A CASE STUDY OF TEACHERS OF ELEMENTARY GIFTED STUDENTS AND THEIR
PERCEPTIONS OF BEST PRACTICES FOR TEACHING VISUAL SPATIAL ACTIVITIES
IN THE CLASSROOM

by

Sandra J. Young

Liberty University

A Dissertation Presented in Partial Fulfillment
Of the Requirements for the Degree
Doctor of Philosophy

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ABSTRACT

Elementary gifted students with spatial strengths are often overlooked, under identified, and underserved in elementary school. The purpose of this qualitative case study was to identify how visual spatial training can be implemented in the elementary gifted curricula and how the teachers of the gifted program can be supported in their efforts to develop visual spatial activities for the elementary gifted classroom in a large, urban school district in South Carolina. There are approximately 35 teachers of the district’s elementary gifted program. This program services those students in grades 3, 4, and 5 who qualified based on state-mandated criteria. The participants came from this group of teachers and were selected based on willingness to participate. This study sought to answer the questions: what are the perceptions of best practices of elementary gifted teachers with teaching and using visual spatial activities in the gifted classroom, and how can the district’s elementary gifted program support and further equip gifted elementary teachers to enrich the spatial ability of students in the gifted program? The conceptual framework guiding this study was the theory of mindset (Dweck, 2006) with influences of Albert Bandura’s theory of self-efficacy (1977). Dweck’s mindset theory provided the theoretical framework as it relates to the perceptions and beliefs that teachers and students have about learning and intelligence. Through the use of a self-efficacy survey, individual interviews, and physical artifacts, data was collected and analyzed, and themes in teachers’ perceptions of best practices for teaching visual spatial activities were identified.

Keywords: visual spatial intelligence, spatial ability, spatial reasoning, STEM, gifted students, gifted curricula, technology, project-based learning, gaming, best practices, self-efficacy, growth mindsets, fixed mindsets
Dedication

The glory through this process goes to God. I dedicate this dissertation to my Lord, Jesus Christ. It was a collaborative effort, with the Lord providing me with the strength, wisdom, and motivation to complete this. I never felt alone during this journey as I knew He was with me every step of the way.

The credit goes to my parents who gave me a beautiful childhood and upbringing. They taught me about life, and the lessons I learned from them have guided me through my entire life. My mom, Mary Taylor, who showed me how to be a loving and giving mother and how to live a Godly life. She gave, and continues to give, so much to her family, always putting others first. Mom, your lessons helped create a firm foundation for my life. My Dad, Jackie C. Taylor, whom I know was so very proud of me and wanted to see me accomplish this goal. He always believed in me and encouraged me to achieve my dreams. He changed the narrative for my family, not only for me but for the lives of my children. I owe so much to him and know that I’m the person I am today because of him. Dad, thank you for the amazing memories you left with me. Yours’ was a life well lived. And thank you for teaching me about staying on the train. I’m still riding, Dad! Thank you, Mom and Dad, for seeing me, loving me, and making me feel that I was the most important person alive.

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List of Abbreviations

2D (Two-dimensional)

3D (Three-dimensional)

Cognitive Abilities Test (CogAT)

Coronavirus Disease 2019 (COVID-19)

Elementary and Secondary Education Act (ESEA)

Every Student Succeeds Act (ESSA)

Gifted and Talented (GT)

Institutional Review Board (IRB)

Jacob Javits Gifted & Talented Students Education Act (Javits)

Naglieri Nonverbal Ability Testing (NNAT)

National Association for Gifted Children (NAGC)

National Council of Teachers of Mathematics (NCTM)

National Research Council (NRC)

National Science Board (NSB)

Otis-Lennon School Abilities Test (OLSAT)

Performance Task Testing (PT)

Science, Technology, Engineering, Mathematics (STEM)

Wechsler Intelligence Scale for Children (WISC)
CHAPTER ONE: INTRODUCTION

Overview

Visual spatial ability, defined as “the ability to generate, retain, retrieve, and transform well-structured visual images” (Lohman, 1994, p. 254), has been linked to academic achievement in science, technology, engineering, and mathematics (STEM) fields (Lakin & Wai, 2020; Metz et al., 2012; Wai & Uttal, 2018). Gifted students, considered to have the greatest potential of having STEM careers, do not always receive curriculum that is appropriate for their intelligence and abilities (Lakin & Wai, 2020; Senne & Coxon, 2016). In particular, elementary gifted students with spatial strengths are often overlooked and underserved. More research is needed to describe, understand, and evaluate the best practices of teachers using visual spatial activities in the elementary gifted classroom. This data could potentially be of value to educators and curriculum developers of elementary gifted programs. To that end, this chapter discusses the background of visual spatial intelligence, the problem and purpose statements, the research questions, and the key terms that will be used throughout this study.

Background

Currently, there are over 3.2 million American children being served in gifted programs in the United States (NAGC, 2019). Despite a federal law that recognizes the needs of the gifted students (Every Student Succeeds Act (ESSA)), a national curriculum for gifted education programs does not exist. The National Association for Gifted Children (NAGC) does provide Pre-K-Grade 12 Gifted Programming Standards, which they recommend be used a tool in creating differentiated curriculum for gifted learners (NAGC, 2019). Most elementary gifted programs are focused on enrichment and accelerated learning in math and language arts with little change in the last 20 years (Callahan et al., 2017). Gifted education must continuously
monitor and adapt to the trends in society, including the STEM initiatives, which are considered key components of 21st century education (Andersen, 2014). One way that elementary gifted programs can support these components is the inclusion of visual spatial puzzles and activities in the gifted curriculum.

Visual-spatial intelligence is the ability to orient and manipulate three-dimensional space (Moran et al., 2006). According to Logsdon (2019), spatially intelligent individuals tend to have advanced nonverbal cognitive skills, which includes the ability to analyze and problem solve using spatial reasoning. Additionally, visual-spatial ability is considered to be a “multifaceted component of intelligence that has predictive validity for future achievement in STEM occupations” (Andersen, 2014, p. 114). To think spatially involves three elements: concepts of space, tools of representation, and reasoning (National Research Council, 2006).

While there is literature on visual-spatial intelligence and the connections with STEM fields, there is very little research on the effects and benefits of visual-spatial activities with elementary gifted students and even less research on the perceptions of teachers and their best practices with teaching these activities to elementary gifted students. Given a study of visual-spatial puzzles and activities with elementary gifted students, educators can use this information to create and develop appropriate, advanced and rigorous curriculum for elementary gifted students. Early interventions aimed at improving the spatial reasoning of young gifted children can lead to later academic and career success (Hawes et al., 2017). Gaining these skills at an earlier age may better prepare these advanced learners for STEM education and careers and help them reach their highest potential.

**Historical Context**
From the beginning of time, humans have had to rely on spatial intelligence to survive and navigate in their world (Newcombe & Frick, 2010). Early man crafted concrete tools from abstract ideas, after imagining the shapes that would perform necessary functions. Over a century of research has concluded that spatial thinking is the principal complement to verbal thinking (Newcombe & Frick, 2010). Spatial intelligence and abilities have been widely studied and found to be fundamental to higher order, critical and creative thinking and reasoning skills (Sorby et al., 2013). Spatial reasoning can help in domains that are not obviously spatial, such as the use of graphs, maps, and diagrams (Newcombe & Frick, 2010). Spatial abilities are particularly important in the fields of science, technology, mathematics, and engineering. For example, when the famous physician John Snow drew the cholera map to indicate how the disease was spread, spatial abilities were used (Newcombe & Frick, 2010). In 2005, the Johnson O’Connor Research Foundation tested 32,000 people on cognitive abilities and found that the spatial visualization skills of engineers were highly developed compared to other professions (Sorby et al., 2013).

Following the Soviet’s launch of Sputnik in 1957, there has been a national focus on accelerating the development of the intellect of America’s youth, and the field of gifted education was thrust into the national spotlight. Since then, gifted programs have continued to evolve and expand. The Elementary and Secondary Education Act (ESEA) was established in 1965 to ensure civil rights and quality education for all students (United States, 1965). A report released in 1972 by Congress, Education of the Gifted and Talented (Marland Report) stated that over 50% of gifted students were underperforming and underachieving (Marland, 1972). The 1983 publication of A Nation at Risk, a report released by the National Commission on Excellence in Education, caused national attention on education as the report detailed how
American students were being outperformed by students from other countries (National Commission on Excellence in Education, 1983). In 2015, President Obama signed the Every Student Succeeds Act (ESSA) which includes key sections for the specific needs of gifted and talented students (NAGC, 2020). ESSA, which evolved from the Elementary and Secondary Education Act (ESEA) and originally known as “No Child Left Behind”, is the primary K-12 federal education law which includes programs such as the Jacob Javits Gifted & Talented Students Education Act (Javits) (NAGC, 2020). The Javits Acts, which is the only federal program dedicated specifically to gifted education, does not provide funding to local gifted education programs (NAGC, 2020).

In the same year that the Russians launched Sputnik, a report was released by the National Science Foundation (NSF), which contained recommendations for future research on identifying and developing programs to support exceptional careers in science and engineering (Lubinski, 2010). The report, *Scientific Careers*, discussed the characteristics of those individuals with STEM talent and noted that spatial ability are often salient features of individuals with exceptional general intellectual potential (Lubinski, 2010). This suggestion was later supported by empirical evidence from longitudinal studies (Shea et al., 2001, Wai et al., 2009).

In 1980, the National Council of Teachers of Mathematics (NCTM) declared that mathematically gifted students are the most neglected in terms of realizing full potential. According to the NAGC (2008), the research shows this is the case for science as well. Test scores indicate that there has been little progress in addressing this need (NAGC, 2008). Despite its fundamental and significant role in mathematics and science, spatial training is not typically included in the K-12 curriculum (National Research Council, 2006). In the report *Learning to
Think Spatially, issued by the National Research Council (2006), the authors noted that spatial thinking can be learned and should be taught at all education levels. An emphasis on visual-spatial intelligence and ability is needed in gifted programs (Andersen, 2014). Gifted students, who traditionally excel in math and science, need this instruction (Wilson, 2018; Yoon & Mann, 2017).

Many researchers consider the cognitive skills of visualizing in three dimensions to be linked to the success in STEM fields (Metz et al., 2012; Sorby, 2009; Towle et al., 2005; Webb et al., 2007). STEM is at the centerpiece of the current Secretary of Education’s comprehensive education agenda with the U.S. Department of Education investing nearly $540 million to support STEM education as of November 2019 (U.S. Dept. of Ed., 2020). In December 2018, the Committee on STEM Education of the National Science and Technology Council released a five-year Federal strategy that defines a vision for the best STEM education in the U.S. education system, including an interdisciplinary approach to the learning of these four disciplines.

It is the recommendation of the NAGC, that gifted students be provided learning opportunities that provide depth, complexity, critical-thinking, creative production, and research (NAGC, 2020). They advise teachers of the gifted to offer activities that provide problem finding and problem-solving skills which stimulate mathematical reasoning and spatial reasoning in order to meet the unique academic and social-emotional needs of these diverse learners (NAGC, 2020).

Social Context

Visual spatial ability is essential to everyday life. It is used to see the existence of people, objects, structures that exists in space, patterns, shapes, and directions (National Research
Council, 2006). It is used when problem-solving, as it helps with analyzing, transforming, and communicating data, especially complex data sets (National Research Council, 2006). Visual spatial skills are used to understand maps, charts, diagrams and appear in computer and phone apps and other equipment used daily (Bobek & Tversky, 2016). These skills underlie the STEM concepts needed and used by the largest employers and business (Bobek & Tversky, 2016).

Spatial ability is a fundamental skill needed for scientists and engineers and has played a critical role in many significant scientific and technical discoveries including the discovery of the structure of DNA and Einstein’s theory of relativity (Hawes et al., 2017; National Research Council, 2006). In the current COVID-19 pandemic, researchers, scientists, and medical personnel may need to call upon visual spatial skills as they work to understand and battle this, as well as other, viruses.

Education curricula is often a reflection of the values of society (Lalor, 2016). The National Research Council (2006) stated that math and science are the two most valued subjects and the success of these subjects is to think spatially. Despite the significance, visual spatial ability is not systematically taught in the K-12 curriculum, particularly within early educational contexts (Clements, 2004; Clements & Sarama, 2011; Hawes et al., 2015; National Research Council, 2006). These skills can be learned and are essential for the current and future world (Uttal et al., 2013). According to its 2010 report, *Preparing the Next Generation of STEM Innovators*, the National Science Board (NSB), suggests expanding the search for STEM talent beyond the traditional high verbal and mathematics skills sets to include those with high spatial ability (Sorby et al., 2018).

Visual-spatial intelligence is often overlooked in gifted education, despite the fact that STEM initiatives are a national priority (Andersen, 2014). There are few studies examining how
spatial activities and instruction impact STEM reasoning in younger students (Burte et al., 2017). Children develop foundational cognitive skills during their early years and waiting until high school to teach these critical visual-spatial and STEM skills may be too late to capitalize on a student’s ability to learn them at a much earlier age (Burte et al., 2017). A lack of learning opportunities for visual spatial intelligence development poses a threat to continued STEM innovation (Senne & Coxon, 2016). Ultimately, this can affect businesses who seek people with STEM degrees. Due to the global COVID-19 pandemic, even people with careers not typically associated with STEM degrees find themselves thrown into the world of technology, whether performing their job virtually or in helping their children navigate through e-learning. Now, more than ever, the development of visual spatial ability skills needs attention and further studied.

**Theoretical Context**

The theoretical framework used in a study helps the researcher to narrow the focus of the research to the most important ideas and factors for the study (Rockinson-Szapkiw & Spaulding, 2014). The theories used in educational research help researchers make sense of interrelated phenomena (Check & Schutt, 2012, p. 34). For this study, Carol Dweck’s (2006) theory of fixed and growth mindsets was used as the theoretical framework. Dweck’s theory guided this study of the perceived benefits of using visual-spatial activities in an elementary gifted classroom.

Carol Dweck’s (2006) theory of fixed and growth mindsets is based on the research she conducted about the beliefs and mindsets that people have and how these mindsets potentially affect a person’s motivation, achievement, and overall well-being. Having a growth mindset can lead to benefits including the understanding that meaningful growth is possible for all and can be achieved through sustained effort, good strategies, and guidance from others (Dweck, 2019). A
person’s mindset can play an important role in motivation, performance, and achievement (Dweck, 2006; 2015). As a result, growth mindset practices have been widely adopted and implemented in education (Dweck & Hogan, 2016; Dweck, 2019).

Similarly, Bandura’s (1990) social cognitive theory, which suggests that people not only learn from their social environments, but that they also use cognitive and social factors to process information, can been applied to educational principles. In regard to the learning process, Bandura contributes self-efficacy as one of the determinants of motivation and the one most closely related to the field of growth mindsets (Pajares, 1995). Teacher self-efficacy can influence students and their achievement (Tschannen-Moran & Hoy, 2001).

Dweck’s (2006) theory of mindset was used as the theoretical framework for this study along with influences of Bandura’s theory of self-efficacy (Bandura, 1977). Literature regarding visual spatial ability, the benefits as they pertain to gifted students and curriculum, and the connection to growth mindset are examined and discussed.

**Situation to Self**

My background includes 26 years of public-school teaching, with the last 22 years being in gifted education. I earned a master’s degree in gifted education and have written curriculum for the district’s gifted program. Currently, I teach the gifted program for third, fourth, and fifth grade students who qualified for gifted services based on state-mandated criteria. Having a background in gifted education, my beliefs and opinions are based on my experience as a teacher as well as my education. As an advocate for quality gifted education, I strive to expose my gifted students to learning opportunities that stretch their minds and expand their knowledge while helping them reach their greatest potential. Within our curriculum, there is some flexibility for teachers to add and enrich as needed. I enhance the curriculum with the addition of various
visual spatial skill activities. It is my belief that most of the GT teachers do not purposely expose their students to visual spatial activities, instead choosing other enrichment opportunities. Until it becomes an actual objective in the curricula, spatial training activities will require teachers to choose to incorporate it on their own.

As part of this study, I interviewed each teacher participant and explained the study’s procedures and answered any questions they had. Using a survey, interviews, and physical artifacts, I collected important data for the study. While I know most of the teachers who teach in the gifted program and have worked with them for many years, I am not in a supervisory role over any of them. I am confident that I stepped outside my role as teacher and peer of the teacher participants and set aside my personal opinions in order to learn and gain insight from their perspectives.

As the human instrument in this study, I approached my study and research through certain paradigms and epistemological assumptions. A paradigm, also known as a worldview, is a basic set of beliefs that guides people through certain actions (Guba, 1990). The paradigm that guided me was social constructivism as I sought to understand and gain meaning from the experiences and perceptions of others (Creswell & Poth, 2018). Through my research and study of other teachers of gifted students, I better understand my career world which is the field of gifted education. A social constructivism framework with an ontological philosophical belief involves the construction of multiple realities, which can be subjective and varied, through the participants’ experiences and interactions with others (Creswell, 2013). Using an ontological philosophy, the multiple perceptions and self-efficacy views of the participants provided this study with the essence of reality through their own voices. As I explored the perceptions and best practices of my peers, it was important to gain the varied perspectives of this diverse group.
Epistemological, or philosophical, assumptions underlie qualitative research in that they help determine the research goals and outcomes (Creswell & Poth, 2018). These assumptions are the guiding philosophy behind qualitative research (Creswell & Poth, 2018). The epistemological assumption of relativist perspective guided me on this qualitative case study as I collaborated and worked alongside the participants in order to gain the subjective experiences and perceptions (Creswell & Poth, 2018). Creswell and Poth (2018) noted that it is important in qualitative research to conduct studies at the participants’ workplace in order to gain valuable contexts of understanding for what the participants are saying. The goal of the research was to rely on the participants’ views and perceptions which were multiple and varied (Creswell & Poth, 2018). The axiological assumption of qualitative research involves the researcher making their values known in the study (Creswell, 2013). Because I am the primary instrument in this study, my values and biases were defined and identified throughout each phase of the research in order to ensure the validity and reliability of the study.

**Problem Statement**

Gifted students do not always receive curriculum that is appropriate for their intelligence and abilities (Lakin & Wai, 2020; Senne & Coxon, 2016). Visual-spatial skills are often ignored in gifted education, despite the fact that STEM initiatives are a national priority (Lakin & Wai, 2020; Metz et al., 2012; Wai & Uttal, 2018). Numerous studies have shown that there is a strong connection between spatial skills and STEM outcomes, and further evidence that visual spatial skills are strong predictors of future interest, education, and success in the STEM fields (Burte et al., 2017; Newcombe & Frick, 2010; Senne & Coxon, 2016). The problem is gifted students with spatial strengths are often overlooked, under-identified, and underserved in elementary school.
According to Newcombe and Frick (2010), there is strong evidence suggesting that progress and performance in STEM fields is significantly related to people’s spatial ability. Studies have revealed that middle and high school students with higher spatial skills are more likely to major in STEM degrees and pursue STEM careers (Shea et al., 2001; Wai et al., 2009). Other studies have shown that spatial ability can be improved and is considered malleable (Baenninger & Newcombe, 1989; Bruce & Hawes, 2015; Uttal et al., 2010). Another study showed that even a single session of spatial training with elementary students led to significant improvements on certain math problems which further supported the claim that spatial ability and mathematical reasoning are connected (Cheng & Mix, 2014). Sorby et al. (2013) discovered through their research that Michigan Tech University engineering students who tested as having poor spatial skills at the beginning of their freshman year showed substantial overall performance improvements in spatial skills and improved grades in a calculus course after spatial interventions.

Students who exhibit giftedness in spatial reasoning are successful in mathematical and scientific problem-solving (Mann, 2014; Wai et al., 2009). In this global, competitive world, educators cannot afford to waste the talents of these gifted students who have the greatest potential to become leaders in the STEM fields (Adams et al., 2008). While there are numerous studies on the benefits of visual spatial training on high school students, there are very few detailing how and why visual spatial training should begin in elementary school. Additionally, there are gaps in the literature regarding the identification and education of children with spatial strengths and the factors that contribute to the success and frustration of gifted students with spatial strengths (Mann, 2014). Often in gifted programs there is flexibility in the curriculum where teachers can add appropriate material and instruction to enhance and challenge these
unique learners. Curriculum should not be thought of as a program that teachers teach “as is” (Tomlinson, 2014). Teachers have the ability to embed visual spatial activities within existing curriculum. Educators must learn how to nurture the strengths of the gifted learners, including visual spatial intelligence, because these future adults are valued and needed by society for problem-solving in the real world (Mann, 2014). For this study, I examined the perceptions of best practices of teachers of elementary gifted education with using visual spatial activities in the gifted classroom. With some thought and creativity, limitations to the teaching tools available for developing spatial ability can be minimized, resulting in positive returns (Uttal et al., 2013).

Currently, gifted students are not receiving the instruction they need in order to maximize their visual spatial development. In an effort to shed light on the importance of early spatial training, this study examined educators’ perceptions of best practices and self-efficacy with regard to developing spatial skills especially with respect to elementary gifted students.

**Purpose Statement**

The purpose of this qualitative single-case study is to describe the perceptions of best practices of elementary gifted teachers with teaching and using visual spatial activities in the gifted classroom, and examine how the district’s elementary gifted program can support and further equip gifted elementary teachers to enrich the spatial ability of students in the gifted program. The teachers all work with students in the elementary gifted program in a large urban school district in South Carolina. At this stage in the research, best practices of visual spatial activities in the elementary gifted classroom is generally defined as those activities resulting in a positive student and teacher experience for the participants, and activities which promote the development of visual spatial ability. Spatial activities which would require and/or promote visual spatial ability could include mental rotation, such as predicting the three-dimensional form
of a two-dimensional representation. Another possible activity would require students to mentally flip or rotate an object and then predict what the object would look like from another angle. The theory guiding this study is the theory of fixed and growth mindsets (Dweck, 2006) with influences of Bandura’s theory of self-efficacy (Bandura, 1977). Dweck’s (2006) growth mindset theory, which describes how one’s beliefs about effort and perseverance through challenges can impact achievement and success, was used as a theoretical foundation as this study examined how growth mindset can impact elementary gifted education, particularly in regard to the inclusion of visual spatial activities. Bandura’s (1977) theory of self-efficacy influences the theoretical foundation as the self-efficacy of the teachers can influence students and their achievement (Tschannen-Moran & Hoy, 2001).

**Significance of the Study**

The significance of the study was to further investigate and add to the literature the ways in which teachers can incorporate visual spatial activities into the gifted classroom. There is very little research on how teachers go about teaching visual spatial activities, especially with elementary gifted students. Due to this lack in research of how teachers can integrate visual spatial training in gifted education, affected teachers may be unable to provide these students with opportunities that could maximize their abilities. Through this research, teachers of gifted education may be given tools for personalizing and extending the gifted curricula beyond what is expected, directly expanding their toolbox and enhancing their ability to teach, and thus their work environment. On a wider scale, society may benefit from this research as teachers of gifted students have a responsibility to meet the needs of these high-ability students who have the potential to be future STEM leaders and global problem-solvers (Wai & Worrell, 2016). This research is important as many researchers consider the spatial and cognitive skills of visualizing
in three dimensions to be connected and linked to success in the academic disciplines of science, technology, engineering, and mathematics (Metz et al., 2012; Webb et al., 2007). According to the National Research Council (2006), spatial thinking is not an add-on to the already existing curriculum but rather a missing link which would enable students to achieve a deeper and more meaningful understanding of subjects across the curriculum. The findings of this study may have theoretical significance for researchers, gifted education policy makers, educators, and students.

Dweck’s (2006) theory of fixed and growth mindsets, which is the theoretical foundation for this study, focuses on how the beliefs and mindsets that people have may potentially affect a person’s motivation, achievement, and overall well-being. Since mindset plays an important role in motivation, performance, and achievement, growth mindset practices have been widely adopted and implemented in education (Dweck & Hogan, 2016; Dweck, 2019). In addition, Bandura’s (1990) social cognitive theory, which strongly influenced this study, suggests that people not only learn from their social environments, but that they also use cognitive and social factors to process information. As a result, teacher self-efficacy can influence students and their achievement (Tschannen-Moran & Hoy, 2001). Therefore, this research may support the importance of implementing growth mindset into education practices and curriculum, as a teacher’s mindset and self-efficacy can directly affect and influence students.

**Research Questions**

There is significant literature on the benefits of visual spatial ability and the connections with STEM success, but the majority of the research is on high school or older students. There is a gap in the literature on the benefits of using visual-spatial activities and the connections with STEM, as it pertains to younger students, particularly gifted elementary students. Visual-spatial activities may improve students’ problem-solving skills, nonverbal cognitive intelligence,
logical-mathematical intelligence, and visual-spatial intelligence (Andersen, 2014). Through a curriculum rich in activities that promote visual-spatial intelligence, STEM features, and critical thinking and problem-solving, the uniqueness of the gifted learner is recognized and encouraged. This type of curriculum can lead to later academic and career success (Hawes et al., 2017). The following questions have been developed in order to learn more about the perceptions and best practices of using visual spatial activities in the gifted classroom.

Central Question: How can a gifted program be improved to equip and support gifted education elementary teachers to enrich the spatial ability of students in the gifted program? This question was the primary focus of this qualitative case study as teachers of elementary gifted students shared their perceptions and best practices for teaching spatial ability in the gifted classroom.

1. How do teachers’ self-efficacy and mindsets in the classroom influence the development of visual spatial skills? According to Bandura (1993), a teacher’s perceived self-efficacy not only influences what and how a teacher teaches, but it can impact what the student learns. The self-efficacy theory is based on one’s effort, ability, and knowledge regarding a challenge (Bandura, 1986).

