerged from the primary data sources compiled, including parent interviews and researcher field notes, and the secondary data source of photographs that support the themes produced. Three themes materialized from analyzing the qualitative data sources, new parent perceptions and possible remaining parent misconceptions, home connections and family engagement, and the extent of parent encouragement of STEM.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

Overview

The family STEM events held in the remote rural study community were well attended and families were actively engaged. Parents were equipped with resources and insights to more dynamically participate with their children, creating an enriched learning experience. Parents interviewed believed that STEM education was very important and that young children were capable of participating in STEM education.

Discussion

The family attendance and engagement were successful for the family STEM events. The attendance for the events were exceptional for the size of the study community. The elementary school in the community serves 70 children, preschool through sixth grade. The events had attendance that steadily rose as more people began to talk about the events with one another, chronological attendance being 45, 87, and 93 for the three months the family STEM events were held. Those attendance numbers include participating children and their families, the numbers do not include community members that attended just to spectate, like local pastors and priests, teachers, and senior citizens. These events were community events and were also represented in the local newspaper. This attendance is consistent with current research stating that parents of students in rural communities are more likely to attend school events than parents of students living in cities (National Center for Education Statistics, 2007). Statistics from the National Center for Education Statistics also found that students in rural remote schools have less access to out of school STEM learning experiences because of geographical access, which is consistent with the findings of this study. The families were not only present in

attendance but also were engaged with their children throughout the STEM experiences. This is consistent with research completed by Galindo and Sheldon, they found that schools that encourage family engagement and connections were more likely to have families more involved (2012). Parents were given a short educational presentation and ideas to guide children through the activities. Parents were actively engaged and leading children to process their thoughts through questioning. Research also finds that parents have interest in interacting with their children in science events but need support and guidance to most effectively engage in academic experiences with their children (Tuttle et al, 2017). This was consistent with data found in this study, but data compiled from this study may suggest that the same outcome could be applied outside of the subject of science, in STEM related activities as well. Making the most of rural family attendance and engagement has potential to nurture and encourage parents to explore STEM learning experiences both outside and inside the home. The research in this study found that participants showed an increased interest STEM related experiences both at home and seeking out STEM related attractions. Equipping parents through guidance and providing resources to enrich those STEM experiences could advance the knowledge gained by the children while participating in STEM play or activities. Exposing young children to STEM related activities is beneficial (McClure et al., 2017), but can be enriched through quality family engagement (Nugent, Kunz, Sheridan, Glover, & Knoche, 2017). When parents are interacting, probing children to think deeper and process what they are doing, the STEM play and activity is more meaningful and valuable. Parents play a critical role in developing problem solvers. With guided inquiry and scaffolded play, it is possible that children could understand, process, and verbalize their learning in a rich way.

Research has exposed common public misconceptions about capabilities of young children in STEM education (McClure, et. Al., 2017). Parents in this study were able to see their young children as capable of engaging in STEM experiences, from as young as birth. Research from Yanowitz and Hahas-Vaughn (2016), finds that child self-efficacy and parental beliefs about their child's capabilities in STEM disciplines are related to the child's future successes in STEM areas. It is possible that engaging in family STEM events could bring to light the capabilities of young children in regards to parental perceptions. Clements (2016), found that it is a misconception that young children are not capable of learning STEM concepts. This was inconsistent with the findings of this study. After participating in the family STEM events, parents were interviewed and all participants indicated that they do believe young children are able to learn in STEM education activities. Researchers at the Joan Ganz Cooney Center at Sesame Workshop suggest that waiting until children are older to expose and engage them in STEM activities and education is a missed opportunity (McClure et al., 2017). McClure and associate researchers go on to attest that it is very important for parents to understand that young children, as young as infants, are capable and ready to explore meaningful STEM play and engagements. Unfortunately, a common public STEM misconception is that young children are not ready for STEM related activities and should be taught those subjects in isolation first and later introduced to STEM activities after foundational skills are acquired first. Alternatively, Clements (2016), completed research that suggests that including STEM education in early childhood, could bridge the gap of disadvantaged children and their deficient knowledge base entering kindergarten (Clements, 2016). The findings of this study suggest the potential that parents who engaged in family STEM

events for young children do not have the common public misconception that research from The Joan Ganz Cooney Center at Sesame Workshop found, that STEM education is important for students who are advanced in STEM subject areas and STEM subject areas should be taught individually before introducing an interdisciplinary approach. Prior to having these experiences at the family STEM events, parents' responses may have been more consistent with Clements findings. It is possible that engaging in family STEM events could help to reduce this common parent misconception and help bring to light the capabilities of young children in STEM related activities.