2. How do gifted education elementary teachers describe their best practices using technology, problem-based units, and puzzles to enrich spatial ability? Problem-based units, such as units on architecture or bridges, can help elementary gifted students develop talents in math, creativity, and visual-spatial ability and have resulted in significant gains in student learning and spatial ability (Senne & Coxon, 2016; VanTassel-Baska et al., 2000). These types of units provide opportunities for students to work with real-world problem-solving while using various STEM skills to design and test potential solutions. There are many opportunities for interactive lessons through the use
of computers, smart boards, and various interactive media devices, which can increase student motivation and academic achievement and improve spatial and STEM skills (Siegle, 2015; Wetzel et al., 2020).

3. What other strategies and best practices do gifted education elementary teachers use to enrich spatial ability? Research has shown that using puzzles, including 2D and 3D mental rotation puzzles, in the classroom can result in academic gains for students in the STEM fields, and can help to develop and strengthen inductive and deductive reasoning, which helps to improve critical thinking skills, and enhance visual-spatial intelligence (Farnell, 2016; Wanko, 2017).

**Definitions**

1. *Gifted students* – Students with gifts and talents who have the ability to perform at higher levels compared to others of the same age, experience, and environment in one or more domains (NAGC, 2020). For this study, gifted students refer to those students identified as gifted and talented based on state-mandated criteria and are participating in the district’s gifted program for third, fourth, and fifth graders.

2. *Differentiation* – Tailoring instruction to meet individual needs (Tomlinson, 1999).

3. *Project-based learning* – Learning opportunities that encourage the process of inquiry, exploration, and discovery in open-ended, real-life challenges (Laur, 2020).

4. *Spatial ability* – Cognitive skills that involve the ability to comprehend the relationships between fluid, changing patterns and the ability to create, retain, retrieve, and manipulate complex visual material (Gardner, 1993; Mann, 2014).

5. *Spatial reasoning* – The ability to mentally rotate objects in space (Bruce & Hawes, 2015).
6. **Visual Spatial Intelligence** – The capacity to construct a mental representation of the spatial realm and to use that representation to perform valued activities in the world (Cary, 2004; Gardner, 1983).

**Summary**

There have been few changes over the last twenty years to the curriculum and practices of most elementary gifted programs, with the focus being on enrichment and accelerated learning (Callahan et al., 2017). Gifted education must reflect the critical thinking skills and STEM initiatives which are considered key features of 21st century education (Andersen, 2014). One way to support these components is through the use of activities that promote visual-spatial intelligence for gifted students. Visual-spatial intelligence and STEM outcomes can be nurtured through the use of problem-based units, technology, and puzzles. These activities can provide the differentiation and rigor necessary for these advanced learners (Mann, 2006). There is significant literature on the benefits of visual spatial ability and the connections with STEM success, but the majority of the research is on high school or older students. There is a gap in the literature on the benefits of using visual-spatial activities and the connections with STEM, as it pertains to younger students, particularly gifted elementary students.

More research is needed on the effects and impact that visual-spatial instruction and activities may have on younger students and the extent to which these activities are being provided to them. Learning these skills at an earlier age may better prepare these advanced learners for STEM education and careers and help them reach their highest potential. The results of this type of research could help educational leaders to design and develop curriculum for elementary gifted students that further promotes their strengths and talents. Visual-spatial activities may improve students’ problem-solving skills, nonverbal cognitive intelligence,
logical-mathematical intelligence, and visual-spatial intelligence (Andersen, 2014). Through a curriculum rich in activities that promote visual-spatial intelligence, STEM features, and critical thinking and problem-solving, the uniqueness of the gifted learner is recognized and encouraged. This type of curriculum can lead to later academic and career success (Hawes et al., 2017).
CHAPTER TWO: LITERATURE REVIEW

Overview

A systematic review of the literature was conducted to define the constructs of spatial reasoning and ability and to explore teachers’ perceptions and self-efficacy towards teaching spatial skills in the elementary gifted classroom through various activities including project-based learning, technology and gaming, and puzzles. The literature provided a strong foundation for the role that spatial intelligence plays in the academic and career success of students. In the first section of this chapter, the theory of growth mindset which was used as the theoretical framework for this study is discussed, followed by the synthesis of other theories which also influenced this study. The chapter continues with an examination of recent literature pertaining to spatial intelligence and spatial ability, the connections to mathematical learning, STEM success, and virtual adaptations stemming from COVID-19 pandemic, and the necessity for creating curricula which benefits the development of visual spatial intelligence in elementary gifted students. Lastly, literature discussing the best practices of implementing spatial training through activities including project-based learning, technology and gaming, and puzzles are presented. A gap in the literature is identified which lends support to the need for the current study. This gap is the lack of qualitative data about teachers’ perceptions and self-efficacy towards teaching spatial skills in the elementary classroom.

Theoretical Framework

Theories, which are explanations of how and why variables are related, are used in educational research to help make sense of interrelated phenomena (Check & Schutt, 2012). Theories can help explain and make sense of how unrelated empirical observations and evidence are connected (Galvan & Galvan, 2017). These theories guided the study before, during, and
after the research. Using a theoretical framework as a guide helps narrow down the research to the most important factors of the study (Rockinson-Szapkiw & Spaulding, 2014). Dweck’s (2006) theory of mindset was used as the theoretical framework for this study with influences of Bandura’s theory of self-efficacy (Bandura, 1977). Fostering a growth mindset in the elementary gifted classroom was the focus as the literature regarding visual spatial ability and the benefits as they pertain to gifted students and curriculum were examined and discussed. This study may contribute to a better understanding of Dweck’s mindset theory and have positive implications on education curriculum for elementary gifted students.

**Growth Mindset Theory**

Carol Dweck, considered to be one of the world’s leading researchers in the fields of personality, social, and developmental psychology, developed the theory of fixed and growth mindsets (Hildrew, 2018). Dweck’s (2019) research examined the beliefs and mindsets that people have and how these mindsets potentially affect a person’s motivation, achievement, and overall well-being. Dweck suggested that the benefits of having a growth mindset include the understanding that meaningful growth is possible for all and can be achieved through sustained effort, good strategies, and guidance from others (Dweck, 2019). Growth mindset practices have been widely adopted and implemented in education, such as Khan Academy (2018), businesses like Microsoft (Dweck & Hogan, 2016), sports, and government policies and programs (Dweck, 2019). Research has shown that having a growth mindset can lead students to take on more challenges (Dweck & Leggett, 1988; Hong et al., 1999; Paunesku et al., 2015; Yeager et al., 2016), persevere in the face of setbacks (Nussbaum & Dweck, 2008), and affect student’s achievement (Blackwell et al., 2007) (Dweck, 2019). Growth mindset has become more mainstream and is considered one of the 10 vital skills needed for the future (Marr, 2019). Active
learning with a growth mindset is listed as the fourth most vital skill needed, preceded by creativity, emotional intelligence, and analytical thinking (Marr, 2019). According to Marr (2019), the jobs of the future will require workers to actively learn and grow and having a growth mindset will help individuals to understand that their abilities and intelligence can be developed, and effort will result in greater achievement (Marr, 2019). Those with a growth mindset are more likely to take risks, learn from mistakes and seek new knowledge and experience (Marr, 2019). This has become even more evident with the COVID-19 global pandemic and the need for most industries to embrace new forms of technology.

Dweck’s (2006) implicit theories of intelligence include the incremental theory of intelligence, also known as growth mindset, which is the belief that one’s intelligence is controllable, malleable, and increasable (Dweck, 2006). Those with a growth mindset believe that their success is dependent on hard work, learning, training, and seeking input from others (Dweck, 2006). In contrast, the entity theory of intelligence is the belief that one’s intelligence is fixed, limited, and uncontrollable and success is based on innate ability (Dweck, 2006). While individuals may not be aware of their own mindset, it can be evident through their behavior, especially in regard to failure (Dweck, 2006). People with fixed mindsets view failure as a statement of their basic abilities while those with a growth mindset see failure as an opportunity to learn and grow (Dweck, 2006).

The mindset theory is based on the idea that a person’s view of their abilities (mindset) plays an important role in their motivation and achievement (Dweck, 2006, 2015). Those with a growth mindset believe that intelligence, talents, and abilities can be developed and enhanced through hard work, trying and using different strategies, and seeking input from others (Dweck 2015, 2016). In contrast, those with a fixed mindset tend to believe that abilities, intelligence,
and talents are innate, and therefore fixed, and there is little potential for growth (Dweck, 2015). Their goal is to look smart at all times and never show weakness (Dweck, 2006). Those with a growth mindset tend to be more successful than those with a fixed mindset because they tend to put more effort and energy into learning, they understand that people can become smarter if they work at it, and they worry less about appearing smart (Dweck, 2016). Having a growth mindset can also lead to a less stressful but more successful life (Dweck, 2006).

The theory suggests that people must recognize the role that effort plays in success and achievement (Siegle, 2015). For successful student achievement effort is crucial, but, in addition, students need opportunities to try new strategies and to seek help from others in order to learn and improve (Dweck, 2015). In education, growth mindset needs to be encouraged in students, so they learn from challenges and setbacks and see these as part of learning and progress (Dweck, 2016). A classroom that promotes growth mindset encourages appropriate risk-taking, collaboration, and rewards productive effort, learning, and progress (Dweck, 2016).

Educators need to understand that “the path to a growth mindset is a journey, not a proclamation” (Dweck, 2015, p. 21). Dweck (2015) contended that the growth mindset theory was intended to help close achievement gaps. This can be accomplished by being honest with a student about his current achievement and teaching them how to become smarter through growth mindset strategies (Dweck, 2015). Dweck suggests that mindset can be affected by subtle environmental cues (Dweck, 2015). To tell a student, “Don’t worry, you’ll get it if you keep trying” may not always be truthful and is not necessarily teaching the student the right strategies to move forward (Dweck, 2015, p. 24). In addition, praising a child’s intelligence may negatively affect motivation and achievement (Dweck, 2015). Instead, teachers can model growth mindset thinking by saying things such as, “That feeling of math being hard is the feeling of your brain...
“growing,” or “The point isn’t to get it all right away. The point is to grow your understanding step by step. What can you try next?” (Dweck, 2015, p. 24). When a teacher hears a student say they are not good at math, she can remind them to add “yet” to the statement (Dweck, 2015). Dweck (2015) encourages teachers to not accept less than optimal performance from students and suggests that saying “Great effort! You tried your best!” is counterproductive to a growth mindset (Dweck, 2015). These kinds of statements should be avoided as they do not foster the foundation of a growth mindset. Outcomes matter so teachers should avoid giving empty praise and rewarding just effort (Dweck, 2016).

Teachers can help students to overcome “fixed-mindset triggers” when facing challenges (Dweck, 2016). These are situations that cause people to feel threatened, defensive, insecure, and can inhibit growth and learning (Dweck, 2016). Teachers can help students identify and work with such triggers so they can remain in the growth zone and not shut down when they receive negative feedback or make a mistake (Dweck, 2016; Garwood & Ampuja, 2018). Through modeling and examples, teachers can help foster a growth mindset classroom (Garwood & Ampuja, 2018). Dweck (2006) reminds teachers of the importance they play in a student’s life and that using the growth mindset with students plays a key role in “helping us fulfill our mission and helping them fulfill their potential” (p.204).

Dweck’s mindset theory will play an important part in this study as teachers present elementary gifted students with challenging, rigorous spatial activities. The findings could further advance and extend Dweck’s growth mindset theory by providing additional evidence of the importance of mindset on motivation, performance, and achievement.

Social Cognitive Theory
The growth mindset theory is closely connected and rooted to Bandura’s (1977, 1986) social cognitive theory. In 1977, Bandura proposed in his Social Learning Theory that most learning occurs in social environments as opposed through observation and imitation (Bandura, 1977). Then, in 1986, he changed the name of the theory to Social Cognitive Theory as a way to better reflect the idea that people not only learn from their social environments, but that they also use cognitive and social factors to process information as part of the learning process (Bandura, 1990). In his Social Cognitive Theory, Bandura contributes self-efficacy as one of the determinants of motivation and the one most closely related to the field of growth mindsets (Bandura, 1997). People use self-evaluations to judge their capabilities to accomplish specific tasks (Pajares, 1995). This is known as self-efficacy, which is “beliefs in one’s capabilities to organize and execute a course of action required to produce a given attainment” (Bandura, 1997, p. 3).

Teacher and student self-efficacy can play an important role in student achievement. An individual’s self-efficacy influences their behavior and effort level (Pajare, 1995). For example, people tend to gravitate toward activities in which they have strength, and in which they feel confident and competent in their abilities. When people avoid tasks in which their competence and confidence levels are low, this is characteristic of a fixed mindset. Those with a high self-efficacy and a growth mindset will face challenges with effort and view the challenge as an opportunity for growth and learning.

In education, a teacher’s self-efficacy can influence students and their achievement (Tschannen-Moran & Hoy, 2001). Teacher self-efficacy is defined as teachers’ confidence in their own ability to guide students to success (Hattie, 2018). Teachers’ beliefs on how they can influence students and achievement is considered teacher self-efficacy (Bandura, 1977;
Tschannen-Moran & Hoy, 2001). These beliefs can affect a teacher’s effort output, persistence and perseverance in the face of difficulty, and stress in coping with demanding situations (Bandura, 1997). Teacher efficacy has strong connections to student achievement (Tschannen-Moran & Hoy, 2001). In assessing one’s self-efficacy of teaching competence in a particular context, teachers rate their abilities, skills, and knowledge against their weaknesses and deficiencies (Goddard et al., 2000). This judgement leads to self-efficacy for a particular teaching task (Goddard et al., 2000). Bandura (1997) furthered his theory of efficacy to include collective efficacy, which is the groups’ shared beliefs about a particular curricula task and the goals and actions required to result in the attainable goals (Bandura, 1997). While teacher self-efficacy is focused on the individual teacher, collective efficacy considers the whole group’s beliefs (Goddard et al., 2000). Since teachers are members of a school organization, by nature they can be considered as having collective efficacy. For this study, the participants are members of a school district organization, the elementary gifted program. Their shared beliefs affect and influence this organization, as well as the students and each teacher’s individual school. These beliefs include the “tasks, level of effort, persistence, shared thoughts, stress levels, and achievement of groups” (Goddard et al., 2000, p. 482). Goddard et al. (2000) suggested all of these beliefs can have significant effects on students and is rooted in Bandura’s social cognitive theory. Bandura (1986, 1997) defined four areas of self-efficacy information, all of which can be applied to collective teacher efficacy: mastery experience, vicarious experience, social persuasion, and emotional arousal (Goddard et al., 2000). Mastery experience relates to each individual teacher’s successes and failures and collectively, these can have significant impacts on the group’s beliefs about the attainment of their goals (Goddard et al., 2000; Huber, 1996; Levitt & March, 1996). Vicarious experience relates to the achievement and experience of others,
which could be other teachers or schools, and how the organization learns and applies this experience of others (Goddard et al., 2000; Huber, 1996). Social persuasion affects a group’s collective efficacy by strengthening their beliefs about their abilities. Encouragement received through professional development and workshops, and feedback from parents, students, faculty, and administration can bolster the collective efficacy of a group (Goddard et al., 2000). Finally, just as each individual teacher feels and reacts to emotional stress, the collective organization does as well (Goddard et al., 2000). Learning to react positively and effectively to pressure and crises, and to adapt and cope with emotional arousal is important to the success of an organization (Goddard et al., 2000). This is dependent on how challenges are interpreted and responded to by the organization (Goddard et al., 2000).

Teachers of gifted students have a significant impact on the achievement of these students (Early et al., 2014; Tomlinson & Jarvis, 2014). When teachers believe they are successful teachers who can effectively teach all children, they are more likely to establish teaching behaviors that support this goal (Protheroe, 2008). When teachers are confident in their teaching abilities, they tend to be more open to new teaching ideas and are more willing to try new methods. However, when a teacher lacks confidence in her own abilities, she is less likely to try new instructional methods and fails to push herself and her students through difficulties (Protheroe, 2008). Teachers with a high sense of efficacy tend to have greater levels of organizational skills, are more open to new ideas and more willing to try new teaching methods, are more persistent and resilient, and display more positive attitudes with their students (Protheroe, 2008). When teachers have a high confidence in their abilities, student learning and achievement will be greater (Gonzalez & Maxwell, 2018). Strong teacher self-efficacy has connections to gifted student achievement as teachers with higher self-efficacy select appropriate
teaching practices that successfully support gifted students’ academic needs (Bennett-Rappel & Northcote, 2016; Guo, Connor, Yang, Roehrig, & Morrison, 2012; Dixon et al., 2014).

Using Dweck’s (2006) mindset theory with strong influences by Bandura’s (1986) social cognitive learning theory provided the theoretical foundation for this study. The findings may show that having a growth mindset and strong teacher self-efficacy can impact a teacher’s perceptions and willingness to provide challenging spatial activities to elementary gifted students.

Related Literature

To understand the importance of visual spatial activities and the impact they may have on visual spatial intelligence, several factors must be considered. A literature review of theories that pertain to multiple intelligences is explored. Following this, the concepts of spatial ability in regard to the connections to mathematics learning and STEM fields is discussed. Additionally, gifted education is one area that could benefit from the inclusion of visual spatial activities and units. Literature is reviewed exploring the characteristics of gifted learners, gifted programs, and gifted curriculum and the possible benefits of adding visual spatial activities to elementary gifted programs. Teacher self-efficacy is explored as it can play a critical role in the successful implementation of spatial activities within the gifted curricula. Finally, an examination of the literature discussing activities that incorporate visual spatial intelligence that can be included in gifted classrooms is discussed.

Theory of Multiple Intelligences

Published in 1983, the same year A Nation at Risk was released, Gardner’s (1983) book, Frames of Mind: The Theory of Multiple Intelligences, proposed the idea that humans are made up of a combination of multiple intelligences rather than the commonly believed notion of one
general intelligence. Historically, people believed that humans are born with one general intelligence, with little change in it over the course of a lifetime (Gardner, 1983). Gardner’s (1983) theory suggested that humans actually have seven intelligences which include: logical-mathematical, musical, bodily-kinesthetic, interpersonal, intrapersonal, verbal-linguistic, and visual-spatial. He eventually added two more intelligences which include naturalist and existential (Gardner, 1994).

Universally known as the father of multiple intelligences, Gardner (1983) noted that each person has a unique combination of these multiple intelligences which further supports the importance of differentiated instruction. Since each student has their own unique profile of intelligences, this should be taken into account when planning academic instruction (Gardner, 1983). Teachers who understand the uniqueness of each student can plan appropriate instruction and activities to better serve the individual strengths and weaknesses of students. In addition, research suggests that people with heightened visual-spatial intelligence tend to have advanced nonverbal cognitive skills. These skills include the ability to analyze information and solve problems using visual or hands-on reasoning, which, simply put, means to be able to make sense of the world without using words (Logsdon, 2019). Nonverbal intelligences, also referred to as “common sense”, give students the ability to analyze, plan, and solve problems without relying on language skills is also known as “common sense” (Logsdon, 2019). These “common sense” skills are used in daily living, such as visualizing how to pack a suitcase or a car with lots of items and assembling furniture or other items with visual directions. Nonverbal cognitive intelligence may be improved through the use of puzzles, building toys, and other similar hands-on activities.
Prior to the theory of multiple intelligence, L.L. Thurstone, an early pioneer in the field of intelligence, argued that multiple intelligences should be considered rather than one general intelligence (Beaujean & Benson, 2019). In the 1940s, Thurstone developed an instrument to measure broad abilities rather than one intelligence but suffered criticism for technical inadequacies of the instrument (Beaujean & Benson, 2019). Gardner’s (1983) theory also challenged the idea that overall intelligence can be measured through traditional IQ tests. Because students bring diverse abilities and intelligences to the classroom, a traditional IQ test is simply insufficient to measure, evaluate, and label a student’s educational plan (Moran et al., 2006). Rather than describing a student’s cognitive ability through one general intelligence, Gardner proposed that cognitive ability be seen in terms of several independent but interacting cognitive capacities (Moran et al., 2006). Multiple intelligences are not isolated but rather interact with one another to provide a variety of outcomes (Moran et al., 2006). When teachers recognize that students have diverse ways of learning and focus on the strengths of their intellectual profiles, students are more likely to be successful (Barrington, 2004).

The implications of the multiple intelligence theory on teaching and learning are significant. Traditionally, gifted programs used qualification criteria based on verbal/linguistic and logical/mathematical intelligences and the curriculum for gifted programs centered around these intelligences. Gardner (1983) noted that most schools in most cultures have centered on a combination of linguistic and logical intelligences while ignoring the other intelligences. Focusing on these two intelligences is an invitation for criticism of elitism as gifted programs exclude those who are not strong in these two intelligences (Barrington, 2004). Using the theory of multiple intelligences for gifted identification and curricula can help to broaden the capacity
for learning as it allows students to use their strengths and talents to grow in knowledge and not be bound to traditional ways of learning (Barrington, 2004).

Critics of the multiple intelligence theory claim that Gardner’s (1983) intelligences are not all equal and to assume to teach to all is a mistake (White & Breen, 1998). However, the multiple intelligence theory was not developed as an education policy, but rather as an explanation for how the mind works (Moran et al., 2006). Another criticism of the multiple intelligence theory is that it lacks empirical support (Waterhouse, 2006). Waterhouse (2006) stated that there have been no published studies offering validity evidence of multiple intelligences. According to Waterhouse (2006), the theory of multiple intelligences “cannot be validated through application research because such research assumes the validity of the intelligences and because positive application effects may be caused by confounding independent factors such as novelty and excitement” (p. 210). Most of this criticism comes from those in the field of cognitive psychology or the psychometric, or testing, community (Armstrong, 2009).

Willingham (2004) noted that hard data on the theory of multiple intelligences and the effects from implementation of the theory in education are lacking. Studies providing information on the multiple intelligence curriculum approach have been criticized due to the lack of control groups, generalizations that are difficult to infer, and lack of longitudinal evidence of effectiveness (Latham, 1997; VanTassel-Baska & Brown, 2007). One of the most comprehensive studies done was a three-year study of 41 schools claiming to use multiple intelligences theory in the education of students (Kornhaber et al., 2004). This study has been criticized for multiple reasons including the researcher’s (Kornhaber) close connection and collaboration with Gardner
(Willingham, 2004). Additionally, Willingham (2004) claimed the study lacked a control group, offered no comparisons with other schools in the district, and the findings were hard to interpret.

Critics argue that Gardner’s intelligences are actually secondary to an overarching single intelligence, known as “the g factor” (Armstrong, 2009; Gottfredson, 2004; Visser et al., 2006). Some argue that Gardner’s intelligences are actually talents and should be referred to as such (Armstrong, 2009; Willingham, 2004). The criteria Gardner used to define each intelligence are considered less rigorous than the psychometric criterion, and Gardner’s requirement that only a majority of the criteria be satisfied in defining an intelligence adds to the validity debate for critics (Willingham, 2004). Willingham (2004) disputes Gardner’s claim that the majority of psychometricians favor a general intelligence perspective. Willingham (2004) noted that, in fact, the vast majority of psychometricians regard intelligence as a “multifaceted phenomenon with a hierarchical structure” (p. 19).

Gardner (1995) disputed these criticisms by claiming that hundreds of empirical studies were used in his book, and the empirical findings were used as the basis for the identification of the intelligences. Armstrong (2009) points out that Marzano’s (2004) evidence-based six steps to vocabulary development model uses several multiple intelligence strategies.

**Triarchic Theory of Intelligence**

Robert Sternberg, known for his research of human intelligence, took a more cognitive approach to intelligence (Sternberg, 1985). Sternberg’s triarchic theory of intelligence is based on the idea that individuals have three intelligences: analytical, practical, and creative (Sternberg, 1998). Some tasks involve using one type of thinking while others may require a combination of these three (Sternberg, 2003). Analytical intelligence is a person’s ability to problem-solve and to evaluate and judge the quality of ideas for solving the problem (Sternberg, 1998). Analytical
abilities involve analyzing, judging, and evaluating one’s own ideas, but also the ability to generate new ideas and sell those ideas to others (Sternberg, 2003). These types of tasks or problems usually have single, correct answers. Creative intelligence is the ability to deal with new kinds of problems or situations by using existing knowledge and skills (Sternberg, 2003). These tasks are typically open-ended and have many possible answers. Practical intelligence is the ability to adapt to problems found in everyday life by drawing on existing knowledge and skills (Sternberg, 2003). Practical intelligence focuses on tacit knowledge, which Sternberg defines as “what one needs to know in order to work effectively in an environment that one is not explicitly taught and that often is not even verbalized (Sternberg, 2003; Sternberg et al., 2000; Sternberg & Wagner, 1993; Sternberg et al., 1993). The level of these intelligences varies among people with most people strong in one of the three and a few individuals strong in all three (Sternberg, 1998).

Like Gardner, Sternberg believes these intelligences make up a person’s intelligence profile. The intelligences can be used in combination, and the intelligences can be improved and increased over a lifetime (Fluellen, 2005). Success is determined by a person’s balance of their innate abilities and the ability to compensate for the shortcomings within their skill set (Sternberg, 2003). The triarchic theory’s beliefs are similar to that of growth mindset in that learning and intelligence are enhanced through effort, taking risks, using various strategies, and seeking input from others in order to work through challenges.

Sternberg’s Triarchic Componential Model is a curriculum model used in the field of gifted education in an effort to provide high-level learning opportunities for gifted students (VanTassel-Baska & Brown, 2007). The model is based on Sternberg’s information processing theory and the three components used in thinking: executive, performance, and knowledge-
acquisition (VanTassel-Baska & Brown, 2007). Units of study based on this model have been developed for gifted programs. Evidence has shown that students who receive triarchic instruction achieve greater academic gains than students who received conventional instruction, regardless of the grade level or subject matter (Grigorenko et al., 2002; VanTassel-Baska & Brown, 2007).

**Spatial Ability**

Spatial ability is a general term used to describe a person’s mental ability to “visualize, transform, and manipulate nonverbal information, such as symbols, figures, and 2-D and 3-D objects based on visual stimuli (Linn & Petersen, 1985; Yoon, 2011, p. 4). Similarly, visual-spatial intelligence is known as the ability to represent the spatial world mentally (Gardner, 1983). Spatial intelligence (also called spatial reasoning and spatial ability) helps us to reason, understand, and make sense of our world (Burte et al., 2017). It is the ability to understand the spatial relations among objects and to mentally manipulate objects (Mulligan, 2015). Individuals with heightened visual-spatial ability have the ability to visualize the world accurately, create mental pictures of complex ideas, and mentally manipulate these representations.

Spatial intelligence involves the ability to conceptualize and manipulate large-scale spatial arrays, like pilots and sailors must do, and smaller forms of space, for architects and artists. Spatial ability involves understanding the relationships between fluid and changing patterns (Mann, 2013). Those with advanced spatial intelligence can perform spatial transformations and relationships between objects (Mann, 2013). Spatial intelligence involves using spatial relations between objects to reason, understand, and make sense of the world (Burte et al., 2017). Individuals with spatial strength create visual images to understand their world and have a heightened ability to visualize two- and three-dimensional shapes and objects. These
students tend to be strong at interpreting models, pictures, graphs, and charts, adept at drawing, visual arts, pattern recognition, and solving puzzles, and have vivid imaginations (Cherry, 2019). They often pursue careers in engineering, architecture, art and graphic design, computer science, physics, and mathematics (Mann, 2013). These traits are essential and highly valued for studies and careers in the science, technology, engineering, and mathematics (STEM) fields. Research has shown that there is a strong connection between visual-spatial intelligence and academic achievement in the STEM fields (Metz et al., 2012; Wai et al., 2009). Early spatial training is strongly linked to later success in STEM careers such as architecture, technology, engineering, mathematics, and visual arts (Kell & Lubinski, 2013; Lakin & Wai, 2020; Lubinski, 2010; Shea et al., 2001; Wai et al., 2009).

Research has shown that spatial ability skills, which are malleable and can be adapted and changed over time, can and should be introduced early in a child’s life (Mulligan, 2015). While spatial skills are certainly necessary for daily living, they also play a fundamental role in creative productivity, scientific discovery and innovation (Anderson, 2014; Hawes et al., 2017). The works of many scientists, including Einstein’s theory of relativity, are considered to have started with spatial thinking (Hawes et al., 2017). Einstein, Thomas Edison, Leonardo DaVinci, and Nikola Tesla, all considered to have had strong visual-spatial strengths, made powerful and significant contributions to our world (Mann, 2013). A lack of learning opportunities for visual spatial intelligence development poses a threat to continued STEM innovation (Senne & Coxon, 2016). Gifted students, considered to have the greatest potential of having STEM careers, do not always receive curriculum that is appropriate for their intelligence and abilities (Senne & Coxon, 2016). Visual-spatial skills are often ignored in education with little opportunity for spatial reasoning and innovation, yet these are skills highly valued in the STEM fields (Mann, 2013).
Educators must recognize the importance of including these skills in education, particularly in gifted education (Mann, 2013).

There are different types of spatial abilities which are reflected in distinct skills (Lakin & Wai, 2020; Mix et al., 2017). Various assessments measure these distinct skills. Yoon (2011) defined six classifications or domains of spatial ability. This literature review discusses two central forms of spatial reasoning: visualization and rotation.

One category of spatial ability is visualization, which is the ability to interpret and understand spatial information (Lakin & Wai, 2020). Spatial visualization is “the ability to mentally rotate, twist, or invert pictorially presented visual stimuli” (McGee, 1979, p. 6; Yoon, 2011, p. 4). A common task in this domain would involve the ability to predict the three-dimensional form of a two-dimensional representation (Sorby et al., 2018). There is strong correlational evidence that spatial visualization skills predict success in physics, chemistry, engineering, and geology (Kozhevnikov et al., 2007; Wu & Shah, 2004; Sorby, 2001; Orion et al., 1997; Sorby et al., 2018). A common test for measuring visualization is the paper folding test, as well as the Purdue Spatial Visualization Test: Rotations (Lakin & Wai, 2020; Sorby et al., 2018).

Another domain of spatial ability is mental rotation, which is the ability to observe 2- and 3-dimensional objects and then mentally rotate them in space (Lakin & Wai, 2020). Mental rotation involves the ability to imagine a two-dimensional or three-dimensional object rotating around an axis in order to visualize it from various angles (Shepard & Metzler, 1971). When objects are flipped or rotated on a plane and students are asked to select what the object would look like viewed from another angle, this involves mental rotation. Studies of mental rotation ability are abundant and may be due to the ease of measuring results and the strong and
predictive connections with STEM (von Károlyi, 2013). In fact, mental rotation is one of the domains tested in the Spatial Test Battery used in the Johns Hopkins’ Talent Search program (von Károlyi, 2013). The Purdue Spatial Visualization Test-Rotations is another assessment used to measure these rotation skills (Lakin & Wai, 2020; Yoon, 2011).

Longitudinal research revealed a strong relationship between spatial ability, mental rotation, and STEM success for gifted students (von Károlyi, 2013; Wai et al., 2009). Many spatial tasks involve mental rotation. Mental rotation ability is important in the success of the STEM domains, and activities that develop and improve mental rotation skills also increase success in the STEM fields (von Károlyi, 2013). Gifted students need opportunities to develop these important mental rotation skills and gifted programs should increase emphasis on developing spatial abilities and mental rotation skills for gifted children (von Károlyi, 2013). Research findings have suggested that mental rotation supports higher level cognitive tasks including navigation, which is a form of spatial ability (de Castell et al., 2017).

Although visual-spatial ability is important for STEM, many popular assessments for children do not measure adequately for this (Andersen, 2014). One test that is used for measuring visual-spatial intelligence is the Wechsler Intelligence Scale for Children (WISC). This test is comprised of various ability tests. This test is considered a good assessment for identifying visual-spatial ability, along with subtests from modern intelligence batteries (Andersen, 2014). In addition, the Naglieri Nonverbal Achievement Test (Naglieri, 1997) and the Universal Nonverbal Intelligence Test (UNIT) are nonverbal tests used with elementary students which can identify spatial ability (Andersen, 2014). Identification of students with high spatial ability is an important and critical step in increasing interest, graduates, and careers in STEM (Anderson, 2014).
Historically, intelligence was thought to be basically fixed, and there was little one could do to improve it (Gardner, 1983). However, studies have shown that spatial ability can be improved through spatial reasoning activities and strategies (Hawes et al., 2017; Sorby et al., 2018). One study on 2D and 3D mental rotations provided evidence that mental rotations, which require visual-spatial skills, are malleable, and with practice, they can be improved (Bruce & Hawes, 2015). Another study found that not only did spatial thinking improve through practice, but spatial training transferred to other spatial tasks (Hawes et al., 2017; Uttal et al., 2013). This research supports the beliefs of growth mindset. As people recognize that they become smarter through challenging opportunities, they may be more willing to persevere. With evidence that spatial skills are malleable, individuals with a growth mindset may welcome the challenge that these activities can present. When individuals believe that some ability or skill is important, worthy of effort, and attainable, growth mindset is further fostered. Research has shown that having a growth mindset can lead students to take on more challenges (Dweck & Leggett, 1988; Hong et al., 1999; Paunesku et al., 2015; Yeager et al., 2016).

**Connections to Mathematics Learning**

The National Council for Teachers of Mathematics recommended that at least half of mathematics curriculum for elementary students should focus on geometry, measurement, and spatial reasoning (Bruce & Hawes, 2015). Despite this, the majority of research on elementary math curriculum focuses on numbers and computation (Mulligan, 2015). In their study, Bruce and Hawes (2015) concluded that spatial reasoning plays an important role in predicting overall mathematical achievement and success, possibly with even greater predictive power than math assessment scores. Other studies have provided evidence of strong connections between spatial thinking and mathematics performance (Hawes et al., 2017). The National Association for Gifted
Children (2019) recommends that gifted students be given experiences in investigating rich concepts in depth and opportunities to apply mathematical reasoning to a variety of scientific and engineering problems. Teachers of the gifted should provide students with activities and opportunities that stimulate mathematical and spatial reasoning (NAGC, 2019).

**Connections to STEM**

In the literature, there is evidence that visual spatial skills are strong predictors of future interest, education, and success in the STEM fields (Burte, et al., 2017; Mulligan 2015). Visual-spatial ability is fundamental in the STEM fields because many problems are solved through visualizations (Andersen, 2014). Numerous studies have shown that there is a strong connection between spatial skills and STEM outcomes (Burte et al., 2017; Newcombe & Frick, 2010; Senne & Coxon, 2016). One recent study concluded that intermediate elementary students’ spatial abilities increased after attending a four-day STEM engineering design camp (Trumble & Dailey, 2019). These fourth through sixth grade students showed a slight yet significant increase in their spatial visualization mental rotation skills after attending the STEM camp (Trumber & Dailey, 2019).

Since students can vary in their spatial abilities, there have been proposals that spatial testing should become part of STEM selection processes (Dawson, 2019; Lubinski, 2010). Due to the correlation between spatial ability and surgical precision in a study by Wanzel et al. (2002), it has been proposed that spatial ability scores be used in the selection process for surgical residents and dental students (Dawson, 2019; Newcombe & Shipley, 2015). The lack of spatial ability may inflict a barrier to success in STEM fields; however, this barrier can be removed with appropriate spatial training (Dawson, 2019).
Spatial skills can predict STEM education and career choices among high school students (Burte et al., 2017; Wai et al., 2009). Most of these studies, however, focus on high school students and the strong connections between their spatial skills and STEM success. There are few studies examining how spatial activities and instruction impact STEM reasoning in younger students (Burte et al., 2017). Researchers have noted that waiting until high school to teach visual spatial skills may be too late to maximize a student’s highest potential when research has shown that students are able to learn these skills at a much earlier age (Burte et al., 2017). Children develop foundational cognitive skills during their early years, at a time which visual-spatial reasoning should be taught and enhanced. Developing these skills in elementary school may have a more pronounced impact on STEM outcomes (Burte et al., 2017).

Despite the fact that STEM initiatives are a national priority, spatial ability is rarely measured and often ignored in gifted education (Andersen, 2014). Visual-spatial ability is important in the success of STEM subjects. A student who has strong spatial ability has skills needed for STEM success, including being able to create and manipulate mental representations of complex ideas (Andersen, 2014). Having a heightened level of visual-spatial intelligence plays a significant role in determining which students enter and succeed in STEM fields (Hawes et al., 2017). Success in STEM areas relies on visual-spatial intelligence and activities, and curricula that promotes spatial training should be a critical component of elementary gifted education programs (Andersen, 2014; Mann, 2006, 2013; Mulligan, 2015; Senne & Coxon, 2016; Siegel, 2015; Wilson, 2018).

STEM careers often include professional positions such as engineering, technology, science, and math. Radiology and sonography technicians, along with others in the medical field, also benefit from highly-developed spatial ability skills. In addition, spatial ability skills are
often necessary for “middle skill jobs” in STEM fields. These “middle skill jobs” include manufacturing machinists, electricians, and pipe fitters. (Wai & Uttal, 2018; Wai & Lakin, 2020). These positions provide middle-class salaries without requiring a four-year college degree (Newman & Winston, 2016; Wai & Lakin, 2020). Broadening the pool of gifted students by including spatial ability would help prepare these students to fill STEM jobs at every level (Kell & Lubinski, 2013; Wai & Uttal, 2018; Wai & Lakin, 2020).

**Connections to Virtual Adaptations**

In the current world of a virus pandemic, the importance of teaching spatial skills becomes ever more evident. With many everyday activities now taking place in an online format, including virtual schooling, those skills used in visual spatial activities can only help to enhance the online experience. These skills are needed and necessary throughout the medical field, including sonography, surgery, virology, and the study of DNA, to name a few. Businesses and millions of employees had to shift to a remote working, virtual environment involving a host of digital tools for communicating, learning, working, and sharing (Gautam, 2020). As life becomes more immersed in technology, visual spatial skills need to be enhanced and improved.

During the COVID-19 pandemic, over 1.2 billion children in 186 countries were affected by school closures and were faced with virtual learning (Li & Lalani, 2020). In the United States, nearly 93% of households with school-age children reported their children participated in distance learning (McElrath, 2020). The COVID-19 pandemic resulted in a dramatic shift in the way children are educated, and education has had to adapt very quickly to these changes with teaching and instruction being provided remotely and on various digital platforms (Li & Lalani, 2020; McElrath, 2020). It is estimated that over $18.66 billion had been spent in 2019 on educational technology, and experts are seeing this increase significantly since COVID-19 (Li &
Lalani, 2020). Many online tech companies have quickly adapted and modified their platforms to accommodate the sudden rise in usage, having to redefine and redesign the global server infrastructure and engineering capabilities for reliable connectivity and capacity expansion (Li & Lalani, 2020). Major networks, including PBS and BBC have formed partnerships with school districts to offer educational broadcasts (Li & Lalani, 2020).

One major issue with the sudden and significant increase in the use of technology for education is the lack of training and little preparation for teachers (Li & Lalani, 2020). However, many are touting the benefits of online learning. Retention is greater when material is presented online, with research showing that students retained 25-60% more online material (Li & Lalani, 2020). Students are able to learn faster online since students can learn and work at their own pace (Li & Lalani, 2020). The need for gaming in education is even more critical as studies have shown that integration of games increases higher engagement and increased motivation towards learning (Li & Lalani, 2020). Many feel that it is time for a shift in the education system which continued to focus on traditional academic skills and rote learning. The move to online learning and mainstream integration of technology in the education system could shift the focus to other skills, including critical thinking and adaptability, as educators and policymakers explore technology and its full potential (Li & Lalani, 2020). Spatial ability is a skill which can only be positively impacted through this increase in technology use. Experts believe e-learning is here to stay and it is crucial to prepare the digital world and educators for this shift and create solutions to support the education of all children (Li & Lalani, 2020; United Nations University, 2020). The rise of technology use in education is dependent on educators’ knowledge, experience, and expertise in working with these tools (United Nations University, 2020). Lack of training can be
detrimental to the success and progress of implementation of technological tools (Li & Lalani, 2020; United Nations University, 2020). Therefore, teacher training is critical.

As a result of the worldwide shift to e-learning and remote virtual workplaces, the World Economic Forum’s (WEF) list of the top 10 skills and skill groups needed for the future (2025) has changed (Palmer, 2020). The top 2 highest-ranked skills were ones that were not even previously listed before (Palmer, 2020). These top skills are analytical thinking and innovation, and active learning and learning strategies. Also included in the top 10 skills needed for 2025 are critical thinking and analysis; creativity, originality, and initiative; complex problem-solving; reasoning, problem-solving, and ideation; and technology design and programming (Palmer, 2020). All of these skills have connections to spatial ability. Much of the advancement in technology has been the result of the science, technology, engineering and mathematics (STEM) fields, and as the world becomes more digital, the demands for technological innovations, especially in these fields, will continue to increase (Belyh, 2020). These innovations will come as a result of the ideas and efforts of the workers with advanced STEM skills, furthering the demand for workers with these skills (Belyh, 2020).

**Elementary Gifted Students and Curriculum**

Gifted students need curriculum that meets their academic needs for rigor, advancement, and acceleration. These learners require appropriate learning opportunities in order to realize their fullest potential (NAGC, 2019). In fact, adverse developmental effects can occur if gifted students do not receive early education or they are not offered challenging learning opportunities (NAGC, 2019). A quality curriculum with increasing levels of difficulty has a strong connection to higher student achievement for gifted students (Callahan et al., 2017; Callahan et al., 2015; VanTassel-Baska & Little, 2003).
Studies suggest there is a significant relationship between a student’s achievement scores and cognitive ability scores (Kettler, 2014). In addition, Kettler (2014) suggested that gifted students have more advanced critical thinking skills compared to their non-gifted peers. When developing appropriate curriculum for gifted students, the characteristics and traits of gifted students should be considered.

**Characteristics of Gifted Students**

The NAGC (2019) states that gifted children are those who demonstrate levels of aptitude and achievement in one or more domains which include intellectual, creative, and artistic. Children are considered gifted when their ability is significantly higher than what is considered the norm for their age (NAGC, 2019). These children are found in all segments of society and across every demographic and personality type, as giftedness does not discriminate (NAGC, 2019). Even though gifted children are very diverse and unique, there are some common characteristics often seen in them (NAGC, 2019; Webb et al., 2007). These characteristics can include being able to learn at a faster pace than their peers, long attention spans, excellent memory, abstract thinking, and strong problem-solving skills (NAGC, 2019).

Gifted students need lessons and activities that build on these characteristics and help these students reach their highest potential. Rich, educational opportunities that promote deeper thinking are needed to help these gifted learners to advance their skill sets and maximize their intellectual potential (Wilson, 2018; Weinstein & Laufman, 1980). Through appropriate differentiation in the curriculum, opportunities can be offered to these students to help develop their strengths and further their intelligence (Andersen, 2014). Gifted students with strong spatial abilities may fall through the cracks and not be identified through common gifted program screening procedures (Wai & Lakin, 2020). It is estimated that 4 to 6 % (2 to 3 million)
students in the K-12 school system in the U.S. are currently overlooked for their spatial talents, due to testing and curricula that are not appropriate for their talents (Wai & Lakin, 2020). This may result in underperforming achievement and lost potential for these students (Wai & Lakin, 2020).

**Elementary Gifted Programs**

The U.S. Department of Education’s Office of Civil Rights states that approximately 6% of American public-school students are enrolled in a gifted and talented program (NAGC, 2019). Almost all decisions about gifted education, including curricula, are made at the state and local levels (NAGC, 2019). Due to many factors, including funding, there is a disparity of gifted services between states and districts. Informed curriculum leaders of gifted education recognize that a quality curriculum is critical for the academic success of the gifted students. A quality curriculum with rigor, acceleration and advanced levels of difficulty has been linked to increased achievement for gifted students (Callahan et al., 2017). Additionally, an effective gifted curriculum should allow for a continuum of content and skills as the students progress through their educational careers (Wilson, 2018).

The key to success for gifted programs is to begin with quality curriculum and instruction which is a response to students’ learning capacities (Tomlinson, 2005). While the area of mathematics tends to be the focus of content for gifted students in middle school, language arts has been identified as the most developed content area for serving elementary gifted students (Callahan et al., 2017). By incorporating a foundation of technology and engineering concepts, which help to promote visual-spatial intelligence, elementary gifted programs can offer a curriculum that provides the necessary differentiation and to help these students strengthen their skills and reach their highest potential. Gifted students need opportunities to work with
meaningful problems and solutions, at a higher level of difficulty, and at an accelerated pace (Tomlinson, 1997). Educators should give gifted students, particularly those with spatial strengths, opportunities to work with complex material that requires creativity and higher order thinking skills (Mann, 2006). Gifted classrooms need teachers who provide differentiation through a range of instructional activities and who become partners with their students so that the learning environment supports the learner (Mann, 2006; Tomlinson, 2014). Visual-spatial activities that promote STEM initiatives can provide the differentiation and accelerated rigor needed for these students. Despite the societal value of STEM and spatially talented individuals, curriculum continues to strongly focus on verbal reasoning and mathematics (Wai & Lakin, 2020).

Gifted education is based on the idea that traditional school curriculum does not provide high ability students with the appropriate learning pace, content complexity, or educational opportunities needed to develop their highest potential (Wai & Lakin, 2020). Services for identified gifted students is offered through a variety of ways including differentiation in the regular classroom, inclusive services, and “pull-out” classes or schools (Callahan & Hertberg-Davis, 2017; Wai & Lakin, 2020). Traditionally, identification of gifted youths has centered primarily on reading and mathematics ability as measured through widely used assessments (Wai & Lakin, 2020). In recent years, however, there has been a shift to identify students with the potential for academic excellence in other academic domains (Lo & Porath, 2017; Wai & Lakin, 2020). This is primarily motivated by equity concerns (Wai & Lakin, 2020). Adding spatial ability measures should be considered as a means to narrow achievement gaps and expand the definition of giftedness (Wai & Lakin, 2020). Researchers have suggested that spatial reasoning skills, with their strong connections to STEM achievement and success, should be measured and
screened for identification for appropriate educational services, including gifted education (Lubinski, 2010; Wai & Worrell, 2016; Wai & Lakin, 2020).

The challenge for gifted programs continues to be small numbers of low-income and underrepresented groups of students. Researchers suggest that broadening the identification criteria and looking at potential in other academic domains, such as spatial ability, would greatly improve the number of disadvantaged but gifted students who would then receive gifted education opportunities (Wai & Worrell, 2016; Wai & Lakin, 2020). Curriculum needs to be expanded to include spatial ability skills for those spatially talented students (Wai & Lakin, 2020).

**Best Practices Using Visual Spatial Activities**

Providing elementary students with visual-spatial activities has led to many benefits, including significant mathematical gains (Burte et al., 2017). In a study done by Hawes et al. (2017) fourth grade students demonstrated gains in visual-spatial skills and higher levels of classroom engagement after participating in a visual-spatial reasoning implementation program. In addition, the implementation of visual-spatial activities with elementary students showed gains on three areas of spatial thinking: spatial language, visual-spatial geometry, and 2D mental rotation (Hawes et al., 2017). It also showed a symbolic number comparison which was significant as it indicated that spatial training may transfer to basic numerical skills (Hawes et al., 2017). These gains could result in a ripple effect of improving students’ interest and performance in STEM courses and careers (Hawes et al., 2017).

There are many ways educators can incorporate visual spatial instruction and activities into the gifted curriculum. These physical and digital activities can provide the necessary differentiation to meet the needs of these unique and diverse learners. These spatial activities can
be provided through the use of problem-based units, technology and gaming, and puzzles (Brophy & Hahn, 2014; Bruce & Hawes, 2014; de Castell et al., 2017; Farnell, 2016; Kalbfleisch & Gillmarten, 2013; Mann, 2004; Newcombe & Frick, 2010; Senne & Coxon, 2016; Siegle, 2015; Terlecki et al., 2008; VanTassel-Baska et al., 2000; Wanko, 2017; Wetzel et al., 2020).

**Project-based units**

Project-based learning provides students with the opportunity to design and complete projects while solving problems along the way (Mahasneh & Alwan, 2018). These types of activities require active learning and application as students work to find solutions (Mahasneh & Alwan, 2018). Through the use of problem-based units, such as architecture, elementary gifted students can develop talents in math, creativity, and visual-spatial ability (Senne & Coxon, 2016). These types of units provide opportunities for students to work with real-world problem-solving while using various STEM skills to design and test potential solutions. Problem-based units have resulted in significant gains in student learning and spatial ability (Senne & Coxon, 2016; VanTassel-Baska et al., 2000). Spatial ability can be nurtured and enhanced through problem-based units as students use visualization to work with images and objects in two-dimensional and three-dimensional space. Problem-based units can provide the challenge and complexity that is needed for gifted learners. These units allow for student ownership and deep, intense product development (Senne & Coxon, 2016; VanTassel-Baska et al., 2000).

Units on architecture and engineering design and construction can provide students with real-world problems and scenarios and the opportunity to create solutions involving creativity and visual spatial skills (Mann, 2004; Senne & Coxon, 2016). Projects that could be used to promote visual-spatial intelligence in a unit on architecture include large projects such as designing structures or arenas for sporting events or outdoor classrooms, or small projects such
as designing and building a better lever or other simple machine (Senne & Coxon, 2016). Using problem-based units, such as architecture, can help foster STEM potential and provide growth in visual-spatial ability for gifted students.

The use of inquiry as a central strategy in gifted education curricula is considered best practice (VanTassel-Baska & Brown, 2008). Using inquiry-based instruction allows students to make choices that involve using creative problem solving and complex decision-making skills (VanTassel-Baska & Brown, 2008). Teachers can support and guide students to make appropriate choices which will challenge and stretch them, fostering growth mindset behaviors (Dweck, 2006).

**Technology**

Technology is a recommended tool to be used in gifted classrooms to help differentiate curriculum and instruction (NAGC, 2019). With the use of various interactive media devices, including computers, smart boards, Ipads, and tablets, there are new opportunities for interactive lessons which can improve student motivation and academic achievement (Wetzel et al., 2020). These devices can be useful for spatial skill training. Through technology, gifted students can improve spatial and STEM skills (Siegle, 2015). Teachers of gifted education, due to their multiple year relationship with their students and the freedom they may have in the curriculum, are in an important position to impact students’ technology proficiency (Zimlich, 2015). Technology tools, such as gaming and virtual reality, help to promote spatial and STEM skills. New educational technology tools provide opportunities of enhancing gifted curriculum with visual spatial activities. Through various software, including a Computer Aided Design (CAD) program, students can interpret, manipulate, and create 2D and 3D models of various things (Bruce & Hawes, 2014). Recent technology tools which can help develop spatial skills include
augmented reality and virtual mental rotation training (Herrera et al., 2019). In augmented reality, real objects are modeled virtually, with students creating a mental image of the object (Herrera et al., 2019). Virtual mental rotation training encourages users to manipulate objects in virtual reality, while selecting, rotating, zooming, and navigating with 3D models from six sides (Herrera et al., 2019). Research provides evidence that these 3D tools develop spatial visualization skills (Herrera et al., 2019).