One public misconception referred to by McClure and colleagues (2017), is that of gender stereotyping, some thinking that boys are naturally better at STEM subjects. The findings of this study are consistent with research about gender stereotype misconstructions (McClure, et al., 2017). It is important to continue with parent education and rich STEM experiences to abet gender stereotyping misconceptions in the study community. Parents and children should be explicitly enlightened on these common misconceptions, opening dialogue between educators, parents, and children about the competences of women in STEM careers. Exposure and experience with female STEM career role models could also help disprove the misconstructions. Another activity that could expose gender stereotype misconceptions could be to have genders compete in a STEM challenge, giving boys and girls the opportunity to authentically reveal that both sexes are equally capable of participating in STEM learning and challenges.

Parents in this study all indicated that they believed STEM education was very important to their child's education and that they would encourage their child to pursue a STEM career. The National Center for Education Statistics (2007), found that parents in

rural communities were more likely to believe their children will obtain a high school diploma as their highest attainment of education than their peers in cities and suburbs. This research is inconsistent with the results of this study. Revealing current workforce innovations, exposing parents to STEM careers, and observing their child's capabilities in STEM activities could potentially encourage parents to aspire for more for their children than a high school diploma as the highest level of education.

Conclusions

Engaging parents in STEM activities, exposing them to STEM careers, and introducing parents to the current advances in agricultural technology has the potential to stimulate parents' perceptions of the importance of STEM education and the capabilities of young children in our community. A gender stereotype misconception may still remain after participating in a family STEM event. Making the most of the benefit of rural family participation could encourage parents to pursue STEM learning experiences with their children and enrich their engagement with their children in STEM related activities. It is important to continue give families rich STEM experiences, guiding parents through education and equipping them with tools so that they can be knowledgeable about what they can do at home, what experiences to seek out, and for parents to acknowledge the potential of their young children both presently and in the future.

Family STEM events could be a powerful tool to develop positive parent and community perceptions of the importance of STEM education and the capabilities of young children participating STEM related activities. The findings of this study could serve as a model for other schools looking to improve the perception of STEM education in early childhood. The administration at the study school has already approved family

STEM events for the next school year. The teachers, parents, local school board, and administration have expressed interest in continuing the family STEM events and have been encouraged by the community response. Our school is diligently engaged in a Profession Learning Community Triad with two other area schools that are not only geographically close but also very similar in school demographics as well. There has been interest expressed by other communities to hold similar events. The open lines of communication among the schools has potential to encourage family STEM events in surrounding areas, with possible impacts not only the study community but also expanding. Another avenue to share the results of this study, could be to present these findings at educational conferences such as the Nebraska Academy of Sciences, Nebraska Association of Teachers of Mathematics, other state education conferences, and possibly national conferences as well.

Limitations

There are limitations of this study to address. This study community is exceptionally geographically isolated, even in the context of what is considered remote. The study school has a very high participation rate for school and community events. This context may make the study a unique situation and difficult to replicate the results of this study. This context may limit the study's capability of generalizability.

Though all of the consenting parents were put into a pool and randomly selected the sample size of the study is small with a total of 26 consenting families. There were eleven interview participants which could be considered a small sample size when attempting to replicate the data compiled.

Another limitation of the study was that the interviews were completed after participating in the family STEM events, therefore perception changes and current perceptions were recorded and documented after engaging in the events. It is also important to note that these events and interviews were completed in a relatively short time frame, the months of February through May of 2019.

Future Research

Future research is needed to offer more clarity and reliability. Further research could be completed to gain understanding with regards to remaining gender stereotype misconceptions. Posing research questions could include: How typical is the parent perception in rural areas that sons are more capable in STEM activities than daughters? How would that research differ if the family had only daughters? To what extent does birth order of the genders make a difference in the parent perceptions of capabilities? To what extent do rural remote areas reinforce the stereotypes of gender specific abilities and careers? How consistent are these findings with data compiled in suburban or urban areas?

Another area of future research could include following up on the families that had parents interviewed. Finding whether or not parents did seek out STEM related activities at home or outside of the home, and if children that participated in STEM activities in family time would be more likely to pursue a STEM career.

Future research replicating this study in a different area may address the limitations included in this study.