Teachers can use technology in their efforts to foster a growth mindset classroom environment. Technology activities can provide students with immediate feedback about their effort and achievement. This immediate and concrete feedback about effort encourages motivation and ties in with the growth mindset theory which is based on the idea that people must make the connection between effort and performance (Dweck, 2006; Siegle, 2015). By using technology tools, teachers can provide opportunities for enhancement and improvement in creativity, problem-solving, and spatial skills, and STEM achievement (Siegle, 2015).

**Gaming**

Gaming began in 1962 with the first-ever computer game, *Spacewar* (GamingScan, 2020). In 1972, the release of Atari’s *Pong* game resulted in an explosion of gaming popularity (GamingScan, 2020). Gaming is now considered the world’s most popular form of entertainment, with more purchases than movies, television, and music (Reuters, 2018). In the gaming industry, recent games such as *Fortnite* have brought in over $2.4 billion in sales in 2018 (GamingScan, 2020). In all, the gaming industry made $135 billion in sales in 2018 which was a 10.9% growth from 2017, with sales expected to reach over $180 billion in 2021 (GamingScan, 2020). The United States leads in consumer spending on video games having spent $36.9 billion in 2019, followed closely by China at $36.5 billion (GamingScan, 2020). According to
GamingScan (2020), over 75% of US households own a device for playing video games with an average of 2 gamers in each household. Over 65% of Americans play video games, 74% of parents believe video games are a positive influence on their children, and 79% of gamers feel that video games have a positive impact on their lives (Entertainment Software Association, 2020; GamingScan, 2020). The average age of gamers is 33, and children under the age of 18 make up 25% of the total gamers (GamingScan, 2020). In fact, 66% of children aged 8 to 12 play video games an average of 2 hours per day and over 80% of them own a gaming console (Center on Media and Child Health, 2020). Mobile gaming is the highest and fastest growing platform for gaming (GamingScan, 2020).

Video games are extremely popular among children and adults and many have studied to see how and what can be learned from videogame play (de Castell et al., 2017; Feng et al., 2007; Greenfield et al., 1994; Okagaki & Frensch, 1994). Studies have provided evidence that visual spatial skills benefit from video game playing time (Greenfield et al., 1994; Okagaki & Frensch, 1994). Feng et al.’s (2007) study revealed that playing 10 hours of an action videogame improved selective attention and mental rotation.

The first noted use of educational computer games in the classroom occurred in the mid-1980s with the introduction of Carmen Sandiego and the Oregon Trail games (Chen, 2014). Since then, gaming has become mainstream with 74% of K-8 teachers reporting the use of digital games for instruction (Takeuchi & Vaala, 2014). Gaming has captured the attention of educators, game developers, funders, and policymakers (Chen, 2014). Computers, Ipad, cell phones, and the internet can be used as platforms for student gaming (Siegle, 2015). Research has shown that video games can provide many benefits to students when used in the classroom. These benefits include cognitive, motivational, emotional, and social gains (Siegle, 2015). In addition, video
games can provide an avenue for differentiation for gifted learners. Through gaming, a student’s academic confidence and problem-solving skills can be improved (Siegle, 2015). Spatial abilities can be improved through video games as students navigate in 3D space, having to think quickly and make fast decisions. In one study, researchers found that functional connectivity and structural remodeling, both of which relate to visual spatial intelligence, increased during video gaming, as quickly as within two hours of exposure to the game (Kalbfleisch & Gillmarten, 2013). Researchers note that teachers can use gaming as a means of measurement as they discover what students know as well as how students learn (Siegle, 2015).

Visual-spatial intelligence is an underused talent, one that can be developed through gaming and should be of significant importance to gifted education (Kalbfleisch & Gillmarten, 2013). Several video games, including the two-dimensional puzzle game Tetris, provide opportunities for enhancing visual spatial intelligence through visualization and imagery (Newcombe & Frick, 2010; Terlecki et al., 2008). Gaming is considered by many to be a proven venue to provide challenging, differentiated learning opportunities that gifted learners need to reach their potential (Siegle, 2015). Playing video games such as first-person shooters and spatial puzzle games can increase spatial ability, including mental rotation, according to research (Adams et al., 2015; Feng et al., 2007; Ogunkola & Knight, 2019; Terlecki et al., 2007). One study, which revealed a correlation between spatial ability and video game scores, discovered that the more experienced video game players had higher spatial ability scores (Gagnon, 1985; Ogunkola & Knight, 2019). Other studies have suggested that boys tend to have more advanced spatial skills due to early video game experiences (Baenninger & Newcombe, 1989; de Castell et al., 2015; Gold et al., 2018; Spence & Feng, 2010; Terlecki & Newcombe, 2005). In their meta-analysis, Uttal et al. (2013) provided evidence that spatial skills can be learned and enhanced
through video game play and those skills can be transferred to other non-gaming spatial tasks, such as construction and mental rotation skills. Research has shown that video gaming can lead to not only cognitive, but motivational, emotional, and social benefits as well (Granic et al. 2014; McGonigal, 2011; Russoniello et al., 2009; Ventura et al., 2013).

Teachers can also use gaming as a means of assessment of students’ progress (Siegle, 2015). In most classrooms, learning involves three separate steps: instruction, practice, and assessment (Siegle, 2015). In gaming, these steps occur more naturally and simultaneously (Siegle, 2015). Using gaming as a source of assessment may also be helpful for teachers as they continue to refine their e-learning curricula. Teachers are able to assess the choices students make during gaming, which helps teachers to discover not only what students know but how the students learn (Siegle, 2015).

**Tetris.** First released in 1984 as a PC game, the game *Tetris*, invented by Alexey Leonidovich, played a part in the rise in popularity of gaming (Sorokanich, 2014). In 1989, *Tetris* was redesigned and released as a highly visuospatial game for the handheld Nintendo Gameboy (GamingScan, 2020). It became the best-selling game of the system with over 30 million games sold (Sorokanich, 2014).

The concept of this interactive, highly engaging game is simple with no storyline but continuously falling bricks, also known as tetrominoes, into a playing field. The bricks can be moved and rotated 90 degrees with the goal of creating a complete horizontal line of the bricks without gaps. When this happens, the bricks are deleted, leaving optimal playing field space. In the beginning, the bricks fall slowly but as the game progresses, the speed of the falling bricks increases. The player must keep an eye at the top for the falling brick while continuously scanning the playing field for the optimal open spot. Once the bricks reach the top of the playing
field, the game ends. The challenges of *Tetris* include problem-solving, fast responses, mental rotations, and making predictions (Belchior et al., 2013). Playing *Tetris* can provide cognitive benefits, including developing spatial ability, selective visual attention, and mental rotation skills (Belchior et al., 2013; Moreau, 2013; Okagaki & Frensch, 1994; Terlecki et al., 2008). *Tetris* is just one of many games that could help students and teachers develop growth mindsets as it provides honest and immediate feedback on performance.

**Puzzles**

Puzzles are an effective way of providing visual spatial inclusion, especially in the elementary gifted classroom. One way to engage younger children in visual spatial activities is through the use of puzzles like 2D and 3D mental rotations and paper folding activities. Research has shown that using 2D and 3D mental rotation puzzles in the classroom can result in academic gains for students in the STEM fields (Farnell, 2016). Puzzles can develop and strengthen inductive and deductive reasoning, which helps to improve critical thinking skills, and enhance visual-spatial intelligence (Wanko, 2017). Children with high levels of visual spatial intelligence can excel and thrive at activities requiring higher order thinking skills and creative problem solving such as puzzles, mazes, map readings, and model building (Mann, 2006). Providing these students with visual spatial activities, such as Tangrams and Sudoku puzzles and Origami, can result in significant positive impacts on student engagement and learning ability (Brophy and Hahn, 2014). Nonverbal puzzles, such as Tangrams and paper folding activities, help to develop and promote inductive and deductive reasoning skills, and enhance visual-spatial intelligence (Wanko, 2017).

Providing challenging spatial puzzles may help to foster a growth mindset classroom. In her study, Dwerk (2006) presented a series of puzzles, increasing in difficulty, to elementary
students. Those with a fixed mindset chose to repeat the puzzles which they had successfully completed, in order to ensure continued success (Dweck, 2006). Choosing to continue to a more difficult puzzle would be risky and possibly expose ability deficiencies (Dweck, 2006). However, the children who chose to continue with the more difficult puzzles displayed growth mindset (Dweck, 2006). They understood that success is dependent on seizing the chance to stretch, learn, and grow (Dweck, 2006).

**Teacher Training**

In order for teachers to feel confident and proficient at using some of these suggested best practices for spatial ability, proper training and professional development should be offered, and possibly required for teachers. When teachers feel more confident and they have higher levels of self-efficacy, they become more willing to offer these types of activities to their students, helping them reach their highest potential.

Teacher training needs to occur so that teachers are better able to meet the needs of these students, especially for spatial ability. Education majors tend to have the lowest average spatial ability scores compared to other college majors (Wai et al., 2009; Wai & Lakin, 2020). Therefore, they may not be prepared to teach these students and may lack the appropriate level of teacher self-efficacy to confidently instruct these students (Wai et al., 2009). Teachers can better differentiate the curricula and vary the activities and instructional methods when they are well versed in the content they teach (Siegle, 2015). The NAGC (2010a) devotes an entire set of guidelines for high-quality professional development in gifted education in its Standards. Therefore, training and professional development should be offered to teachers of gifted students who plan to teach visual spatial activities such as project-based learning, gaming, and puzzles.
However, much remains to be done in regard to proper teacher training and professional development, especially with gaming (Chen, 2014).

The trend typically has been that of teachers teaching each other about gaming in the classroom rather than formal, comprehensive professional development (Chen, 2014). As a result, teachers may not be getting specific pedagogical strategies and resources that are needed in effective instruction and achievement (Takeuchi & Vaala, 2014). In fact, only 8% of K-8 teachers received pre-service training on digital game inclusion and integration (Takeuchi & Vaala, 2014). Younger teachers, as well as teachers who play digital games for their own pleasure, tend to incorporate gaming more frequently in their classrooms (Takeuchi & Vaala, 2014). Teachers have reported that they are “not sure how to integrate games” into their classrooms, and 80% of digital game-using teachers indicated they wished it was easier to find curriculum-aligned games for use in the classroom (Takeuchi & Vaala, 2014). However, just handing teachers new tools and resources without proper training is an invitation for disenchantment (Takeuchi & Vaala, 2014).

Training can be offered to pre-service teachers through universities and certification programs. Current teachers can receive training through various means including district-sponsored professional development, colleagues and mentors, partnerships with universities, and online training resources. However, teachers’ perceptions, as well as those of administrators and other stakeholders, about the value of these types of activities in their classrooms could be an issue. It is important that teachers and administrators be informed of the findings and evidence which supports the inclusion of visual spatial activities in the classroom with elementary gifted students for the enrichment and enhancement of spatial ability skills. Doing so helps to create a
shared vision and align decision-making among the teachers, administrators, and all stakeholders (Takeuchi & Vaala, 2014).

**Summary**

An emphasis on visual-spatial intelligence and spatial ability is needed in gifted programs (Andersen, 2014). Most elementary gifted programs are focused on enrichment and accelerated learning but have not changed much in the last 20 years (Callahan et al., 2017). Gifted education must continuously monitor and adapt to the trends in our society, and reflect the critical thinking skills and STEM initiatives, which are considered key components of 21st century education (Andersen, 2014). Ways to support these components is through the inclusion of visual spatial activities in the gifted curriculum. Visual-spatial intelligence and STEM outcomes can be nurtured through the use of problem-based units, technology, creativity, and puzzles. These activities can provide the differentiation and rigor necessary for these advanced learners (Mann, 2006). While there is significant literature on visual-spatial intelligence, the benefits of spatial ability training, and the connections with STEM success, particularly with high school students and older, there is very little research on the benefits and best practices of visual-spatial activities with elementary gifted students. There have been few studies published in the last three years that focus on spatial skills and students under the age of 18 (Trumble & Dailey, 2019). There is a gap in the literature on the benefits of using visual-spatial activities and the connections with STEM, as it pertains to younger students, particularly gifted elementary students.

More research is needed on the effects and impact that visual-spatial instruction and activities may have on younger students. Newcombe (2000) stressed the importance of spatial training with younger students for academic and STEM success later in life and how educational leaders can use spatial activities to support the development of spatial cognition for young
students. Gaining these skills at an earlier age may better prepare these advanced learners for STEM education and careers and help them reach their highest potential. Early interventions aimed at improving the spatial reasoning of young gifted children can lead to later academic and career success (Hawes et al., 2017). By studying the benefits and best practices of including visual-spatial puzzles and activities with elementary gifted students, educational leaders can use this information to create and develop appropriate, advanced and rigorous curriculum for elementary gifted students that further promotes their strengths and talents. Visual-spatial activities may improve students’ problem-solving skills, nonverbal cognitive intelligence, logical-mathematical intelligence, and visual-spatial intelligence (Andersen, 2014). Through a curriculum rich in activities that promote visual-spatial intelligence, STEM features, and critical thinking and problem-solving, the uniqueness of the gifted learner is recognized and encouraged. This type of curriculum can lead to later academic and career success (Hawes et al., 2017).
CHAPTER THREE: METHODS

Overview

The purpose of this qualitative single-case study was to describe the perceptions and best practices of elementary gifted teachers with teaching and using visual spatial activities in the gifted classroom, and to examine how the district’s elementary gifted program can support and further equip gifted elementary teachers to enrich the spatial ability of students in the gifted program. The methods section of this chapter describes the research design, research questions, setting, participants, procedures, and researcher’s role in the study. Additionally, data collection and data analysis is explained. Finally, the chapter concludes with a discussion on trustworthiness and ethical considerations and concludes with an overall summary.

Design

This study used a qualitative, descriptive single-case study design to discover the perceptions and best practices of elementary gifted teachers with teaching and using visual spatial activities in their classrooms, and to suggest how the district can best support the teachers in teaching these important skills. Qualitative research focuses on examining and understanding the meaning that individuals assign to social or human problems (Creswell & Poth, 2018). This type of research uses a setting that is natural to the people and places being studied while collecting data to establish patterns or themes (Creswell & Poth, 2018). Qualitative research “involves an interpretive, naturalistic approach to the world” (Denzin & Lincoln, 2011, p. 3). Using qualitative research provided the opportunity to observe, examine, and understand the best practices of using visual spatial activities by the gifted teachers. Also, the researcher was able to collect the data and not rely on an instrument developed by other researchers (Creswell & Poth, 2018).
Yin (2018) described the foundational trilogy of case study research with the case study research being the mode, the case study as the method, and the units as the cases. Stake (1995) explained that case study research is the study of an issue through one or more cases within a bounded system, bounded by time and place. This type of study allows the researcher to focus on a “case” in-depth in real-world perspective (Yin, 2018). A case study approach was used for this study as it is bounded and can be described within certain parameters (Creswell & Poth, 2018). This research was the study of a case within a natural, real-life setting (10 or more elementary gifted teachers working within a large urban school district in the southeastern part of the United States). For defining the case, information about the participants was collected. The uniqueness of a case is established through the nature of the case, the physical setting, the historic background, and other contexts, such as economic or political (Stake, 1994). This study sought to answer how teachers perceive their self-efficacy and best practices with using spatial activities in the elementary gifted classroom. Seeking to answer the “how” of some social phenomenon works is evident of a case study design (Yin, 2018). The use of a case study enables unique features and commonalities to be identified within its real-world context (Stake, 1995). Clarifying the boundaries of the case should strengthen the connection between the case and the research questions and propositions (Yin, 2018).

Yin (2018) proposed that there are three different types of case study research design. These include explanatory, descriptive, and exploratory (Yin, 2018). Since a descriptive case study’s purpose is to describe a phenomenon, the “case”, in a real-world context, this study is classified as a descriptive case study (Yin, 2018). This study used a single case, the district’s gifted program, to illustrate the phenomenon. The participants worked in the same educational program but at different schools and with different students. This allowed for different
perspectives on the phenomenon (Creswell & Poth, 2018). Therefore, a descriptive, single-case study method was used.

**Research Questions**

Central Question: How can a gifted program be improved to equip and support gifted education elementary teachers to enrich the spatial ability of students in the gifted program?

1. How do teachers’ self-efficacy and mindsets in the classroom influence the development of visual spatial skills?

2. How do gifted education elementary teachers describe their best practices using technology, problem-based units, and puzzles to enrich spatial ability?

3. What other strategies and best practices do gifted education elementary teachers in the district use to enrich spatial ability?

**Setting**

The district’s elementary gifted program, called Challenge, served as the single case for the study. All of the participants taught the district’s elementary gifted program at their individual schools within the large urban public school district. The district and the participants’ schools were convenient to me since I taught in this school district. There were 35 teachers of the elementary gifted program serving the 51 elementary schools in the district. Due to allocations and number of qualified students per school, some teachers worked at multiple schools. It was possible that a selected teacher worked at more than one school.

There were 93 schools in the district being studied, with 51 being elementary. Per the 2019 state report card, there were 76,057 students and 4,908 teachers. Of the students, 59% were white, 27% were black, 10% were Hispanic, 3% were Asian, and 1% other. The district has an overall graduation rate of 85.1%. There were 25.2% of the students served by the gifted and
talented program. As of November 2020, for grades 3 to 5, there were 4343 students participating in the elementary gifted program. Of these students, 75.8% were white, 7% were black, and 17.2% were other. Males made up 50.2% of the total while there were 49.8% female. The district’s elementary gifted program is called “Challenge”.

Qualification for the gifted program is based on state-mandated criteria. All students in grade 2 in the district are screened for identification using multiple assessment measures, including OLSAT (Otis-Lennon School Abilities Test), CogAT (Cognitive Abilities Test), and NNAT (Naglieri Nonverbal Ability Test). Students may qualify automatically with an aptitude score of 96% or higher for their age group. If a student does not qualify automatically based on aptitude, the student must then meet the criteria in two out of the three dimensions (aptitude, achievement, academic performance). Students who score at the 93% or higher in aptitude meet the aptitude dimension and a score of 94% or higher is necessary for meeting the achievement criteria. If a student meets the achievement criteria, but not the aptitude, they are retested using Performance Task Assessment. Beginning in third grade, qualified students are placed in the academically gifted and talented program. Students in grade 3 attend the gifted class for at least 125 minutes per week, and students in grades 4 and 5 attend for at least 200 minutes per week. Each elementary school in the district receives a teacher for the gifted classes, with the classes having a teacher-student ratio of 1 to 20, or less.

The differentiated curriculum for the district’s elementary gifted program consists of a problem-solving unit and an introductory algebra unit for all the gifted students. In addition, each grade level has a year-long interdisciplinary unit. These include multidisciplinary units on Shakespeare (3rd grade), bridges and the engineering design process (4th grade), and architecture and viewpoints (5th grade). A team of the gifted program’s teachers put together
these units for the program. The curricula include resources from teacher-developed materials, predeveloped materials, and project-based units created by the College of William and Mary.

A state endorsement in gifted education is required to teach in the district’s gifted program. Professional development is provided monthly for the district’s gifted teachers. This occurs at the gifted program’s monthly staff development. Typically, these are conducted by the teachers of the gifted program, with an occasional guest speaker. The topics vary but predominantly focus on best practices and strategies for teaching gifted education.

The focus of this study was on the perceptions and best practices of teachers using spatial activities within the elementary gifted program. The study examined the teachers’ confidence and their self-efficacy with using technology and other methods to enrich and encourage spatial ability skills of their students. The demographics varied per school. Permission was obtained from the IRB, the school district and each participant (see Appendices A, B, and C).

**Participants**

There are approximately 35 teachers of the elementary gifted program in this district. Ten participants for the study were selected by using purposeful sampling, which was based on having a gifted and talented teaching endorsement, currently teaching in the district’s gifted program for a minimum of three years, and a willingness to participate. Purposeful sampling is used when the researcher intentionally selects a group of people that can best inform about the topic under study (Creswell & Poth, 2018). The participants all held current South Carolina teaching licenses and have achieved gifted endorsement on their teaching licenses. They varied in age, gender, years of experience, and levels of education (see Table 1). Though there were efforts to recruit a more ethnically diverse population, the study was limited to those who were willing to participate. All participants were Caucasian.
Table 1

Participant Demographics

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Highest Degree Earned</th>
<th>Years Teaching</th>
<th>Years Teaching Gifted</th>
<th>Other Certifications</th>
<th>Experience outside of Greenville, SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artie</td>
<td>Master’s</td>
<td>6</td>
<td>6</td>
<td>Learning and Technology</td>
<td>Florida</td>
</tr>
<tr>
<td>Austen</td>
<td>Master’s</td>
<td>19</td>
<td>5</td>
<td>Special Ed, Early Childhood Administration</td>
<td></td>
</tr>
<tr>
<td>Blair</td>
<td>Master’s</td>
<td>16</td>
<td>8</td>
<td>Gifted, Learning and Technology</td>
<td></td>
</tr>
<tr>
<td>Finley</td>
<td>Master’s</td>
<td>20</td>
<td>5</td>
<td>Administration</td>
<td></td>
</tr>
<tr>
<td>Frankie</td>
<td>Master’s</td>
<td>16</td>
<td>6</td>
<td>Secondary Ed, Special Ed, National Board Certified</td>
<td></td>
</tr>
<tr>
<td>Jackie</td>
<td>Bachelor’s</td>
<td>32</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Koda</td>
<td>Bachelor’s</td>
<td>35</td>
<td>17</td>
<td>Special Ed, Early Childhood, Literacy Teacher, Project Lead the Way Read to Succeed</td>
<td>Columbia, SC</td>
</tr>
<tr>
<td>Landy</td>
<td>Master’s</td>
<td>13</td>
<td>6</td>
<td>Early Childhood, Gifted</td>
<td>Georgia</td>
</tr>
<tr>
<td>Riley</td>
<td>Master’s</td>
<td>25</td>
<td>10</td>
<td>Instructional Systems Technology</td>
<td>North Carolina</td>
</tr>
<tr>
<td>Zane</td>
<td>Master’s</td>
<td>17</td>
<td>5</td>
<td>Gifted</td>
<td></td>
</tr>
</tbody>
</table>

The students in their gifted classrooms were in grades 3, 4, and 5 who qualified for the district’s gifted program based on state-mandated criteria. The gifted program in this district is a nongraded, enrichment, pull-out program. Students in grade 3 attend the gifted class for at least
125 minutes per week, and students in grades 4 and 5 attend for at least 200 minutes per week.

**Procedures**

For this study, the procedures are as follows. I obtained permission from the Institutional Review Board (IRB) (see Appendix A) and the school district (see Appendix B). Upon receiving that, the researcher communicated with the district’s elementary gifted program’s teachers. This was done through an email sent by the researcher to all of the teachers of the gifted program (see Appendix D). Once ten participants agreed to the study, permission was obtained from each participant (see Appendix C). All participants were provided with a link to a private video on YouTube of the researcher describing the study and its procedures, including the goals of the study and the expectations of the participants. In the event a participant was unfamiliar with visual spatial ability and/or activities that involve visual spatial awareness, a set example was provided (see Appendix E). Permission was obtained to use an online standardized self-efficacy survey and the participants were provided with a link to take it (see Appendix F and G). Once on the website, participants entered a survey code and student number, which was specific for each participant. The participants rated their self-efficacy using a Likert-type scale. The responses of the participants were recorded. The researcher then scheduled a 30-minute interview with each participant. The interviews were held via the Google Meets platform. The interviews were at the participant’s convenience. Open-ended, semi-structured interview questions (see Appendix H) were used with some questions based on the results of the self-efficacy survey instrument. The interviews were recorded and transcribed for data analysis. Each teacher was given the opportunity to review the transcripts in order to check accuracy. A spreadsheet was created to note the occurrence of certain words and data from each participant in order to locate emerging themes and patterns. Finally, each teacher participant was asked to provide a copy of a visual
spatial activity used in their classroom and/or a copy of a student’s completed visual spatial activity work. The participants were told this selection was based on their choice in an effort to highlight and showcase what they were doing in regard to spatial ability in their individual classrooms. These were in the form of photos or screenshots, emailed attachments, and internet website links. In addition, correspondence with the participants via emails or texts was used as part of the data collection. Using the data from the surveys, interviews, and physical artifacts, analysis of the data was performed.

The Researcher's Role

My job was to obtain permission from IRB, the school district, and all participants. I provided all participants with a link to a private video on YouTube of me describing the study, including the goals of the study and the expectations of the participants. In the event a participant is unfamiliar with visual spatial ability and/or activities that involve visual spatial awareness, a set example was provided (see Appendix E). As the human instrument in this study, I used the survey, interviews, and physical artifacts to collect important data for the study. The research questions and survey responses guided the development of the open-ended interview questions used for each interview (see Appendix H). My goal for the research was to rely on the participants’ views and best practices which were multiple and varied (Creswell & Poth, 2018).

I have taught in the gifted program for the selected school district for the last 21 years and have a master’s degree in gifted education. I have a good working relationship with the gifted coordinator for the gifted program and have interviewed her for a previous course. I knew most of the teachers who teach in the gifted program and have worked with them for many years as their peer. I was not in a supervisory role and did not have any authority over the teachers in the gifted program. Since there is some flexibility in our gifted curriculum, I have always
included visual spatial activities as enrichment for my students. It was my belief that most of the other teachers do not expose their students to these types of activities but choose other enrichment activities.

Data Collection

A major strength of case study research design is the opportunity to collect and use different sources of data (Yin, 2018). Using multiple sources of evidence supports the in-depth study of a phenomenon and provides the opportunity to develop converging lines of inquiry (Yin, 2018). The findings are likely to be more convincing and accurate if based on multiple sources of information (Yin, 2018). Data triangulation strengthens the construct validity of the case study (Yin, 2018). When researchers use multiple sources of data to shed light on a theme or perspective, they are triangulating information and providing validity to their findings (Creswell & Poth, 2018). Therefore, a triangulation of data collection was used in this study through the use of a survey, interviews, and physical artifacts.