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APPENDIX A: Parent Interview Questions

Parent Focus Group Questions

1) Do you believe your child is interested in STEM activities?
    a. Did participating in last night's Family STEM event reaffirm or change that perception?
2) Did participating in last night's Family STEM event change any of your perceptions about your child? If so, in what way?
3) When do you think STEM education should start?
4) Before last night, what did you think STEM was for early childhood students?
    a. Did attending the Family STEM night change your perceptions of when STEM education should start?
        i. If yes, can you tell me more about what made your perception change?
5) Are there any new things you learned about the way your child thinks?
6) How often do you attend STEM related activities or attractions?
7) How important do you think STEM instruction is to your child's education?
8) Would you like to see your child pursue a STEM career?
9) What were some takeaways you observed from last night's STEM event?
    a. Was there a memorable activity or moment?
10) If I was going to do this again next month (on the last night, next year), what advice would you give me?

APPENDIX B: February family STEM event

February family STEM event schedule and activities with descriptions.
Thursday, February 21, 2019
Though each night including families with children of all ages, this event's activities were planned with children Kindergarten through sixth grade in mind.
There were 45 family members in attendance, this number does not include volunteers, teachers, community members, and local clergy in attendance.

In planning the first family STEM event, I used two specific resources, "Family engineering: An activity & event planning guide," (Jackson, 2011) and Vivify STEM Bundle: STEM Family Night Planning Guide, STEM Activity Instructions, Posters (Vivify STEM) to help plan the event and have it run smoothly. This was the first event like this ever held at the school. Activities were chosen based on research by Tuttle and associates (Tuttle et al., 2017), the activities chosen had elements that were interactive, collaborative, contained a mutual goal, and/or were open-ended. It was also important for the families to have fun and enjoy the activities!

5-5:15- Welcome/Sign in-Consent Table
5:15-Introduce the night and begin short parent education session.

Parents were introduced to STEM activities and the importance of being fully engaged with their children throughout the event. Each station had questions to guide inquiry and encourage children to vocalize their process. I spoke to families expressing that while STEM activities are beneficial but when parents are interacting and probing with questions it is possible for children to understand, process, and verbalize the learning of the activities in a richer way. Presentation points included:

a. What is STEM?
b. Encourage families to work together, talk/ discuss, and be engaged throughout the night
c. Engineering focus tonight- Design Process: While this night was an integrated STEM event, many of the activities had an engineering emphasis. stEm
d. Community Career Role Model speaking- The guest speaker was an engineer living in the study community. He spoke about the opportunities in engineering and the multitude of ways that engineering innovations affect and shape our daily lives. The exposure to an engineer in our community introduces young children to the career and hopefully makes the career seem more attainable and realistic for both children and parents.

5:45- Ice breaker Family STEM challenge- Families were to work together to create the tallest freestanding structure from notecards and tape with an eight-minute time constraint. Families were then asked to reflect on their design and discuss possible improvements.

6:00- 6:30- STEM activities positioned throughout the school and gymnasium. At each station the families had resource posters with real world connections, guiding questions for parents, and related STEM careers.

Arches: Families explored the strengths of various arches.
Build a Boat: Families used a piece of tin foil to build a boat that could hold the most amount of pennies possible.
Domino Diving Board: Families worked to build a ledge that could extend to or beyond the specified goal point, using a ruler to measure progress.
My foot, your foot: Families explored measuring with each family members foot for a specified number of steps and then measured using meter sticks or masking tape. This activity explored the topic of the necessity of standard units of measure.
Who Engineered It: Families worked to together, matching engineered products and the engineering career fields involved.
Inspired By Nature: Inventions and innovations were examined to match the nature inspired invention with the corresponding element from nature.
Paper Footballs: Families constructed paper football that could fly through finger goal posts. They kept track of accuracy and using fractions and percent when applicable (for older children).

APPENDIX C: March family STEM event

March family STEM event schedule and activities with descriptions.
Thursday, March 21, 2019
Block Party
Though each night including families with children of all ages, this event's activities were planned for children ages birth through third grade.
There were 87 family members in attendance, this number does not include volunteers, teachers, community members, and local clergy in attendance.

To begin to explain this event it is important to first acknowledge the training associated with the event and the collaborating entity involved. The preschool teacher and myself scheduled a "Block Party" event inviting an extension educator from The Learning Child Team, from the UNL extension office. The volunteer event facilitators and myself were trained on the benefits of block play, how to enrich block play for our students, and how to guide families through an effective questioning process during various levels of play or ages. Another focus of the training was to teach us to be facilitators for the night, coaching parents on how to "get more," or enrich block play for their children through guided inquiry.