Survey

A standardized self-efficacy survey, the Self-Efficacy Formative Questionnaire (Gaumer Erickson & Noonan, 2018) was provided to each participant (see Appendix G). The Self-Efficacy Formative Questionnaire, developed in 2015 by Research Collaboration, is an instrument designed and used to measure perceived level of proficiency in two components of self-efficacy: 1) belief that ability can grow with effort; and 2) belief in one’s ability to meet specific goals and/or expectations (Gaumer Erickson & Noonan, 2018). The questionnaire was in an online format with a private link specific to this study. Each participant was provided with the link to the survey website. Once there, participants entered a survey code and a student number which I provided each participant. The participants completed the survey by self-rating items
using a 5-point, Likert-type scale, ranging from 1 (not very like me) to 5 (very like me) (Gaumer Erickson et al., 2018). The survey was designed to build awareness of one’s perceptions and beliefs about their ability to impact and contribute to their academic success (Gaumer Erickson et al., 2018).

The survey instrument was tested for reliability using Cronbach’s coefficient alpha and was found to be highly reliable with $\alpha = .894$ (Gaumer Erickson et al., 2018). The responses were automatically graphed for each participant and available to them once they completed the survey. This enabled them to verify and reflect on the results. The goal of the survey was to recognize some collective efficacy among the participants as well as achieve some level of convergence with the data in order to corroborate the phenomenon (Yin, 2014). The survey served as a part of the triangulation of data collection needed for this study. Through the responses of the survey questions, I looked for commonalities and differences among the self-efficacy of the participants. Since qualitative research is exploratory in nature, using a survey can provide information about the general attitude and opinions of a particular topic. Surveys offer confidentiality and anonymity (Creswell, 2013).

**Interviews**

Yin (2018) considered interviews one of the most important sources of evidence in a case study. They are commonly found in case studies and are an essential source of evidence (Yin, 2018). Interviews can help with answering the “hows” and “whys” of a case study research (Yin, 2018). The strengths of interviews are they provide targeted and insightful data (Yin, 2018). They can provide personal views which include perceptions and attitudes (Yin, 2018).

In order to answer the research questions of my study, each participant was interviewed individually. The purpose of the interview was to obtain data regarding the participant’s
knowledge of visual spatial intelligence, their perceptions of how it can be and/or is used in the classroom, their perceived self-efficacy in teaching spatial skills, and the level to which they feel they are incorporating visual spatial skills within their individual classes. A semi-structured interview was used to allow for a more natural flow to the questioning. The questions were open-ended, fluid, and attempted to inquire into the participants’ attitudes, feelings, concerns, and values relating to teaching visual spatial skills. I pilot tested the interview questions with a participant not involved in the study and used the feedback to refine the research questions (Yin, 2014). The interviews were held via the Google Meets platform, lasting approximately 30 to 45 minutes. These interviews were recorded and transcribed. The interviews were also used to corroborate the self-efficacy results obtained through the survey.

Questions for interview (see Appendix H)

1. Describe your experience with teaching elementary gifted students.

2. What activities in the current Greenville County School District’s Challenge curriculum do you think promote STEM enrichment/success?

3. Describe an example of a visual spatial activity.

4. What is your perception and/or experience with visual spatial intelligence and ability?

5. What are some ways that the Challenge curricula promotes visual spatial instruction?

6. In what ways can technology be used for teaching visual spatial skills?

7. Describe your strengths and weaknesses with using technology in your classroom.

8. Describe your strengths and weaknesses with teaching the problem-based units within the Challenge curriculum.

9. What are some things a gifted program can do to expose elementary gifted students to visual spatial skills?
10. What are some things a district could do to further equip and support GT teachers in their efforts to teach visual spatial skills?

11. How do you feel about gaming in the classroom?

12. How are today’s perceptions about gaming different than the perceptions of gaming 20 years ago?

13. What benefits can be gained from playing video games?

14. What are some enrichment activities that you do with your students that are outside the GT curriculum that may be encouraging visual spatial skills? Please describe the activity and why you selected this one to share.

15. In what ways does a teacher’s self-efficacy affect and influence his students?

16. How important is fixed and growth mindset in education, and in particular, how does a teacher’s mindset affect his students?

17. What do you consider to be the best practices for teaching visual spatial skills in the gifted classroom?

All of the interview questions were Level 1 questions (Yin, 2018). Level 1 questions are the questions which are actually asked to the interviewees (Yin, 2018). Questions 1 through 8 were specific to the activities each participant chose to teach and her experience with the activities. Questions 9 through 17 were more thought-provoking and required the teachers to use their experiences with teaching visual spatial activities in order to answer these questions. The questions were fluid and built upon each other.

**Physical Artifacts**

Physical artifacts have been used extensively in studies focused on children (Yin, 2018). I used physical artifacts as part of the triangulation of data collection needed for my case study.
Each participant was asked to provide a copy of a spatial ability activity and/or a copy of a student’s completed spatial activity work. Some of these came in the form of an internet website link while others were screen shots, photographs, or word documents. These artifacts were an important component in this case study (Yin, 2018). Using the students’ finished products helped me to develop a broader perspective concerning all the different methods the teacher participants can choose to teach spatial ability (Yin, 2018). As I examined the physical artifacts provided by the participants, I looked for evidence of best practices of visual spatial activities, those which are reflected in the students’ learning and understanding of these spatial skills. The strengths of using physical artifacts in a case study include being able to gain deeper and broader perspective and insight, far beyond that which could be observed in a classroom visit (Yin, 2018). These artifacts were used to supplement the survey and interviews (Creswell & Poth, 2018).

**Data Analysis**

In case study research design, the researcher has the flexibility to “play” with the data and search for patterns and themes, and not be constrained by restrictive rules as in other forms of research (Yin, 2018). The goal of data analysis in case studies is to define the priorities for what to analyze and why (Yin, 2018). Four general strategies for data analysis include relying on theoretical propositions, working the data from the “ground up”, developing a case description, and examining rival explanations (Yin, 2018). Within each of these strategies, five analytical techniques can be used which include pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis (Yin, 2018). For my study, I used the general strategy of working the data from the “ground up”. As I combed through the data, I looked for patterns or concepts emerging. These insights lead to other additional relationships among the data (Yin, 2018). All forms of data were categorized during the data collection process which
was important for accurate record keeping (Creswell, 2013). I pilot tested the interview questions with a participant not involved in the study in order to refine the questions before conducting the actual participant interviews. Using the data from the survey, interviews, and physical artifacts, information was transcribed, coded, analyzed, and interpreted for emerging themes and trends. These interpretations helped to make sense of the data, with the “lessons learned” from the study (Lincoln & Guba, 1995; Creswell & Poth, 2018).

At the start of the study, I discussed what I expected to find in the perceptions and best practices of the participants in regard to their self-efficacy with using visual spatial activities in the gifted classroom. From the study propositions to the “lessons learned”, these findings provided the basis for the written analysis. Natural generalizations, which were developed from analyzing the data, may help others apply the learnings or transfer them to similar cases (Creswell & Poth, 2018).

**Transcription**

Recordings from the interviews were transcribed verbatim by me, the researcher. I looked for common themes, as well as differences, among the participants’ interview answers. I also looked for common themes and patterns in the survey responses and the supporting physical artifacts. Relevant words, phrases, and sentences were labeled and prepared for coding.

**Coding**

Coding helps to make sense of the data collected (Creswell & Poth, 2018). Coding was used in an effort to piece together the codes into broader themes. The responses from the interviews and survey were manually organized into codes and themes (Yin, 2014). I defined the codes and looked for common themes and patterns among the teachers’ perceptions, responses, and physical artifacts. These were noted in the margins of the interview transcripts as well as in
the field notes (see Appendix I). The results of the survey are displayed on a 100-point scale, similar to grades, with results presented for each essential component (Gaumer Erickson et al., 2018). I created a word table of the survey data. The interview responses were coded based on repetition, surprise, significant words and phrases, or anything deemed as important by the participant or me. Also, any word, phrase, or sentence that related to the literature was coded as such. In addition, I looked for commonalities and differences among the participants’ selections of the physical artifacts. Coding was used for the physical artifacts as I looked for themes and patterns among these selections. I created themes by grouping similar codes together. These themes are displayed in figures and tables. Coding of relevant data helped with conceptualization of underlying patterns (Yin, 2013). The coding process helps the researcher interpret and gain meaning from the data (Yin, 2013).

**Field notes**

Field notes, which can take a variety of form, are usually the most common component of a database in case studies (Yin, 2018). I used field notes in order to describe what was seen and heard during the interviews (see Appendix I). Notes were also used to comment on the survey responses and the physical artifacts of the spatial activities and/or students’ work. The notes were organized and categorized according to the major topics of my study (Yin, 2018).

**Pattern matching**

Pattern matching is one of the most desirable data analysis techniques (Creswell & Poth, 2018). This type of analysis compares an empirically based pattern with a predicted one (Yin, 2018). Pattern matching compares the collected data with a pattern established prior to the study. At the start of the study, I discussed what I expected to find in the perceptions and best practices of the participants. Using pattern matching, I compared the patterns discovered through the study
with the ones I predicted (Yin, 2018). The data collected from the survey, interviews, and physical artifacts were used in pattern matching. From the codes created during the coding step, themes and categories were created based on connections which helped with pattern matching among the participants’ responses and artifacts.

**Trustworthiness**

In order to establish trustworthiness for this case study’s procedures and results, steps were taken to ensure the credibility, dependability and confirmability, and transferability of the study and its findings. These criteria were developed for qualitative research in order to support the trustworthiness of the results of a study (Lincoln & Guba, 1985). Using three different sources of data collection helped provide valid and reliable findings from the research. The interview questions were pilot tested before conducting the actual study interviews in order to refine and adjust the questions and the interviewer’s style based on the participant’s feedback (Creswell & Poth, 2018; Yin, 2014). I recorded and transcribed the individual interviews verbatim. I maintained a neutral perspective during the interviews to avoid influencing the participants and their responses. The interview questions were adjusted based on the results of the participants’ survey.

**Credibility**

Credibility is the internal validity of a study (Lincoln & Guba, 1985). The use of multiple sources of evidence helped my findings more accurately describe reality (Yin, 2018). Data triangulation increases the credibility of case study research (Yin, 2018). I used data triangulation through the survey, interviews, and physical artifacts to understand the perceptions and best practices of the participants. Robust evidence exists when data collection utilizes three independent sources (Yin, 2018). The participants’ interviews were recorded and transcribed
verbatim. Member checking was used so that the participants had the opportunity to examine the preliminary analysis of their interview transcription and offer feedback on the credibility of the findings (Creswell & Poth, 2018). This ensured that there was no misunderstanding of the participants’ perspectives and no relevant data was left out of the study. Member checking is a crucial technique for establishing credibility (Lincoln & Guba, 1985). Member checking enhanced confidence in the data collection, which was a key validation step in the research process (Yin, 2018). I replicated the survey and interview procedure for each participant which helped provide credibility (Yin, 2018).

**Dependability and Confirmability**

Dependability in qualitative research is the degree to which the procedures are reliable. An interview protocol was used to help ensure dependability. Peer review was conducted as an external check on the research process for validation (Creswell & Poth, 2018). Researcher bias, values, and experiences were disclosed from the outset of the study (Creswell & Poth, 2018). Writing with thick, detailed description further increased the dependability and confirmability of this study (Creswell & Poth, 2018). An audit trail was used in which each research step was described with great transparency. Detailed research records were kept throughout the study. These steps ensured that the findings were meaningful and important (Merriam & Tisdell, 2016).

**Transferability**

Transferability is the ability to which the findings of a qualitative study can be applied or generalized to other people or contexts (Merriam & Tisdell, 2016). In order to ensure that the findings are transferable, thick description is necessary and was provided in this study (Creswell & Poth, 2018). The interview questions were aligned with the research questions and were supported by the literature. By using 10 participants, with variances in terms of gender, years of
teaching, and certificates/degrees held, I sought the maximum variation in my purposeful sampling which helped increase the transferability of the findings. Diversity among the participants helped provide a large amount of rich data for the study. Because this study used thick descriptions and rich data, others may wish to use the findings to further understand and build upon the topic of spatial ability with young gifted students.

**Ethical Considerations**

Ethical considerations included obtaining IRB approval and adhering to the guidelines. I obtained school district approval and disclosed the purpose of the study to the participants. I respected the participants’ time and minimized disruptions. All data and materials were stored using safety measures. All data on my computer relating to the study was password protected. Additional materials, including the students’ work, were stored in a locked file cabinet. At all times I protected the confidentiality of the participants (Creswell & Poth, 2018). Pseudonyms were used during the data collection, transcription, data analysis, and description of findings to protect the identity of the study setting and all participants. Participants were asked for their consent to audio and video record the interview. The participants were made aware that their participation would not have any impact on their teaching evaluations nor be shared with district personnel.

**Summary**

Chapter Three includes a presentation of the research design and methodology that was used in this study in order to answer the research questions related to teachers’ perceptions and best practices with using visual spatial activities in the elementary gifted classroom and how the district can best support and equip these teachers in these endeavors. The methodology, design,
data collection and data analysis that were used in the study are explained and steps to ensure trustworthiness and ethical considerations are included.
CHAPTER FOUR: FINDINGS

Overview

The purpose of this study was to describe the perceptions of best practices of elementary gifted teachers with teaching and using visual spatial activities in the gifted classroom, and to examine how a district’s elementary gifted program can support and further equip gifted elementary teachers to enrich the spatial ability of students in the gifted program. The participants were teachers who worked with students in the elementary gifted program in a large urban school district in South Carolina. Three different data collection methods were used to help answer the research questions. These included a survey, individual interviews, and physical artifacts. Originally, a focus group was going to be part of the data collection for the study, but due to the COVID-19 pandemic, this portion of data collection was eliminated and replaced with the online survey instrument. A copy of the amendment sent to the school district is included in Appendix J. Chapter Four reveals and addresses the findings of the data analysis. This chapter includes a description of each participant and the findings from each data collection method with some displayed through charts and graphs. The emerging themes are identified and discussed. The chapter concludes with a summary.

Participants

Purposeful sampling was used in order to have participants who were in a position to best inform about the research problem being studied (Creswell & Poth, 2018). Purposeful sampling may involve studying a subset of a population and include those participants who are knowledgeable about the issues being studied (Check & Schutt, 2014). In this case, purposeful sampling was used to study teachers with current gifted and talented teaching endorsements, and who were currently teaching in the district’s gifted program since the focus of the study was on
those who work with elementary gifted students. A minimum of three years of teaching gifted students, as well as a willingness to participate were also part of the participant selection criteria. The district coordinator for the program provided a list of the teachers who were currently teaching in the program. From this list of 35 teachers, an email was initially sent to the first 15 teachers who had a minimum of three years’ experience (see Appendix D). This resulted in 10 teachers responding with a willingness to participate. With the goal being to stop data collection when saturation of data was reached, this researcher was confident the essence of the study was reached with these 10 participants, as similar themes kept emerging from the data. The participants were provided with a link to an online video of this researcher explaining the study and the expectations and requirements of the participants. Once the participant signed and submitted the consent form (see Appendix C), the participant was sent instructions and a link to the online self-efficacy survey. This researcher was notified when the survey was complete, and then an email was sent with instructions for the participant to sign up for an interview time through an online appointment website. Participants were asked to send a physical artifact of their visual spatial activity ahead of the interview so it could be reviewed beforehand. As participants completed each step of the study, a spreadsheet (see Appendix K) was kept monitoring the completion of each stage per participant.

In order to provide a framework for the study, participants were initially asked demographic questions including years of teaching experience, total years of teaching gifted education, and degrees and endorsements earned. All had earned bachelor’s degrees, held valid teaching certificates, and had a gifted and talented endorsement. Six of the participants earned master’s degrees, with two of them earning more than one master’s degree. Four of the 10 participants had taught in gifted programs in other districts and/or states. Two of the participants
had early childhood certifications, one had special education certification, and one was certified in secondary education. Four of the participants had taught gifted education for five years or less, four participants for six to ten years, and two of the participants had more than 10 years of gifted education teaching experience.

Pseudonyms were used to protect the participants’ identities. Additionally, all participants are referred to as male, and male gender pronouns are used for all in further efforts to provide anonymity. It is important to note that the participants had not received any formal training by the school district on visual spatial ability, nor were they provided with any examples of visual spatial activities prior to the study. One participant did ask for an example at the end of the interview, and it was then provided (see Appendix E).

Artie

Artie’s background encompassed six years of teaching in two states, both in public and private settings. All of his teaching had been in gifted education. He had a very strong technology background as he was a programming manager for a large internet company before switching to education. Artie got into gifted education because, as the parent of a gifted child, he wanted to learn more about gifted children and educating gifted students. Artie loved the experience and has found it to be,

fantastic because I often learn so much from them, more than I ever thought that I would, you know, their brains will often work in different ways than mine do. They look at problems and kind of see the world from small to big differently than I do, and I love the experience. (Interview, April 27, 2021)

Artie quickly became a leader among the teachers of the gifted program.

Austen
Austen had extensive schooling in education with multiple degrees, including elementary administration. Austen spent time as an assistant principal before taking a few years off to raise his own children. He had completed 19 years of teaching, with five being in gifted education. Austen became interested in teaching gifted students during his first year of teaching. Even though he took the gifted classes and earned the gifted endorsement, Austen did not feel qualified to teach gifted children. Austen admitted that at first, he was not comfortable teaching the older elementary students. However, by chance, Austen was able to experience working in a gifted classroom and, “fell in love with it” (Interview, April 23, 2021). Austen liked giving his students opportunities to do activities that were “practice for the real world.” His passion for education was evident in the interview.

Blair

Blair was a general education teacher for several years, but found that his passion for teaching started shifting to the more advanced students in the classroom. After completing the gifted classes for a master’s degree, Blair made the jump to teaching gifted students where he had spent the last eight years. He was chosen to be a member of the curriculum writing team for the district’s gifted program. Recently, Blair completed a second master’s degree in learning and technology. Blair liked to challenge his students with innovative ways of using technology in solving real world problems and hoped his efforts inspired his students. He believed in continuing to learn and grow as a teacher because “we are teaching the future, and the future looks different than now” (Interview, April 28, 2021). Blair’s enthusiasm and love for teaching gifted students had made him a leader among his peers.

Finley
With a master’s degree in elementary administration, Finley had been in education for 20 years, with the last five in gifted education. Finley said that teaching gifted students was something he always wanted to do. Although not formally identified, Finley felt gifted as a child and was placed in special classes for acceleration. Because of this, Finley felt a connection with gifted students and their thinking. He preferred “natural learning” and provided opportunities for his students to experience this (Interview, April 21, 2021). He considered himself as “math-minded” and loved to expose his students to many opportunities and activities involving math. He was an encourager among his peers and often shared innovative ideas and activities with other teachers in the program.

Frankie

Frankie’s background was widely varied with over 16 years teaching experience, and degrees in English and elementary education. His first job offer after college was in gifted education, but he turned it down because he felt his place was working with high needs students, so special education became his passion. Frankie then spent many years teaching special education at the middle school level. Making the switch to gifted education has shown him that gifted students need good, skilled teachers also, and he felt working with these students made him a better teacher. Frankie said the experience of teaching gifted students has shown him that “differentiation is so hard but so necessary in the classroom” (Interview, April 22, 2021). He believed that students should be allowed to explore and create, both of which teach students to persevere. He was very passionate about choosing activities that helped his students to feel empowered to make change in the world.

Jackie
With over 18 years of teaching fifth grade, Jackie was ready for a change. Having worked with so many high achieving students in the regular classroom, he discovered that he really enjoyed teaching them and made the switch to gifted education where he has been for the last 14 years. “I love their sense of humor and their willingness to learn because at the elementary level, they’re still moldable” (Interview, April 26, 2021). Jackie liked exposing the gifted students to activities with rigor, ones that challenged them and made them think, such as logic grid puzzles. He also provided lots of opportunities for his students to explore and have fun because “if they’re having fun, they’re enjoying it, and they do a better job.” As a veteran teacher, Jackie was considered a mentor by many in the program.

Koda

Koda was another veteran teacher who had been teaching for over 35 years, with the last 17 in gifted education in multiple districts. While teaching early childhood education, Koda became interested in working with gifted children. Being the parent of gifted children as well, only furthered this interest. Koda wanted to “empower these children in the way they need to be empowered” (Interview, April 27, 2021). He experienced negative comments from other educators and administrators who did not have “the right philosophy about gifted kids.” Koda noted that the more involved he became with gifted kids, “the more I wanted to know about how to empower them, how to help them realize the potential that they had.” Koda was quite knowledgeable about visual spatial intelligence as his previous district had adopted and incorporated Gardner’s multiple intelligences throughout the gifted curricula.

Landy

Landy became interested in teaching gifted students while in elementary school due to a teacher who provided unusual, exciting, and challenging activities such as “dissecting eyeballs
and mouse brains” (Interview, April 23, 2021). Landy credited this teacher as being instrumental in setting him on the path to working with gifted students. With a degree in early childhood education and a master’s degree in gifted education, Landy had taught for 13 years, with six of those being in the gifted program in two different states. He believed variety and choice were important in gifted curricula, and creativity was a key component when working with gifted students. Landy mentioned Gardner’s multiple intelligences in the interview and had used these intelligences as guides for enrichment activities in his classroom.

Riley

With over 25 years of teaching experience, in two different states, Riley had seen many different philosophies and their practices in education. He credited these changing philosophies for helping him develop a strong growth mindset, something he felt he instilled in his students. Riley taught general education before earning a gifted endorsement and switching to gifted education 10 years ago. Riley loved to challenge the gifted students with activities that prompted open discussions and enforced communication skills. He believed that in gifted education, “the attempt and thought processes of the students – that’s what’s important to me, not necessarily whether the end answer is right or wrong” (Interview, April 28, 2021). With a master’s degree in instructional systems technology, Riley was a “math-science person” with strong technology skills.

Zane

Zane was very passionate about the topic of gifted children and was enthusiastic about participating in this study as he was clearly a strong advocate for gifted education. He referred to gifted students as the “forgotten kids” (Interview, April 21, 2021). Zane became interested in working with gifted students while teaching general education. After leaving teaching for 10
years to care for his own children, Zane reentered the teaching profession as an elementary classroom teacher. With a high number of gifted students in his classroom, he became intentional about meeting the needs of all of the students, and in his efforts to do this, “fell in love with gifted.” He has been a teacher in the gifted program for the past five years and has served on the curriculum writing team for the district. Zane credited teaching gifted children as his passion, strength, and what energized him as a teacher. Zane noted:

American education almost makes us feel apologetic for gifted education and makes us feel apologetic if those are the kids we love to teach. Not everyone loves to teach gifted kids. Some teachers don’t feel the energy from the gifted kids and every child needs an advocate and so I had to finally embrace that, which didn’t mean I was a horrible teacher because my love was for the gifted. Teaching gifted students is not utopia, not a walk in the park, it can be lonely sometimes, but there’s freedom in being able to truly teach and meet their needs.

Results

The purpose of this qualitative case study was to identify teachers’ perspectives of the best practices for implementing visual spatial skills in the elementary gifted curricula and how the teachers of the gifted program can be supported in their efforts to develop visual spatial activities for the elementary gifted classroom in a large school district in South Carolina. Purposeful sampling was used to provide rich data from the perspectives of teachers who worked directly with elementary gifted students and who taught the gifted curricula for the largest public school district in the state. After analysis of the three data collection methods, which included a survey, individual interviews, and physical artifacts, four themes emerged which helped to
answer the study’s research questions. Table 2 displays the alignment of each research question to the survey, interview questions, and physical artifacts.

**Table 2**

*Alignment of Research Questions to Survey and Interview Questions*

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Survey Questions</th>
<th>Interview Questions</th>
<th>Physical Artifacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do teachers’ self-efficacy and mindsets in the classroom influence the development of visual spatial skills?</td>
<td>1-24, 27-44</td>
<td>1, 3-8, 11, 14-16</td>
<td>All</td>
</tr>
<tr>
<td>How do gifted education elementary teachers describe their perceptions of best practices using technology, problem-based units, and puzzles to enrich spatial ability?</td>
<td>1, 4-7, 35, 38</td>
<td>2-6, 9, 10, 13, 14, 17</td>
<td>All</td>
</tr>
<tr>
<td>What other strategies and best practices do elementary gifted education teachers use to enrich spatial ability?</td>
<td>1, 6, 7, 31, 35, 38, 39, 44</td>
<td>2-6, 9, 10-14, 17</td>
<td>All</td>
</tr>
</tbody>
</table>

**Theme Development**

A major strength of case study research design is the opportunity to use different sources of data collection (Yin, 2018). The findings are likely to be more convincing and accurate if multiple sources of data are used (Yin, 2018). This study utilized a triangulation of data collection including a survey, interviews, and physical artifacts. Categorical aggregation and coding were used to identify emerging themes that developed through the data analysis of the survey results, the transcripts of the interviews, and the types of physical artifacts submitted. Field notes were used throughout all stages of data collection (see Appendix I). All emails, texts, and recordings were kept and stored as document collection. This documentation added further supporting evidence of the themes that developed.
As part of the data collection, the participants were asked to complete an online formative survey rating their behaviors in regard to self-efficacy and mindsets (see Appendix G). The questionnaire measured the participant’s knowledge, perceived level of proficiency and performance with respect to self-efficacy and mindsets (Gaumer Erickson & Noonan, 2021). The participants were required to rate their behaviors on two components of self-efficacy identified in the survey: 1) Focus on effort, progress, and learning, and 2) Steps to increase confidence in self abilities (Gaumer Erickson & Noonan, 2021). The first component (effort, progress, and learning), addressed the participant’s perceived self-efficacy with respect to his own behaviors in a problem-solving situation. The second component (steps to increase confidence), addressed the participant’s willingness to take steps to increase his self-efficacy in a given situation. The questionnaire contained 10 questions based on the first component and 14 questions focusing on the second component (see Figures 1 and 2). In terms of this survey, participants indicated that they had high levels of self-efficacy in both components. For component one, the majority (85.2%) of the participants self-rated a score of 5 (very like me), meaning there was a perceived high level of confidence when faced with a problem-solving situation. For component two, the participants’ average self-rated score was 81.8 (very like me), suggesting the participants were open to taking steps to increase their self-efficacy when necessary. This could also be construed as an indication of a strong growth mindset. All of the participants answered the 10 true/false questions on fixed and growth mindsets correctly, resulting in a score of 100%, indicating they were knowledgeable about mindsets and understood the characteristics of a growth mindset.
Figure 1

Participants’ Responses to Self-Efficacy Component 1

Figure 2

Participants’ Responses to Self-Efficacy Component 2
The individual interviews were conducted through the Google Meet platform at the participant’s convenience. The interview questions (see Appendix H) were developed to help answer the research questions and ultimately the study’s central question. The purpose of the interview questions was to focus on the participant’s perception of best practices of teaching visual spatial skills and their self-efficacy with using these best practices in their gifted classroom. Also, the intent was to discover any factors preventing the inclusion of visual spatial activities in their classrooms. The interviews lasted approximately 30 minutes each, with the shortest being 22 minutes and the longest at 45 minutes. The interviews were video recorded and transcribed using an online transcription service. Each participant received a copy of the transcription to check for accuracy.

The participants were asked to share an artifact of a lesson or activity they had either previously done with students, currently doing with students, or would like to do with students. The participants were told that the artifact could be pictures from the activity, a written description, a lesson plan, or anything else the participant wanted to share. They were encouraged to share something that was not currently in the gifted curriculum, but that they chose to do as an enrichment activity. If the participant didn’t feel like his enrichment activities touched on visual spatial skills, he was encouraged to think of one he would like to have done with students. Each participant emailed links to lesson plans, photos, website links, and apps as artifacts. The participant was given time during the interview to discuss his chosen activity and why he felt it enriched visual spatial skills.

Once data collection was completed, the interview transcripts were read several times, and phrases, key words, and noteworthy quotes were coded. In addition, the participants’ responses to the survey as well as their explanations and discussions of their chosen visual
spatial lesson (physical artifact) were analyzed to identify significant codes, phrases, and quotes. Categorical aggregation was used in an effort to discover issue-relevant meanings from the data (Creswell, 2013). The codes, phrases, and quotes from all three data sources were analyzed for patterns and categories were identified. The phrases, words, and quotes were placed in these categories relative to each of the three research questions. The initial analysis of the code words resulted in a broad range of categories. Table 3 shows the number of recurring words and phrases and supports the resulting themes that emerged. Further analysis of the code words allowed for grouping of similar categories which ultimately yielded the emerging themes.

From these patterns and codes, broad categories developed, and using constant comparison, general themes were identified. The following four themes were identified:

- integrate visual spatial skills across the curricula
- increase the use of hands-on activities
- incorporate more digital apps and gaming
- receive appropriate teacher training

These themes are consistent with the literature on visual spatial education, self-efficacy and growth mindset, teaching gifted children, and STEM education, and helped provide answers to the three research questions of this study. The data collected was used to validate the theme identification and to answer the central research question.
### Table 3

*Themes and Codes for all Data Sources*

<table>
<thead>
<tr>
<th>Themes</th>
<th>Codes</th>
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<tbody>
<tr>
<td>Integration across curriculum</td>
<td>Struggle</td>
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<td></td>
<td>Baby steps</td>
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<td>Smaller units</td>
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<td>STEM</td>
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<td>Scaffolding</td>
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<td>Differentiation</td>
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<td>Consistent</td>
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<td>Engineering</td>
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<td>Building structures</td>
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<td>Hands-On Activities</td>
<td>Manipulatives</td>
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<td>Acting out scenarios</td>
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<td>Tangrams</td>
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<td>Puzzles</td>
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<td></td>
<td>Art</td>
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<td>Problem-based units</td>
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<td>Creating</td>
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<td>STEM</td>
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<td>Origami</td>
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<td>Paper folding</td>
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<td></td>
<td>Logic</td>
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<td></td>
<td>Brain boosters</td>
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<td>Apps and Gaming</td>
<td>Benefits</td>
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<td>What kids know</td>
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<td>Too much</td>
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<td>Student interest</td>
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<td>Perceptions have changed</td>
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<td>Websites</td>
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<td>Brain games</td>
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<tr>
<td>Teacher training</td>
<td>Self-efficacy and mindsets</td>
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<td>Unqualified</td>
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**Theme One: Integrate Visual Spatial Skills Across the Curricula**

A recurring sentiment among the participants was the need to incorporate visual spatial skills across the curricula rather than having one major unit focusing on spatial ability. Words such as consistent, embedded, smaller steps, integration, and incorporated were noted throughout many of the interviews. When asked about best practices for visual spatial skills, one participant said, “I don’t think it needs to be a specific unit. I’d like to see it as a daily challenge or a weekly challenge,” while another stated, “…needs to be incorporated through as many things as possible.” According to Artie:

The best practice is to have it (visual spatial skills) incorporated through as many things as possible, rather than having just a directed unit. I think finding ways to kind of weave it through, even if it’s just short spurts here and there, five minutes here, five minutes there… I think that has far more of an impact on that skill and on a lot of skills, but on that skill specifically, than doing this whole big unit specifically on that. This would play to some of the strengths of some of these kids and strengthen those that don’t have it.

Blair noted that best practices for visual spatial skills included using activities based on student interest and offering multiple modes of hands-on learning and “just kind of hitting it over and over,” while Frankie said that gifted students “should be having lots of opportunities to be getting better at it. I would say for almost every unit or activity, even once every day, probably best practice would be to incorporate those skills.” Landy added that “any chance to kind of incorporate” those visual spatial skills by “using a combination of ways to do things” would be best practices for teaching spatial ability and would get “both sides of your brain crossing.”

Jackie believed that rigor and “constantly challenging the students so that they’re building those
dendrites in and they’re growing” would be important and uses brain-based activities towards this goal. Koda noted:

There are lots of different ways that you can add a visual spatial element to existing activities. So that is what I did. I added that element to push the kids in that direction of visual spatial, to make them really see it, and of course, the goal for visual spatial learners is that they can see it in their head. And even those kids that aren’t just naturally visual spatial, you want them to begin manipulating things in such a way that it helps them begin to see that mentally.

The participants were unanimous in thinking that visual spatial skills should be embedded throughout the gifted curriculum rather than as a major stand-alone unit, and their physical artifacts testified to that. One participant said, “I think there are lots of different ways that you can add a visual spatial element to existing activities.” Several of the participants shared activities that were art-oriented including lessons involving tangrams where students created original designs of animals and shapes using tangram pieces (see Figure 3). One participant shared an activity based on ancient Chinese arts, as an extension of tangrams, where the students created individual initials from the tangram pieces and incorporated personal elements into each (see Figure 4).
The participants felt that integrating visual spatial skills throughout the curricula would allow them to approach these skills slowly and with baby steps, as many expressed a lack of confidence in their knowledge and expertise in the subject. As part of the survey, participants were asked to respond to the following essay question: Imagine that you are facing a challenge and you are not sure you can be successful. Name three things you could do to raise your belief in yourself. The majority of the participants selected “break it into smaller steps” as one of the
three preferred strategies for overcoming a difficult challenge. The participants’ responses are shown in Figure 5.

**Figure 5**

*Participants’ Responses to Essay Question*

Additionally, nine out of 10 of the participants ranked themselves high in response to survey question one: If I worked at it, I could learn just about any skill. All participants indicated high self-efficacy in their responses to survey question 24: I like to challenge myself to learn new things. Despite these high self-ratings, there were many moments during the interviews that some of the participants expressed low self-efficacy about learning and teaching new skills. One explanation for this disparity could be response bias based on social desirability tendencies. The participants may have responded to the survey questions in ways to present the best versions of themselves (Check & Schutt, 2014). As the interviews continued, and they answered questions about visual spatial activities, many began to realize that visual spatial skills were already present in the current curriculum, in units such as building structures and bridges, Rube
Goldberg, and *Hands-On Equations*. Once the participants realized this, they became more noticeably confident in their answers.

**Theme Two: Increase the Use of Hands-On Activities**

All of the participants mentioned the use of hands-on activities for promoting and strengthening visual spatial skills. This theme was evident in all three data collection sources. The participants’ high self-rating of their self-efficacy behaviors on the survey matched their confidence displayed in the interviews when discussing their teaching of the district’s current gifted curricula and the hands-on activities included within it. The physical artifacts submitted by the participants, with many involving manipulatives and physical movement, further supported this theme.

The participants discussed the impact that COVID-19 and the required social distancing and safety precautions in the classrooms during the 2020-2021 school year had on their teaching, in particular the use of hands-on materials and manipulatives. All of the participants discussed the current 4th grade curriculum and its strong STEM and visual spatial components, including coding and engineering and design process. However, most felt that in order to incorporate more of these skills in the current curriculum, there was a need for more hands-on activities that included creating, designing, and constructing. Several of the participants noted that with COVID-19 restrictions, students could not use classroom manipulatives, but had to switch to digital forms of manipulatives.

Building and creating were frequently mentioned in the interviews by the participants when discussing best practices for teaching visual spatial skills. Artie noted that the building and engineering activities in the current curricula were visual spatial activities “because the ability to design something that has a function is a big part” of visual spatial ability and there were
students “that would really benefit from having more of a practical look at those kinds of ideas rather than it being too abstract.” Zane noted the need for providing students with opportunities to build and create, such as having students build “stem structures.” In discussing a unit on fairy tales, Zane gave the example of having students design and build a model of a house that “the wolf can’t blow down” and “building a bridge” to tie in with the Three Billy Goats Gruff story. Austen felt that visual spatial activities were those activities involving “problem solving and fitting pieces, different than a jigsaw puzzle, that putting pieces together to make certain shapes or designs or makes animals” and sees these as great opportunities “for hands on learning and for learning about logical skills and seeing things two dimensional versus three dimensional versus one dimensional.”

The participants discussed the importance of activities involving creativity and movement when sharing ideas and artifacts about visual spatial best practices. Landy said he gravitated towards activities that promoted creativity, including tangrams, activities that involved manipulating and moving things, and “anything with placement and movement” including dramatic arts. Other participants mentioned and shared activities that included tangrams, origami, puzzles, visual representations, tableaus and acting out scenes from Shakespeare plays, pixel art mysteries, and Japanese art projects.

Other visual spatial activities presented as physical artifacts included those involving manipulatives such as contraption kits (Keva Planks) which involved students building contraptions based on verbal instructions and the Hands-On Equations program where the students “go from using the manipulatives to being able to visualize it in their heads.” Riley noted that his students used the hands-on equations manipulatives electronically which
“encourages visual spatial more than when they’re holding the manipulatives.” Koda said he believed best practices started with manipulatives because:

so many kids aren’t geared that way and in order for them to start seeing it, if they can see it visually, then they can begin to transfer that as they spend more on particular best practices…computer apps and websites that have activities and games that push kids forward. Being able to convey what you see, what you expect, as an outcome.

Tableaus were mentioned by several of the participants as a way of helping students visualize and understand literature, in this case, scenes from Shakespearean plays. Finley described an activity of using movement to explain and provide a visual for adding and subtracting positive and negative numbers. In an effort to help his students visualize it, Finley marked off floor tiles (as a number line) in the room and “walked it off” meaning he started on tile zero and walked to positive eight. Then adding negative two he demonstrated walking back two tiles which “helped them visualize the answer through the movement.” He noted that some of his students still got up and walked it off to add and subtract positive and negative numbers. Other hands-on activities mentioned by the participants included a game involving stacking cups to build a tower based on a set of symbols and codes, another game where students designed a blueprint of a structure and then built it as a three-dimensional object using a set of blocks, and the game Five Square which relied on communication and teamwork (see Figure 6).
The participants all agreed that gifted students needed the rigor and challenge offered through hands-on activities. Many commented on the need for more of these types of activities, ones that involved building, creating, and designing, in addition to the ones in the current curriculum. The participants felt that through these types of activities, students learned not only visual spatial skills, but other important skills such as perseverance through trial and error and problem solving. Landy believed:

If people don’t make mistakes, they’re never going to get further, so it’s okay to make mistakes and grow and learn. If you’re too fixed and rigid, I can’t do this or this isn’t possible, especially for gifted learners, when it’s your job to really get them to go above and beyond, then you’re not really achieving what you’re supposed to be doing.
Koda’s comments were similar when he expressed:

The way we encourage students, the way we work toward a growth mindset with them, the way we help them to be confident and competent in things, I think our self-efficacy plays a big role in that. Because if we don’t have a solid, strong self-efficacy, that very often can play into how we encourage and how we push kids in a certain direction to meet expectations.

When discussing the types of activities they were currently doing with their students, including building bridges, structures, and a unit on Rube Goldberg contraptions, they all displayed and discussed high levels of confidence and self-efficacy. Their desire for more of these types of activities was indicative of the growth mindsets they felt were important to student success. Most of their physical artifacts were hands-on oriented, including acting out type games and physically manipulating tangram pieces. Providing students with hands-on activities could involve extra prep work for the teacher, as noted by one participant who said, “One of the things that’s hard is the teacher prep side of it all – a bit time consuming.” However, most felt the effort was worth the potential outcomes. This trait was evident in their responses to question 35 of the self-efficacy survey- all 10 of the participants responded that, “Students with high levels of self-efficacy understand that they have to put in effort in order to learn, so they will work harder.”

Theme Three: Incorporate More Digital Apps and Gaming

As one participant pointed out, “We are teaching the future, and the future looks different than now.” As the participants discussed visual spatial skills, gaming was an emerging trend, with many of the participants mentioning it in their discussion of best practices of visual spatial skills. The participants felt that benefits of gaming included promoting and improving hand-eye coordination, problem-solving, communication, teamwork, and leadership skills. They also noted
that gaming provided spatial awareness and taught perseverance, creativity, collaboration, social skills, and critical thinking, and allowed gamers to learn at their own level. Artie noted:

I’m a huge fan, and any time that I’m able to take any kind of a learning thing and make it into a game, and they’re all in…I find it really engages them. But let’s be honest, this is the video game generation, and so I think it’s meeting them where they are.

“Very often kids know the vocabulary from *Minecraft*. I will use a word and they will say, oh yeah, I know that from *Minecraft,*” said Landy. Blair talked about kids taking screenshots of what they’re doing in *Minecraft* and printing it on the 3D printer. “Taking what they see or what they are building on a flat screen and then printing it in 3D – that’s complete engineering,” said Blair. Jackie felt that “gaming definitely has a place in the classroom. Gaming definitely has a place in this decade and this era,” and Koda suggested to “immerse the kids in it across the curriculum, even related arts” would be beneficial. Frankie stated that:

Gaming is definitely spatial and something they will use in their careers. Today, it’s more accessible to be the creator than just to be the player. Kids see it as almost a way of life, like I think it’s so much a part of who they are and what they’re doing…they are becoming more empowered through it.

The participants noted that gaming was the future and viewpoints and opinions regarding gaming have changed as Koda stated:

Technology is here to stay and it’s increasing all the time. I think there can be productive gaming. There is a learning opportunity there. I don’t think any of us thought that people would actually make money playing video games. That people would make money creating the games but also by playing games as professional gamers.
Finley felt that:

- gaming promotes healthy competition with peers and pushes them to do better. Kids have to figure out how to make things work to get to the end, to get to the next level, so with each failure, they get to retry. It’s that retrying and keeping on until you do figure it out. However, not all of the participants were as enthusiastic about gaming. Austen had hesitation regarding gaming in the classroom and said:

- If I had a plan for why that was useful, not gaming for entertaining them or killing time, but gaming with a purpose. Gaming is everywhere…My initial connotation to gaming is very negative, because I feel it can be all consuming…the flip side of that is that gaming, when used appropriately in the classroom can be super, super engaging for students.

Some of the participants, in their roles as teachers and parents, felt conflicted on the subject of gaming. Blair discussed his experience of raising his own children who are gamers:

- As a parent, I do think technology and gaming needs to be limited. However, as a parent, I try to incorporate technology as much as I can. I’m trying to embrace the future. Kids love it, they’re learning from it, and it’s hard to deny their love for it. So why not embrace it?

While many of the participants claimed confidence and high levels of self-efficacy when discussing their technology skills, this was often contradicted in their responses to other questions, reflecting lower levels of self-efficacy and a fixed mindset towards growth in this area. Teaching in the pandemic led to frustration for many of the participants as they found themselves scrambling to learn new ways of teaching material not necessarily designed to be taught online. As a result, almost all participants said that, in the wake of the pandemic, there was now too much technology in the curricula. Finley noted that one frustration with this surge
in technology was “it’s a gray area and difficult to grade.” One participant felt that technology was “more work and more time-consuming than the old way of doing it and I’m just gonna do it the old way.” Another believed, “It’s a double-edged sword… technology is awesome but shut down the computer and be hands on, eyes on, voice on.” Despite some frustration with technology, several noted how important it was in their classrooms and in efforts to help students reach their highest potential, understood that gaming and technology were here to stay.

The majority of the visual spatial activities shared by the participants involved websites, apps, and videos. One participant shared an activity he did with his students that involved 3D design and printing. His students designed Adirondack chairs, printed the designs with a 3D printer, and then students at a local career center built them (see Figure 7).

**Figure 7**

*Adirondack Chair Artifact*

As the participant noted, doing these types of activities enhanced visual spatial skills as students must go from two-dimensional to three-dimensional. Other activities shared by the participants included websites where students recreated a tangram design by rotating, flipping, and turning shapes which involved students using trial and error in their attempts to figure out how the
puzzle pieces fit together to make the overall image (see Figures 8, 9, and 10). Some of the participants sent links to online videos containing visual spatial puzzles.

**Figure 8**

*Tangram Activity Artifact 1*

**Figure 9**

*Tangram Activity Artifact 2*
Overall, the majority of the participants were enthusiastic about gaming and noted that technology (including gaming and apps) was the way of the future. Unlike other toys that most children outgrow, gaming has continued to be popular with children of all ages since taking hold in the 1990s. Game creators, recognizing that popularity, continue to develop and market games to all audience levels. Blair believed technology was “a new means of teaching and learning.” Careers are now present for those in gaming, not only as players, but as creators of new games, apps, and gaming platforms, which further support the importance and the need for teaching students the appropriate technology skills through apps and gaming.

**Theme Four: Receive Appropriate Teacher Training**

Early in the interviews, participants were asked to define or describe visual spatial ability. Responses varied, with some participants giving a definition and others providing descriptions of activities or skills involving visual spatial ability. Two participants answered that they did not know what it was, while Frankie described visual spatial ability as “put thoughts in pictures and
designs…manipulate things in your mind.” Two participants referenced Gardner’s (1983) theory of multiple intelligences, and two mentioned the video game Tetris. One participant said that visual spatial intelligence is “kids who need visual representation,” while another described it as “problem-solving, fitting pieces.” Artie defined visual spatial ability as the ability to “visualize properties of space – like when you play the videogame Tetris,” while Riley stated that it is when children “picture what they are trying to solve.” Blair said it is “learning by doing and seeing, hand-on learning,” and in contrast, one participant was unsure if visual spatial is a skill that students can learn, and stated:

I don’t know, I kind of felt that it’s not necessarily something you can teach kids to have …and some kids just get it, and some kids don’t see it at all. It’s like what I’ve always said about spelling. I don’t think you can make somebody a good speller; you know, they make them memorize all these spelling words and stuff, but I think some kids are just naturally good spellers and some are not. So, I kind of feel like some kids learn with that visual spatial learning and they have it, and I just feel like some kids don’t have it. I’m not saying they can’t have it. I’m just saying it’s not natural to them.

Visual spatial examples noted by the participants included tangrams, origami, puzzles, mazes, drawing, video games, tableaus, hands-on activities including Hands-On Equations (an algebra unit) and Figure It Out (problem-solving unit), and one participant noted a nonverbal children’s book, The Red String, about a red string moving throughout the story (Blair, 1996). Some of the participants noted their lack of confidence with accurately defining visual spatial ability and asked if their responses were correct. This lack of confidence could be reversed through appropriate training and professional development on visual spatial skills, as many of them noted.
Unanimously, the participants felt they needed specific training and professional
development in order to understand and teach visual spatial skills effectively and successfully.
Jackie felt the teachers needed “more exposure and training.” Many of them noted that they did
not intentionally use visual spatial skills and activities in the classroom because they were not
confident in teaching it, which in turn directly affected visual spatial development in students. As
Austen noted:

You cannot expect a teacher to teach something that they are not confident with,
successful with on their own. You can buy all the materials and they can stay stuck in a
closet unless you give them the resources to understand how to use them. You have to
train the teachers, show them how it’s important and valuable and how to use it, how to
open up a set of materials and what they are like once you open them, what you are
doing, how are you presenting it and really kind of role playing some of that stuff so that
when you get inside the classroom, you’re like, okay, I got this I know what to do.

Frankie felt he would need professional development and mentioned a possible book
study on visual spatial intelligence. “I really don’t know a lot about spatial particularly so
professional development or a book study on this…would help me.” He noted that it might be
beneficial for “teachers to share activities and ideas with each other as we have different skill
sets.”

The participants felt that training would increase their knowledge of the material, which
would help raise their confidence and self-efficacy. Some of the participants noted that this lack
of knowledge could be leading to fixed mindsets regarding the approach to teaching these skills.
“I do think that I’m willing to try new things. I just want to have the support” noted Zane. One
participant noted,
So I think you’ve got to be willing to hop in and, you don’t have to love everything, but you don’t want to just put your head in the sand and not know what’s going on because the world’s going to leave you right behind.

The need for training and its connection to increased self-efficacy and a growth mindset was mentioned often by the participants.

Many of the participants felt they would need training and professional development to better understand and confidently teach visual spatial skills. When discussing how a lack of training can affect a teacher’s self-efficacy, one participant noted:

My first year, I was looking at this stuff and going ‘I have no idea.’ I felt very lost in what the end result would be. I was researching myself, had to do a lot of self-teaching to be confident in front of my kids. There really isn’t a lot of teacher learning in this. It is kind of trial by fire. I feel like you either get burned up and quit or you figure it out.

Another participant discussed how a lack of confidence could lead to unhappiness and stated:

that unhappiness is going to affect everything else about your personality and then you’re not going to feel confident and your self-efficacy is going to decline because you didn’t grow and move with what’s happening around you and then you don’t feel as successful and everything else just kind of falls apart.

The participants explained how the lack of training and knowledge affected their attitudes and self-efficacy which could leave positive and negative impressions on students. Landy felt, If I’m not feeling very strong in my own confidence in how I do things, that could come through to the students. If you have a fixed mindset, you certainly aren’t going to be getting your gifted learners to really think outside the box.

Artie further added:
They take their cues from us and what you’re speaking about your mood, your attitude, anything about yourself is going to translate to them. We are their leaders, modeling the behavior, and you’re never going to know all the answers, nobody knows all the answers but that’s not where you stop, that’s where you start.

While all discussed the importance of having a growth mindset around students, some admitted that it did not always work out that way. Finley explained that:

A teacher’s self-efficacy affects students because I’ve even heard some GT teachers say ‘I’m not good at Hands-On Equations,’ and if they’re saying that right there in front of the kids, then the kids are probably thinking well, if you’re not good at it, what do you think we’re gonna be at it? That’s not to say that I haven’t said it before, but I do understand the importance of not saying it.

Frankie had similar thoughts and said:

I think a lot of what’s modeled in school is not a growth mindset, and I don’t think we do it on purpose, but I think it’s by accident like saying, ‘You’re smart, that was great, you caught on so quickly,’ and that is not really the lesson we want to teach them. I feel the grading system is antithetical to teaching the growth mindset, and we’re up against a lot and so I think that the teacher’s mindset is all they have to show the students that it’s not all about your greatest, it’s not all about being smart.

Similarly, Zane said,

I think that growth and fixed mindsets would impact students based on your expectations of those students. If you form a fixed mindset – well, this child is a low child, or this child is really good at this, then you kind of box them in, and children rise to your expectations.
The survey results indicated that the participants viewed challenges in a positive way and knew the appropriate steps to take to increase confidence and growth mindsets. All but one participant ranked themselves “like me” or “very like me” when asked survey question seven: I’m willing to work on something challenging, even if I know it will take a lot of effort and I may not succeed at first; and survey question 24: I like to challenge myself to learn new things. Further, the participants all indicated their openness and willingness to learn new skills in their response to the following question: Which best describes how self-efficacy can make someone a better learner? All of the participants answered: People with higher levels of self-efficacy understand that they have to put in effort in order to learn, so they will work harder. These responses were in agreement with the sentiment expressed by some in the interviews. As Austen said,

I think that at the rate at which technology and all of the things around us are changing so quickly, if you don’t have a growth mindset, and you can’t absorb and move with the flow, you’re going to find yourself very unhappy, pretty quickly.

While most of the participants showed confidence in sharing their selections for the physical artifacts, a few of the participants were unsure if they had selected an appropriate activity to share. All of the participants expressed interest in learning more about these skills, and the best ways to teach visual spatial skills with their students, which may have been accomplished through appropriate teacher training at the pre-service and professional development levels. The participants recognized that with more training, knowledge, and experience, their self-efficacy and mindset could improve, and ultimately influence their students.