5:00-5:20 Parent Education Presentation. The UNL Extension educator, the study school's preschool teacher, and myself gave the presentation. We wanted to reveal to parents the research based benefits of family engaged block play and the advantages of encouraging productive struggle and independent problem solving. We discussed and learned the cognitive developmental stages of block play and how to scaffold children through inquiry. The training provided research based benefits of block play and how to successfully interact with children, scaffolding their play and mental processing through questioning. The families particularly enjoyed the points about encouraging productive struggle and independent problem solving. Parents were given handout and pamphlets detailing the information discussed and more. They were given handouts of how to make blocks at home using cardboard boxes, a Block Party Pamphlet, and each family received a ring of developmental block play stages and specific questions to scaffold that level of play.

5:30 Block Play The families were able to carry and refer to the guided inquiry rings throughout the event. Scattered throughout the block play areas were canvas posters informing parents on the specific academic and social emotional connections that could be addressed through the that type of block play. These areas included STEM subject areas as well as Language Arts connections. The event was set up in the gym with stations containing a wide variety of block play and ensuring that children could roam and experience seamless free play. There were stations that were designed with babies in mind with easily stackable block with varying textures and sensory opportunities. There were stations that had block materials of all kinds including Keva planks, buildable tree blocks, bristle blocks, foam blocks, mixed textured blocks, a wide variety of traditional wooden building blocks, mental blox-a logic puzzle with blocks of different shapes and patterns, colored patterning blocks, magnetic tiles, wooden building arcs, and a plethora

of building accessories to enhance imaginative constructions like animals, wooden vehicles, and printed rugs.

APPENDIX D: May family STEM event

May family STEM event schedule and activities with descriptions.
Wednesday, May 1, 2019
Though each night including families with children of all ages, this event's activities were planned for children Kindergarten through sixth grade.
There were 93 family members in attendance, this number does not include volunteers, teachers, community members, and local clergy in attendance.

5:00-5:20 The last family STEM event of the year incorporated more technology than the other events, sTem. Each STEM event began with an attempt to enlighten parents with education or exposure. This event presented a video about 3 minutes in length, called the "Future of Work: Will Our Children Be Prepared?" This video illustrated the innovations that are changing the work force now and in the future. This was particularly poignant because of the many agricultural production connections. Families and the group discussed the importance of STEM education and its role in the future.
I spoke briefly on the capabilities of young children in coding and robotics. I explained what coding was and its immersion in our everyday lives.
The Jr. High and High school Science Olympiad Sponsor introduced the Science Olympiad program and encouraged families to participate in the kids' stations.

5:30- 6:30 Families participated in STEM related activities

Coding Cave- The lunchroom was filled with coding and robotics activities for families to explore. Activities included: Literature and Language Arts activities exploring the theme of coding and offering an explanation of what it is and examples in the real world, Scratch, Scratch Jr, PBS Scratch Jr, Code Spark- the Foos, Osmo Applications- Coding with Awbie and Coding Jam, Dash Robots with Dash coding and robotics applications, Ozobots with color coding markers and coding applications.

Spaghetti and Marshmallow Challenge- Construct the tallest structure possible with a large marshmallow on top, using marshmallows and spaghetti noodles.

Heart Rate Math- Find and track your pulse. Then do various exercises to try to raise your pulse as much as possible.

Science Olympiad Presenters: Junior High and High School students presented on their Science Olympiad subject. For example one group designed and built a battery operated car and let families drive it and spoke about their process to complete it. Another student took a test on Morse code but created a presentation by informing families on morse code and creating a morse code for families to break, it was a Disney Quote.

States of Matter exploration with bubbles and slime: Families examined properties of the three states of matter and categorized items based on their properties. QR codes were hung for families to watch short entertaining videos on the States of Matter and Non-

Newtonian substances. Families were able to explore Math with bubbles by using various bubble wands to create different shapes, like a cube bubble for instance. They were able to create giant bubbles with a baby pool and hula hoops. Families made and explored slime. Inquiry and information posters were posted to lead parents to discuss states of matter and math concepts specific to the activity. For instance, slime does not fit into the defined properties of any of the states of matter. Bubbles are a liquid holding gas. Bubbles can be in different shapes, cube, sphere, etc.