**Research Question Responses**
The purpose of this study was to investigate the perceptions of best practices of teachers with using visual spatial activities in the elementary gifted classroom, and how the district’s gifted program can further equip and support these teachers in their efforts to enrich spatial ability of their students. The study was designed to answer the central question and three research sub-questions. The following is a synthesis of the themes as they relate to those research questions.

Central Question

The central question that guided this study was: How can a gifted program be improved to equip and support gifted education elementary teachers to enrich spatial ability of students in the gifted program? Through the survey, interviews, and physical artifacts, four themes were developed which helped to answer the central question of this study. As noted at the outset of the study, these participants had not received any formal training by the district on visual spatial skills and ability, nor did they have any specific curriculum standards for teaching these skills. While most of the participants had a good understanding of what visual spatial intelligence was and were familiar with best practices with teaching visual spatial skills, they all noted that they could achieve so much more in this area with the right support from the district. This included appropriate training and necessary resources.

Several participants noted time, materials and resources, instructional support, and fixed mindsets as factors hindering the teaching of visual spatial skills. Austen noted the necessity of having access to supplies and tangible things:

enough for all the kids in the room so that we don’t have a situation where three kids get to do it and it takes 2 weeks to get through it. You’re gonna have to have the materials, there’s got to be money set aside to buy things so that it’s equitable across the district. So,
if you’re going to put something in the lesson plans that includes materials, you have got to make sure everybody has it, or has access to buy it and use it.

Additionally, many of the participants felt that in order to implement visual spatial skills into their classrooms, they would have to do it on their own time, outside of the required curriculum, as these skills were not standards in the district’s current gifted curricula. One participant noted that teaching skills that are not in the district standards was considered enrichment and viewed as “fluff.” When asked about their experience and perception of teaching visual spatial skills, Austen commented, “I would say that the only time that I’ve really been able to do much of that is when I pull things, like when I’ve had control over curriculum.” The participants felt that including visual spatial skills in the standards and incorporating them across the curricula would help to ensure the implementation of these important skills.

In order to increase the use of hands-on activities, specifically those that enrich visual spatial ability, the participants felt the district would need to invest in more education resources to support this, including acquiring curriculum units that involved construction, building, and creating and obtaining the appropriate manipulatives and other supplies needed for these activities. Similarly, to incorporate more digital apps and gaming into the gifted classroom, the participants felt the district would need to acquire the necessary software and equipment to teach these activities and provide the training to use these tools. All of the participants felt the district could help equip and support them in their efforts to enrich visual spatial skills by providing appropriate teacher training. The participants felt strongly that once they received adequate training, they would be more confident and successful in teaching these critical skills to their gifted students.
Finally, as one participant noted, “We don’t do much of that [visual spatial instruction] in our program…we test on it, but then we don’t teach it or use it or even connect it to the subject areas.” When asked what the district could do to help correct this, Blair said, “resources, money, and training.” Artie added, “I think there needs to be an investment…not a huge investment in hiring but getting people who can train on using what’s already available, what curriculum can be created, and professional development on teaching it.”

**Sub-Question One**

The first sub-question for this study was: How do teachers’ self-efficacy and mindsets in the classroom influence the development of visual spatial skills? Self-efficacy influences the way people think and act in the attainment of their goals and how they handle challenges (Bandura, 1993). In education, teachers’ perceived self-efficacy can influence the choices they make in teaching and the way in which student learning occurs. In this study, the participants all commented on the influence of their own self-efficacy on their students’ perceived ability to succeed. The participants felt strongly about the importance of teachers having a strong self-efficacy and a growth mindset.

During the personal interviews, the participants all noted how influential mindsets can be, especially in education. One participant commented,

I think you can walk into any school building and you can find teachers with very fixed mindsets, and you can find the ones with growth mindset. I think you can find very experienced teachers that are willing to grow, and you can find very young teachers that are very fixed, because it’s not an age and experience thing - it’s a person by person thing.
Blair said, “the way that you act can be very infectious, and can encourage other people around you, your students.” As the interviews continued, the participants made connections between a teacher’s self-efficacy and growth mindset and how a teacher’s mindset can influence the mindsets of students. As Riley noted, “Well, a teacher better not have a fixed mindset, that’s just not gonna work.” One participant stated, “This is not a profession for a fixed mindset; you’ve got to have that growth mindset, …in order to reach all of our students,” while another similarly said,

If we don’t believe in growth mindset, we are not going to set a high bar for them, empower them, encourage them, teach them, prod them, all those times we drag them up the mountain to reach that goal or do those skills.

The participants noted that self-efficacy and mindset seem to be connected and powerful in their ability to affect students. Blair said, “I think it is essential to have some type of growth mindset in order to reach all of our students.” Another participant felt, “Teachers need to believe in growth mindset that everybody can grow. I believe in learning forever, for your whole life. If we have a fixed mindset, we are probably in the wrong profession.” Jackie noted, “I think we all need to have a growth mindset; we’re teachers, and you know, we’re constant learners too,” while Frankie said, “the more self-efficacy you have, the more you’re willing to try new things with your kids, and the more vulnerable you’re willing to share your own struggles so that they learn how to be a learner.”

Since visual spatial skills are not currently spelled out in the district’s curricula nor in the state’s standards for gifted education, the participants felt the teaching of these skills would require them to do so as enrichment through activities such as puzzles, apps, and gaming. The participants noted that this would require extra work on their own, creating assignments and
activities without the guidance of a set curriculum. Having a growth mindset could help teachers see the value of this extra effort and the motivation to work through the challenges of creating activities without the guidance and support of district curricula. Therefore, a teacher’s self-efficacy and growth mindset can influence the development of visual spatial skills of students by the choices a teacher makes in regard to the activities used in the classroom.

Additionally, all of the participants felt that appropriate teacher training, not only in visual spatial ability but in technology and gaming, would increase their confidence and self-efficacy in teaching visual spatial skills. Being more confident in teaching these skills could directly influence the development of a student’s spatial ability as more opportunities for enriching these skills could be provided to the student. Integrating visual spatial skills across the curricula could also help to increase teacher self-efficacy as teachers become more confident in their abilities to teach these skills.

Sub-Question Two

The second sub-question for this study was: How do gifted education elementary teachers describe their perceptions of best practices using technology, problem-based units, and puzzles to enrich spatial ability? Most of the participants discussed the district’s current 4th grade gifted curriculum and its strong STEM connection while pointing out the need for more STEM material in the 3rd and 5th grade units. The 4th grade curriculum consisted of problem-based units centered around the engineering design process, including hands-on units on designing and building structures, building popsicle stick bridges, and a unit on coding which involved writing basic computer programs.

Most of the participants felt that best practices for enriching visual spatial ability involved the use of technology as it gave students the opportunity to work and create in a virtual
world. The participants noted how important this was for today’s youth in preparing them to be technologically savvy in this digital age. The theme of incorporating more technology through digital apps and gaming was consistent in all three data sources and aligned with the participants’ perceptions of best practices. The participants were eager to discuss how their district’s current gifted curriculum used problem-based units, many of which supported STEM education. Through the course of the interviews, some of the participants began to note how visual spatial skills were embedded in some of the units they were currently teaching, including the Rube Goldberg and the popsicle bridge units. This acknowledgement of the integration of visual spatial skills across the curricula further supported their perceptions of best practices of using problem-based units. The participants felt that best practices for teaching visual spatial skills involved the use of problem-based units and embedding these skills throughout these units, rather than as a single, big unit of instruction. This supports the theme of integrating these skills across the curricula. Participants noted that these problem-based units offered students many hands-on opportunities which they considered to be important for teaching visual spatial ability.

Puzzles were also considered best practices for teaching visual spatial ability, as many of the participants’ physical artifacts of spatial activities centered around puzzles. Some of these activities involved the actual physical manipulation of shapes and objects, and others were performed in a digital format. The participants described the use of technology, problem-based units, and puzzles as best practices for teaching visual spatial skills and these were all evident in their interviews and physical artifacts.

Sub-Question Three

The third sub-question for this study was: What other strategies and best practices do elementary gifted education teachers use to enrich spatial ability? The participants discussed
visual spatial enrichment activities that they chose to do with their students which were outside of the district’s curricula. The theme of using hands-on activities and more digital apps and gaming were apparent in the participants’ responses and helped to answer this research sub-question. Many participants mentioned using logic games and brain teasers through various websites and apps and, as one noted,

they really are actually good for your brain because the students are having to think in a different way, and the funny thing is, some of the kids that aren’t good in other areas are pretty good at those games.

Common practice for most of the participants was to start their class with some type of brain booster puzzle or problem, including Sudoku, logic grid puzzle, or a riddle. Also mentioned were websites for visual spatial activities as these can “get the kids to look at things in different ways – in a virtual space.” Blair felt that “visual spatial aspect is incredibly helpful for student achievement,” and practiced it with his students through three-dimensional design and printing activities, including Tinkercad. Landy mentioned Howard Gardner’s theory of multiple intelligences and said, “I typically have the kids do one of those questionnaires,” referring to a questionnaire that labeled a person’s intellectual profile based on Gardner’s theory. Koda, a self-described visual spatial learner, felt that some skills and intelligences were more fixed, but didn’t view visual spatial as a fixed intelligence. He stated:

I like to do activities, not just with certain children that I believe are visual spatial but with all of them, because I do think we can promote it. It’s so important for reading, writing, handwriting, math, STEM, of course, and there are so many careers nowadays where you need some semblance of visual spatial.
Other visual spatial strategies and best practices as noted by the participants included puzzles and mazes, tangrams, paper folding activities such as origami and drawing, video games, tableaus, hands-on activities including *Hands-On Equations* (an algebra unit) and *Figure It Out* (problem-solving unit), and acting out scenes from stories or for problem-solving. As the participants felt that technology, specifically apps and gaming, was best practice for visual spatial enrichment, several mentioned video games including *Tetris* and *Minecraft*. The participants considered creativity and discovery as key strategies and best practices for visual spatial ability and discussed various websites offering students the opportunity to explore, design, and create on their own. The majority of the visual spatial activities shared by the participants involved websites, apps, and videos, and software for designing and building. The strategies and best practices mentioned by the participants not only promoted visual spatial ability, but could contribute to STEM education. Consistency was another best practice mentioned by some of the participants as they felt that daily practice with visual spatial skills would be beneficial for students.

**Summary**

Chapter Four presented a description of each of the study’s participants and the thematic findings from the analysis of data collected. The triangulation of data from an online survey, semi-structured interviews, and physical artifacts resulted in rich, thick data that were used to identify codes which were aggregated and reduced into themes which answered the research questions. Theme development was discussed including the research question responses of the participants revealed in the survey, interviews, and physical artifacts.

The findings led to four themes related to teachers’ self-efficacy and use of visual spatial activities and skills with students in the elementary gifted program: (a) integrate across the
curricula, (b) increase the use of hands-on activities, (c) incorporate more digital apps and gaming, and (d) receive appropriate teacher training. As will be discussed in Chapter Five, these themes were largely consistent with related literature on growth mindsets, teacher self-efficacy, and the inclusion of visual spatial skills in the elementary classroom. The themes, along with narrative text and quotes from the participants, helped to provide answers to the central and research sub-questions guiding this study.
CHAPTER FIVE: CONCLUSION

Overview

The purpose of this qualitative case study was to describe the perceptions of best practices of teachers with using visual spatial activities in the elementary gifted classroom, and to examine how a district’s gifted program can further equip and support teachers in their efforts to teach spatial ability skills to the students in the program. Chapter Five presents a summary and discussion of the research study findings, and the theoretical, empirical, and practical implications based on these findings. Delimitations and limitations of the research and future research recommendations are also discussed.

Summary of Findings

In order to answer the central question of how a school district’s gifted program can further equip and support teachers in their efforts to teach visual spatial skills to elementary gifted students, it was necessary to explore and discover the perceptions of best practices of these skills of the teachers in the program. Qualitative research was used as it provided the opportunity to examine and understand the participants’ perceptions of best practices. A case study design was utilized which allowed the research to focus in-depth in real-world perspective (Yin, 2018). Through the case study research design, unique features and commonalities were identified within real-world context (Stake, 1995). Through a survey, individual interviews, and physical artifacts, data triangulation was achieved which provided the rich, thick data needed to answer each of the three sub-questions and the central research question.

The first research sub-question sought to understand how a teacher’s overall self-efficacy and growth or fixed mindset may influence the use and development of visual spatial activities and skills in the classroom. In order to better understand this, the participants were asked to
complete an online survey rating their perceived level of general self-efficacy. Analysis of this data, along with the participants’ responses to the interview questions and their discussion of their selected visual spatial activity (physical artifacts), revealed four emergent themes that included: integrate visual spatial skills across the curricula, increase use of hands-on activities, incorporate more digital apps and gaming, and receive appropriate teacher training. While all of the participants perceived themselves with high levels of self-efficacy and growth mindsets, not all of their responses supported this. Some of the participants expressed a lack of confidence in teaching these skills, with one participant commenting that he was just not good at math and science. Additionally, three of the participants suggested that visual spatial skills were something one either had or did not have, and one even commented that not much can be done for those that do not already have strong visual spatial abilities. Having a fixed mindset and low self-efficacy toward the subject and skills may be hindering the use of visual spatial skills in the classroom. If teachers do not feel confident in teaching these skills, they may be less likely to expose their students to these types of activities. Therefore, a teacher’s self-efficacy and mindset may influence the development of visual spatial skills in students.

The second research sub-question asked the participants to describe their perceptions of best practices with using technology, problem-based units, and puzzles to enrich spatial ability in the classroom. Analysis of the data revealed that while some of the participants felt there was too much technology in the classroom, they all recognized the importance and necessity of using technology as it is the way of the future. All of the participants felt that visual spatial ability and skills were important and should be incorporated throughout the elementary gifted program, through varied activities. The most common best practice mentioned was the integration of these skills across the curricula. Other themes that developed from the data were to increase use of
hands-on activities, incorporate more digital apps and gaming, and receive appropriate teacher training. Some of the participants were very enthusiastic about increasing the use of technology through digital apps and gaming, and those that were less enthusiastic stated that with appropriate training, they would be confident to introduce these skills and activities in their classrooms.

The third research sub-question attempted to discover other strategies and best practices that elementary gifted education teachers use to enrich spatial ability. Each participant was required to provide a physical artifact of an enrichment activity they did with their students, specifically geared toward enriching visual spatial skills. In doing so, the participants were inspired to begin thinking about creative ways of teaching visual spatial skills. Their selections, and the discussions of their selections, provided valuable data. The activities were varied. Each participant was enthusiastic in discussing his activity of choice and was confident in his ability to teach the chosen activity. Some of the activities involved technology, others were math-oriented such as tangrams, while still others involved critical thinking, such as puzzles. Some even incorporated acting-out drama games. The common theme throughout was the thought that visual spatial skills needed to be taught across the curricula, even though they were embedded within many of their activities already. Participants also noted more activities should be hands-on or involve digital apps and gaming, but that in order for any of these activities to be successful, they would have to receive appropriate teacher training.

The central question that guided this study asked how a gifted program can be improved to equip and support gifted education elementary teachers in enriching the spatial ability of their students. The three sub-questions helped develop data that led to the four themes that ultimately helped to answer this central question. By integrating visual spatial skills across the gifted
curricula, increasing the use of hands-on activities, incorporating more digital apps and gaming, and providing appropriate teacher training, a gifted program may be better able to equip and support the teachers of that program in their efforts to teach and enrich the visual spatial ability of their students.

**Discussion**

This section of Chapter Five discusses the findings in relationship to the empirical and theoretical literature reviewed in Chapter Two. The results of this study add to the research reviewed in Chapter Two, and connections are made between the study’s findings and theoretical and empirical literature. These implications are discussed along with limitations and recommendations for future research.

**Theoretical Literature**

Dweck’s (2006) theory of mindset was used as the theoretical framework for this study with influences of Bandura’s theory of self-efficacy (Bandura, 1977). These theories guided this study and illustrated how mindsets and self-efficacy can influence what a teacher does in the classroom, which ultimately affects and influences students.

**Mindset Theory**

In the same way that having a growth mindset can lead students to take on more challenges (Dweck & Leggett, 1988; Hong et al., 1999; Paunesku et al., 2015; Yeager et al., 2016), persevere in the face of setbacks (Nussbaum & Dweck, 2008), and affect student’s achievement (Blackwell et al., 2007; Dweck, 2019), a teacher’s mindset may influence curricular decisions, especially in regard to selecting activities for their students. This study sought to delve deeper into these theories and understand how self-efficacy and mindset influence teachers of gifted students with respect to enriching visual spatial skills of their students. Those with a
growth mindset are willing to actively learn and grow, and they understand that their abilities and knowledge can be further developed, ultimately resulting in greater achievement (Marr, 2019). At the pace at which technology is changing, curriculum and educational practices will invariably also have to change in order to keep up with the future, to ensure that students are prepared to work careers in the global market. With no teacher training or professional development currently in place with regards to visual spatial learning, it will be important for teachers to have growth mindsets. Until the curricula includes standards specifically aimed at enhancing visual spatial skills, any attempts at adding such activities are often deemed non-essential, with time and lack of resources further hindering their implementation.

Most of the participants seemed willing to take risks, were eager to learn from mistakes, and were enthusiastic about the idea of new knowledge and experiences, all of which are characteristics of a strong growth mindset. However, there were moments when some of their comments inadvertently indicated characteristics of a fixed mindset, including some resistance to change, whether due to fear, lack of confidence, or lack of training. As part of developing growth mindsets, it is important for teachers to know that their intelligence, talents, and abilities can be developed and enhanced through hard work, trying and using different strategies, and seeking input from others (Dweck, 2015, 2016). Most of the participants felt that intelligence and ability are malleable, controllable, and increaseable (Dweck, 2006). This is important as research has shown that spatial ability skills, which are malleable, are skills that can be learned and increased, and should be introduced early in a child’s education (Mulligan, 2015). When teachers recognize that this is not an “either they have it or they don’t” ability, they may be more willing to independently incorporate these skills into the curriculum, until such time as curricula mandates it. The mindset theory plays an important role in the elementary gifted classroom as it is critical
that these students be taught and modeled how to handle adversity and challenges, and how to work through difficult situations. As teachers of gifted education work with these students through challenging, rigorous spatial activities, having a growth mindset, both of the teacher and ultimately of the student, will help students’ motivation, performance, and achievement.

**Self-Efficacy Theory**

Bandura (1977) believed that motivation is a result of one’s self-efficacy. Since people tend to be more motivated to do activities in which they have strength, a growth mindset tends to correlate to those with a high level of self-efficacy. Those with a high self-efficacy and a growth mindset will view challenges as an opportunity for growth and learning and will face challenges with effort and hard work. The participants all rated themselves with high self-efficacy even though some of the responses indicated fixed mindset tendencies. Since the participants were part of a group, with some of the participants on the curriculum writing team for the district, the issue of collective efficacy became very important. The ideas and self-efficacy of one may influence important educational decisions and have an influence on others in the group. In order to ensure that the best interest of the group and students be prioritized, it would be critical to ensure the leaders of an organization have growth mindsets and high levels of self-efficacy. Since social persuasion affects a group’s collective efficacy by strengthening their beliefs about their abilities, it is important that the group’s leaders have a growth mindset and offer encouragement to members of the group through professional development and workshops, and feedback from parents, students, faculty, and administration that can bolster the collective efficacy of a group (Goddard et al., 2000).

**Empirical Literature**
There is very little research on developing visual spatial skills at the elementary school level, especially in the elementary gifted classroom. While research has shown the strong connections between spatial skills and STEM success, most of the studies involved high school or older students. In order to maximize a student’s highest potential, spatial skills need to be taught during a child’s early years when he or she is developing foundational cognitive skills. Waiting until high school may be too late for many students (Burte et al., 2017). This study presented insights as to how a district could better equip teachers of the gifted program in teaching visual spatial skills. In addition, this study sought to understand what teachers viewed as best practices in teaching visual spatial skills with elementary gifted students. This study also presented insights into the possible factors hindering teaching of this important skill, including teacher self-efficacy and mindsets. As teachers noted, unless it is actually a component of the curriculum, due to time, lack of knowledge and training, or lack of resources, teachers are going to find it difficult to seek and use these types of activities on their own.

The problem is gifted students with visual spatial strengths are often overlooked, under identified, and underserved in elementary school. In an effort to identify students with strong visual spatial talents, many states have begun using identification tools and tests, making strides towards minimizing the number of students who may have been previously overlooked. In South Carolina, for example, the Performance Task Testing (VanTassel-Baska et al., 2002) and NNAT were implemented to identify gifted students with visual spatial talents. However, as some of the participants noted, the district tests for visual spatial giftedness, but does not necessarily implement curricula to develop it. This is where gifted students continue to be underserved.
According to the South Carolina Department of Education Gifted and Talented Best Practices Guidelines: Curriculum and Instruction (June 2018), Regulation 43-220 requires that school districts in S.C. provide gifted and talented students with programs that have curriculum, instruction, and assessment which will maximize the potential of GT students. Curriculum will be differentiated to ensure student growth and progress (NAGC 3.1, NAGC 3.1.4). Further, the curriculum is to help students “develop a repertoire of strategies to apply within and across various content areas” (SC Dept. of Ed., 2018). While strides have been made in the identification of spatially strong students, some of the participants of this study suggested that the spatially strong students are overlooked and underserved once they have been placed in the program. This research study corroborates this sentiment and provides factors that may be preventing students from receiving opportunities for visual spatial enhancement. Curricula must be modified and developed to include visual spatial skills which should be a critical component of any elementary gifted education program (Anderson, 2014; Mann, 2006; Mulligan, 2015; Senne & Coxon, 2016; Siegel, 2015; Wilson, 2018). This study offers some suggestions, in the form of themes, for best practices in providing challenging spatial activities to students. These themes include the following: integrate visual spatial skills across the curricula, increase the use of hands-on activities, incorporate more digital apps and gaming, and receive appropriate teacher training.

Even though they are considered to have the greatest potential for STEM success, gifted students do not always receive curriculum that is appropriate for their talents and strengths (Senne & Coxon, 2016). Visual-spatial skills, which are highly valued in STEM fields, are often ignored in education with little opportunity for spatial reasoning and innovation (Mann, 2013).
Studies have indicated that the use of spatial reasoning activities and strategies can improve spatial ability (Hawes et al., 2017; Sorby et al., 2018).

**Theme One: Integrate Visual Spatial Skills Across the Curricula.**

As a component of STEM, visual spatial skills appear in all four disciplines: science, technology, engineering, and math. Therefore, it is important to delve deeper into activities within these STEM fields that encourage further development of visual spatial skills. It would also be beneficial to teach the children about visual spatial ability, identify it, and call it by name, giving examples of careers that use it such as engineering, art, piloting, etc. Several of the participants felt that best practices for teaching visual spatial skills in the classroom included integrating them throughout the curricula. Rather than it being a unit of instruction independent of other subjects, they felt it would be better to have these skills embedded throughout. The participants’ responses substantiate the empirical evidence discussed in the literature review that an effective gifted curriculum should allow for a continuum of content and skills as the students progress through their educational careers (Wilson, 2018), and that integrating these skills throughout the curricula in elementary school can lead to later success in STEM careers (Kell & Lubinski, 2013; Lakin & Wai, 2020; Lubinski, 2010; Shea et al., 2001; Wai et al., 2009).

Research has shown that spatial thinking can be improved through practice, and transferred to other spatial tasks (Hawes et al., 2017; Uttal et al., 2013). The findings of this study align with the recommendations of the NAGC that teachers of gifted education provide students with activities and opportunities that stimulate spatial reasoning (NAGC, 2019). The literature, as well as this current research study, support the idea that since spatial ability skills are needed in a vast array of careers from highly skilled professional positions to middle-skill positions, teaching visual spatial skills across the curricula is a wise and critical choice.
Theme Two: Increase the Use of Hands-On Activities

While noting that technology is certainly on the rise in the classroom and proving their use of technology as a teaching tool through their physical artifacts, the participants were quick to add that for some activities there is no substitute. The actual physical manipulation of materials to aid in discovery, creation, and critical thinking, along with the processes of trial and error and teamwork, is invaluable in educating the whole child so that he ultimately can reason and make sense of the world. Working puzzles via pencil and paper as well as manipulating shapes, as in origami and tangrams, would provide the additional practice on working on visual spatial skills. These types of activities would reinforce the particular skills of mental rotation and visualization, as discussed in the literature review. Tests that were designed to measure visualization skills, such as the paper folding test and the Purdue Spatial Visualization Test: Rotations, contain activities involving the manipulation of shapes. Similar activities could be replicated in the classroom to provide extra practice on these types of skills. The current study’s findings corroborate the literature that found that gifted students need more opportunities to develop these important mental rotation skills (von Károlyi, 2013). Gifted students need opportunities to work with meaningful problems and solutions, at a higher level of difficulty, and at an accelerated pace (Tomlinson, 1997). Educators should give gifted students, particularly those with spatial strengths, opportunities to work with complex material that requires creativity and higher order thinking skills (Mann, 2006). The participants were in agreement that their current problem-based units on structures, engineering design and construction, bridges, and the math unit, Hands-On Equations, provide their students with hands-on activities that involve real-world problems and scenarios and the opportunity to create solutions involving creativity and visual spatial skills which align with recommendations of current literature (Mann, 2004; Senne
& Coxon, 2016). Project-based learning can offer students opportunities to further their visual spatial skills through hands-on activities involving design, construction, and problem-solving. Most of the physical artifacts provided by the participants involved hands-on manipulation and even those that were virtual/digital, could be modified to work three-dimensionally. Additionally, the participants noted the use of puzzles for visual spatial skill reinforcement. These findings add to the literature that puzzles can develop and strengthen inductive and deductive reasoning, which helps to improve critical thinking skills, and enhance visual-spatial intelligence (Wanko, 2017). Nonverbal puzzles and games, such as Tangrams, paper folding activities, and Five Square, and role-playing scenarios from literature or math problems can help to develop and promote inductive and deductive reasoning skills, and enhance visual-spatial intelligence, which is in agreement with the current literature (Wanko, 2017).

**Theme Three: Incorporate More Digital Apps and Gaming**

Almost all of the participants were excited and enthusiastic about using gaming in the classroom as they noted how integral gaming is in not only children’s but adults’ lives. Unlike other “toys” that children outgrow, video games are now a lifelong source of entertainment, with the average age of today’s gamer being 33 years old. As one participant noted, people can and do make careers out of gaming – not only as players, but as creators of new games, devices, and platforms for the gaming industry. New educational technology tools can provide opportunities of enhancing and differentiating a gifted curriculum that include visual spatial activities such as software like a Computer Aided Design (CAD) program, where students manipulate and create 2D and 3D models of various things (Bruce & Hawes, 2014). The literature provides empirical evidence that 3D tools develop spatial visualization skills (Herrera et al., 2019). One participant’s physical artifact was of a visual spatial lesson involving CAD software and a 3D printer which helped add to the literature on using such educational tools. Other technology tools which can help
develop spatial skills include virtual mental rotation training that encourages users to manipulate objects in virtual reality, while selecting, rotating, zooming, and navigating with 3D models from six sides (Herrera et al., 2019).

It is interesting to note that while most of the participants were agreeable with more technology in the classroom, there was a sense of frustration and “too much already” sentiment. This was possibly due to the fact that these teachers had been teaching the gifted curricula to students virtually due to COVID-19 restrictions. While adjustments had been made to the curricula to adapt the material for online learning, the fact remains that little training was provided to these teachers and they were forced to learn many of the nuances on their own. One participant lamented that he had been teaching the gifted program and this particular curricula for many years now, and this year felt like his first year of teaching. At mid-year, some of the students returned to the building, but the gifted teachers had to continue teaching students virtually while also teaching in-person students. Many of the participants commented how hard it was to do the same level of work and achieve the same level of success with both groups because the curricula had originally been written and created to be done in-person, with students working in cooperative groups and with materials and manipulatives they could touch and share. Many shared that they could not teach the virtual students as effectively, and this was the most likely explanation for the "too much technology" comments. The participants discussed the perceived benefits of playing video games, and comments included hand-eye coordination, teamwork, communication skills, problem-solving skills, motivation, and visual spatial skills. Their comments and perceptions were in line with the empirical evidence that visual spatial skills benefit from video game playing time (Greenfield et al., 1994; Okagaki & Frensch, 1994) and student’s academic confidence and problem-solving skills can be improved through gaming.
(Siegle, 2015). As visual-spatial intelligence is an underused talent, especially in the elementary years, it is important to note that these skills can be developed through gaming and should be of significant importance to gifted education (Kalbfleisch & Gillmarten, 2013).

While the next school year may feel more like “normal” with less COVID-19 restrictions, many believe that e-learning, at least in some aspects, is here to stay as education trends involve more and more mainstream integration of technology in the education system. As educators and policymakers explore the benefits and full potential of technology in the education system, the need for gaming in education becomes even more critical (Li & Lalani, 2020).

**Theme Four: Provide Appropriate Teacher Training**

Of course, a major issue with the sudden increase in technology in the classroom is the lack of training and little preparation for teachers (Li & Lalani, 2020). The current study’s findings suggest that this is an issue and a source of frustration for teachers. The findings suggest that it is necessary for a school district to support teachers in their efforts to teach visual spatial skills by providing adequate and appropriate teacher training and professional development. The fact that some of the participants struggled to even define “visual spatial” underscores the need for professional development on the subject. Without such training, teachers may lack confidence and self-efficacy for teaching these skills. A lack of self-efficacy can lead to limited and fixed mindsets which can possibly have a negative influence on students. In addition, districts can further support teachers by offering the necessary resources, including time and money, for more materials for hands-on activities, and updated technology tools including digital apps and devices and platforms for gaming. With these appropriate measures, teachers may successfully integrate visual spatial skills throughout gifted curricula and help students reach their highest potential. In addition, with appropriate training on visual spatial skills and best
practices, teachers will become more aware of the malleability and transferability of these skills and the strong connections that exist with these skills and STEM success. Through professional development, teachers will discover how incorporating visual spatial activities throughout the curricula can provide the differentiation and accelerated rigor needed for these students.

Through teacher training or professional development, teachers can learn the specific tools needed to hone these skills and how to utilize them in their classrooms. This is necessary to avoid the disenchantment that can stem from just handing the teachers new tools and resources without proper training (Takeuchi & Vaala, 2014). The participants, while excited about the idea of gaming in the classroom, pointed out they were not sure exactly how to do that or how it would look. This supports the notion from the literature that teachers have reported that they are “not sure how to integrate games” into their classrooms, and 80% of teachers who have used gaming in the classroom indicated they wished it was easier to find curriculum-aligned games for use with their students (Takeuchi & Vaala, 2014). In order for teachers to feel confident and proficient at using some of these suggested best practices for spatial ability, proper training and professional development should be offered, and possibly required for teachers. When teachers feel more confident and they have higher levels of self-efficacy, they become more willing to offer these types of activities to their students, helping them reach their highest potential.

Implications

The implications of this study are based on the central question that guided the research: How can a gifted program be improved to equip and support gifted education elementary teachers to enrich the spatial ability of students in the gifted program? The findings in this study have implications for curriculum leaders of gifted education, district leaders, gifted programs, and teachers.
Theoretical

This study’s theoretical framework emerged from the theory of mindset (Dweck, 2006) with influences of self-efficacy theory (Bandura, 1986; 1997). The theoretical implications of this study are that the perceived self-efficacy levels and mindsets of elementary gifted teachers are important and necessary for the motivation and willingness to implement visual spatial skills and activities in their classrooms. Teachers’ perceived self-efficacy influences the choices they make in teaching and the way in which student learning occurs (Bandura, 1993). This study revealed that when teachers have choices in the activities and skills being taught in their classrooms, they tend to gravitate toward those activities in which they feel strong and competent in teaching. Finley declared that he was “math-minded” and therefore, he tended to offer math-oriented enrichment activities to his students (Interview, April 21, 2021).

Dweck’s mindset theory provided the theoretical framework as it relates to the perceptions and beliefs that teachers and students have about learning and intelligence. Being that the inclusion of visual spatial skills is not mandated or spelled out in the current district nor the state’s gifted and talented best practices guidelines or standards, it is imperative that teachers have a growth mindset toward visual spatial skills and their importance in the elementary gifted classroom. As Austen noted, “It’s got to be spelled out that it’s something you need to do, otherwise how is there time to get it all done” (Interview, April 23, 2021). Until these skills are actually mandated as required standards and guidelines for elementary gifted education, it will be up to the teachers to implement these through enrichment activities. Having a growth mindset will provide these teachers with the motivation needed to include these types of activities with their students. The mindset theory can affect a person’s motivation, performance, and achievement (Dweck, 2006; 2015).
Dweck’s (2006) theory of mindset emphasizes the power of “not yet” and this concept is an important step in growth and learning. This study’s findings suggest that while these participants and their gifted program may not yet be where they need to be, in respect to visual spatial training for students, they clearly are willing to grow and learn in order to help elementary gifted students become world changers, embrace empowerment, and reach their fullest potential. The power of “not yet” teaches that in situations, one should view it as a learning curve rather than a dead end. This is the belief that you can improve, that if you do not know yet, you can learn. This is the basis for growth mindsets.

Based on the literature review and the findings of this study, it is recommended that educational stakeholders, such as gifted education policymakers, curriculum leaders, and teachers recognize the value and benefits of implementing visual spatial skills in the national, state, and district guidelines and standards for elementary gifted education. In addition, professional development and training on mindset theory should be required of those who teach the gifted program, as teachers’ mindsets and self-efficacy can have a direct influence on students.

**Empirical**

The key to success for gifted programs is to have quality curriculum and instruction appropriate for students’ learning capacities and talents (Tomlinson, 2005). While there have been improvements in gifted program testing used to identify students who have visual spatial ability, such as the Wechsler Intelligence Scale for Children (WISC) and the Naglieri Nonverbal Achievement Test (Naglieri, 1997), appropriate curriculum for developing these skills is still lacking (Andersen, 2014). Curriculum needs to be expanded to address spatial ability skills for those spatially talented students (Wai & Lakin, 2020). Through some of the recommended best
practices addressed in the literature, gifted programs can better serve the needs of students with visual spatial strengths. Best practices of spatial activities discussed in the literature can be provided through the use of problem-based units, technology and gaming, and puzzles (Brophy & Hahn, 2014; Bruce & Hawes, 2014; de Castell et al., 2017; Farnell, 2016; Kalbfleisch & Gillmarten, 2013; Mann, 2004; Newcombe & Frick, 2010; Senne & Coxon, 2016; Siegle, 2015; Terlecki et al., 2008; VanTassel-Baska et al., 2000; Wanko, 2017; Wetzel et al., 2020). It was discovered in this research that some of these best practices were already being applied in the studied district. Activities within the district’s project-based units on bridges and structures and on Rube Goldberg could be considered best practices under these definitions. Additionally, their current unit on coding fits the technology best practice. The physical artifacts supplied by the participants, which were the lessons they chose to do with their students outside of the set curriculum, included activities from project-based units, involved technology, and some involved puzzles, digital and non-digital.

With the rise in e-learning, it is even more important to offer visual spatial opportunities and training for students. However, teachers’ perceptions, as well as those of administrators and other stakeholders, about the value of these types of activities in their classrooms could be an issue. It is important that teachers and administrators be informed of the findings and evidence which supports the inclusion of visual spatial activities in the elementary gifted classroom for the enrichment and enhancement of spatial ability skills. This could result in informed stakeholders who have a shared vision and align decision-making among all who influence the curricula (Takeuchi & Vaala, 2014). Based on the findings of this study and the literature, it is recommended that gifted education policymakers, curriculum developers, and educators be trained in order to recognize the value of these skills. Doing so may result in a quality curriculum
with the appropriate rigor, acceleration, and a level of difficulty that is critical for the academic success of gifted students (Callahan et al., 2017).

Practical

In an effort to address the problem of this study which is students with visual spatial strengths being overlooked, under-identified, and underserved in the elementary gifted programs, not only should gifted programs use tests that can help identify these strengths in students, such as the WISC, the NNAT, and Performance Task Test, but once students qualify based on these talents, curricula should be developed to further meet their needs. Participants noted that while students are tested on visual spatial problems as part of the identification criteria for qualifying for the gifted program in this district, visual spatial skills are not specifically taught or included in the gifted standards. Adding visual spatial skills to the state and district standards for gifted education would provide these skills with the necessary attention and focus they need.

Research shows that the implementation of visual spatial activities with elementary students showed gains in spatial thinking and these gains could result in improving students’ interest and performance in STEM courses and careers (Hawes et al., 2017). Training needs to be offered to pre-service teachers through universities and certification programs, while current teachers can receive training through various means, including district-sponsored professional development, colleagues and mentors, partnerships with universities, and online training resources.

In an effort to make visual spatial training a priority in the gifted classroom, these skills need to be mandated in the national and state guidelines and standards for gifted education. Once these skills are included in the objectives and standards, they will no longer be considered “fluff” or something that has to be fit in as enrichment by a teacher who may want to teach them.
Therefore, recommendations include more resources and adequate and appropriate training for teachers of gifted programs.

To help gifted programs with this goal, these findings can be used by stakeholders, educators, and districts as they create and provide opportunities of rigor and creativity for the gifted classroom with respect to visual spatial education. Training and professional development should be provided to gifted program coordinators and educators so they may understand and discover how visual spatial skills and ability may be enriched through technology, gaming, and puzzles.

**Delimitations and Limitations**

One common concern with case studies is the inability to generalize from the findings (Yin, 2018). Some of this can be due to the delimitations and limitations of the case study. Delimitations are purposeful decisions the researcher makes to set the boundaries of the study, while limitations are potential weaknesses in the study that are out of the researcher’s control.

One delimitation was the boundary that was set upon the study by focusing only on elementary gifted teachers and students. Setting this boundary helped to narrow the focus in an effort to make the findings more relevant to the field of gifted education. Teachers of gifted education were studied because this researcher was a teacher of the gifted program for over 21 years, and an advocate for these students and gifted programs. The goal was to improve the standards and guidelines of gifted education by revealing the study’s findings.

The limitations included a lack of diversity among the participants. All but two of the 35 teachers in the entire gifted program were female, and there was limited racial diversity among the group as well. This is certainly a limitation of the study. Because of this, all of the participants were Caucasian. In an effort to further protect the identity of the participants, this
researcher was, therefore, unable to properly identify their gender and race, and they were not listed in the participant demographics.

Since the research was conducted in only one school district and its gifted program, the study was limited by the curricula of this particular district. Choosing to do the study in the southeastern part of the United States and in a public-school district setting may also be seen as delimitations. Other possible limitations were the result of COVID-19 restrictions, including the inability to observe the participants actually teaching their visual spatial activity of choice, and having to conduct the interviews virtually.

Another possible limitation is researcher bias. This researcher was a peer to the participants as a fellow teacher of the gifted program. Other than the professional relationship, however, contact was limited with them as this researcher and the participants all worked in different schools throughout the district. Additionally, this researcher is fairly knowledgeable and educated in visual spatial intelligence and was careful not to interject, but remained neutral with the participants during their interviews as to not influence their answers. This was explained to the participants at the start of the interviews in the effort to be as friendly and honest as possible in order to create an atmosphere of trust.

While there are naturalistic generalizations that can be deemed from this study’s findings that can benefit others in a similar context, the delimitations and limitations may weaken the transferability of the findings. Natural generalizations are results from studies that can be applied to others in a similar context (Creswell & Poth, 2018). The results can possibly be transferred to other districts’ gifted programs and those writing curricula for a gifted program.
Recommendations for Future Research

As most of the research on visual spatial skills in education has been done with high school students and older, this study fills a gap in the literature. There is very little research on how and why elementary students should be taught visual spatial skills, and even fewer studies done concerning the benefits of teaching elementary gifted students these skills. Therefore, more research needs to be done on the best practices for teaching visual spatial skills with elementary gifted students, the benefits of learning these skills at an earlier age, and how gifted programs can do a better job of effectively incorporating these skills into their curricula. There is little to no research on the teachers who teach visual spatial skills and their self-efficacy, so further research is recommended. Quantitative research is needed in the form of longitudinal studies that may prove how early exposure and training of visual spatial skills can raise the achievement level of gifted students. While this study focused on gifted education, more research is needed on the benefits of implementing visual spatial skills into the general education curricula at the elementary level. Quantitative research is warranted in the field of growth mindsets and its connection to visual spatial ability and development.

Summary

The goal of this study was to discover teachers’ perceptions of best practices for teaching visual spatial skills in the elementary gifted classroom and how a gifted program can help teachers in this endeavor. As more gifted programs are identifying students with visual spatial strengths through talent assessments, and qualifying them for gifted services, it is imperative that the curricula be adapted to include the skills that enhance these students’ talents.

Best practices are considered to be those procedures that are most effective. In order to effectively implement visual spatial skills within a gifted curriculum, this study sought to
discover what teachers of the program believed to be the best practices for doing so. Four themes emerged from the survey, interviews, and physical artifacts: integrate visual spatial skills across the curricula, increase the use of hands-on equations, incorporate more digital apps and gaming, and receive appropriate teacher training.

With so many careers reliant on visual spatial abilities, gifted programs are doing a disservice to the students by not providing them with these critical skills. We must offer these bright, unique learners the essential skills to fully develop their talents and abilities. Educators need to be properly trained to recognize these talents and potential, in order to successfully and confidently teach these skills. Through pre-service education and professional development, educators need training on the most up-to-date technology tools, including gaming. Teacher education must remain current in order for this nation’s students to remain competitive in the global technological market. Some of the nation’s brightest students are currently being served in gifted programs across this country. We must ensure that these students are given opportunities to grow, develop, and thrive as a result of the services of gifted education.
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April 7, 2021

Sandra Young
Rebecca Harrison


Dear Sandra Young and Rebecca Harrison,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study is not considered human subjects research for the following reason:

Your project will consist of quality improvement activities, which are not “designed to develop or contribute to generalizable knowledge” according to 45 CFR 46.102(i).

Please note that this decision only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

Also, although you are welcome to use our recruitment and consent templates, you are not required to do so. If you choose to use our documents, please replace the word research with the word project throughout both documents.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application’s status, please email us at

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office
Appendix B

Study Site Request and Approval

DEPARTMENT OF ACCOUNTABILITY & QUALITY ASSURANCE

RESEARCH & INFORMATION SHARING AGREEMENT

School District of [Redacted]
Research & Information Use Agreement

This Research & Information Use Agreement (the "Agreement") is entered into as of the date last written below ("the Effective Date")
 will be collectively known as "Requestor" where appropriate.

This Agreement consists of the complete signature page, and the following attachments that are incorporated into this Agreement and made a part hereof by this reference:

1. Attachment 1: Research & Information Use Agreement Terms and Conditions
2. Attachment 2: GCS Research & Information Sharing Application

This Agreement is the complete agreement between the parties hereto concerning the subject matter of this Agreement and replaces any prior oral or written communications between the parties. There are no conditions, understandings, agreements, representations, or warranties, expressed or implied, which are not specified herein. This Agreement may only be modified by a written document executed by the parties hereto. Any disputes arising out of or in connection with this Agreement shall be governed by law without regard to choice of law provisions.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be duly executed. Each party warrants and represents that its respective signatories whose signatures appear below have been and are on the date of signature duly authorized to execute this Agreement.

*If you are requesting to conduct research as a student, a university sponsor must be included as an individual. The sponsor, by signing below acknowledges s/he has read and approves this request for Research and Information Sharing in GCS and understands that supervision of this project rests with the sponsor. The privilege of conducting future studies in GCS is conditioned upon the fulfillment of such obligations. Violation of this statement of agreement will be considered a breach of contract.

Deputy Superintendent

Date 12/05/2020

Director of Accountability and Quality Assurance

Date 1/3/20
This document must be completed by the Requestor or Company representative requesting the use of GCS information. *If you are requesting to conduct research as a student, a university sponsor must also be included as an individual.

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Sponsor Name (Required When a Student is the Primary Contact)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rebecca Harrison, PhD.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Requestor(s) Name and Title</th>
<th>Sponsor Title</th>
</tr>
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<tbody>
<tr>
<td>Sandra Young</td>
<td>Director for Gifted Education and Assistant Professor</td>
</tr>
<tr>
<td></td>
<td>Liberty University</td>
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<table>
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<table>
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<tr>
<th>Head of Information Security, Lead IS Admin.</th>
</tr>
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<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12/15/20</td>
<td></td>
</tr>
</tbody>
</table>
Appendix C

Consent for Participation in Research

I volunteer to participate in a research project conducted by Sandra Young from Liberty University. I understand that the project is designed to gather data about the perceptions of best practices of teachers for the use of visual spatial activities in elementary gifted classrooms. I will be one of 10 or more teachers in this district being interviewed and observed for this research.

1. My participation in this project is voluntary. I understand that I will not be paid for my participation. I may withdraw and discontinue participation at any time without penalty. If I decline to participate or withdraw from the study, no one in the district will be told.

2. I understand that the interview and discussion was designed to be interesting and thought-provoking. If, however, I feel uncomfortable in any way during the interview session, I have the right to decline to answer any question or to end the interview.

3. The self-efficacy survey will be provided to me as an online link and will take approximately 30 minutes to complete. I will receive results of my self-efficacy following completion of survey. Following the survey, I will be interviewed by Sandra Young, the researcher, from Liberty University. The interview will be scheduled for a time that causes no disruption to class and instruction. The interview will last approximately 30-45 minutes and will be conducted via face-to-face or virtually. The interview will be audio-recorded and transcribed. If I do not want to be taped, I will let the researcher know. I will be asked to provide an example of a visual spatial activity used in my classroom and will need to present it at the time of the interview.

4. I understand that the researcher will not identify me nor my school by name in any reports from this study, and that my confidentiality as a participant in this study will remain secure. A pseudonym will be used in describing me, my experiences, and my perceptions of best practices. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

5. Faculty and administrators from my campus or district will neither be present for the interview and will not have access to notes or transcripts. This precaution will prevent my individual comments from having any negative repercussions.

6. I understand that this research study has been reviewed and approved by the Institutional Review Board (IRB) for Liberty University. For research problems or questions regarding subjects, the Institutional Review Board may be contacted through G. Michele Baker, MA, CIP, the Administrative Chair of Institutional Research of Liberty University.

7. I have read and understand the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

8. I have been given a copy of this consent form.

My Signature ___________________________ Date __________

My Printed Name ___________________________
Signature of researcher: __________________________________________

For further information, please contact:
Sandra Young, Researcher, PhD candidate, Liberty University
Appendix D

Email Sent to Potential Study Participants

Hi! I hope you can participate!

This is Sandy Young, a fellow teacher in the district. As a doctoral student in the School of Education at Liberty University, I am conducting research as part of the requirements for a Ph.D in Education: Curriculum and Instruction. I am writing to invite you to participate in my study. As part of the study, I have secured school district approval.

The purpose of my research is to describe the perceptions and best practices of teachers with using visual spatial activities in the elementary gifted classroom, and to examine how the district’s gifted program can further equip and support teachers to enrich spatial ability of students in the program. Participants must be currently employed as Boumer teachers for the Greenville County School District. You will be asked to complete an online self-efficacy survey instrument, which will take about 30 minutes to complete. Results of this survey will be provided to you immediately upon completion of the survey. The survey will ask questions about your general overall self-efficacy. Following the survey, you will be asked to participate in an individual interview with me. It should take approximately 30 to 45 minutes for the interview. The interview will be scheduled at your convenience within a designated week and may be face-to-face, a phone interview, or an electronic interview through Zoom or Google Meets, whichever you are most comfortable with. Your participation in the study will be completely confidential, and no personal, identifying information will be revealed to anyone except the researcher. The interview will be audio and/or video recorded.

The study will take place shortly after Spring Break. Should you agree to participate, a consent document will be emailed to you prior to the start of the study with further instructions. The consent document contains additional information about my research. It will need to be signed electronically and returned to me via email prior to participation.

Please let me know by this Thursday, April 1, whether or not you are able to help me by participating in this study.

Sincerely,
Sandy Young
Liberty University

Sandy Young, NBCT
Appendix E

Set Example for Participants

Folding Up Boxes 2

Look at each flattened box. One of the four boxes to the right shows the flattened box folded up. Circle this box.

1

2

3

4

5

Name ____________________

Thinker Tasks: Critical Thinking Activities
Book 3: Visual Perception
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Appendix F

Permission Request and Approval for Use of Self-Efficacy Survey

From: Young, Sandra
Sent: Wednesday, February 17, 2021 4:03 PM
To: Gaumer Erickson, Amy
Subject: Permission to Use Self-Efficacy Formative Questionnaire

Hi Dr. Gaumer Erickson,

I am a doctoral student at Liberty University completing a dissertation in education: curriculum and instruction. I am writing to ask written permission to use the Self-Efficacy Formative Questionnaire in my research study. My study is on the perceptions and practices of teachers of gifted elementary education with using visual spatial activities in the classroom. My theoretical framework is based on the growth mindset theory and self-efficacy, regarding teachers. I plan to use the questionnaire for my teacher participants in order to get an idea of their self-efficacy toward their own abilities and attitudes. My research is being supervised by my professor, Dr. Rebecca Harrison.

At this point, my plan is to use the entire questionnaire. I considered other instruments designed specifically for surveying teachers’ self-efficacy, but the questions were not beneficial to my study. The questions on your questionnaire will help guide my study and will be used in generating follow-up personal interview questions. I plan to use the format offered on your website and in fact, with Covid-19 considerations, your format will allow me to collect this important data with no face-to-face contact.

I would also appreciate receiving copies of supplemental materials that will help me administer the test and analyze the results, such as (1) the test questionnaire, (2) the standard instructions for administering the test, and (3) scoring procedures.

In addition to using the instrument, I also ask your permission to reproduce it in my dissertation appendix. The dissertation may be deposited in the ProQuest Dissertations & Theses database.

I would like to use and reproduce your Self-Efficacy Formative Questionnaire under the following conditions:

- I will use the Self-Efficacy Formative Questionnaire only for my research study and will not sell or use it for any other purposes
- I will include a statement of attribution and copyright on all copies of the instrument. If you have a specific statement of attribution that you would like for me to include, please provide it in your response.
- At your request, I will send a copy of my completed research study to you upon completion of the study and/or provide a hyperlink to the final manuscript

If you do not control the copyright for these materials, I would appreciate any information you can provide concerning the proper person or organization I should contact.

If these are acceptable terms and conditions, please indicate so by replying to me through e-mail at sandya.young703@gmail.com.

Sincerely, Sandra Young
Hi Sandra,

Yes, you may use and/or adapt the Self-Efficacy Formative Questionnaire with an appropriate citation. Please note that we have not yet developed any peer-reviewed publications on the survey and it is not normed. We use it primarily as a student reflection tool and teacher planning tool. Based on our analysis and continued understanding of the research in self-efficacy instruction, we have recently updated our questionnaire (see attached). The online system has been updated to use these items. If you launch the survey through http://researchcollaborationsurveys.org/ it will automatically create a summary report for each student and provide you with composite data (in a summary report and excel download).

The new version includes almost all of the items from the prior version, but adds more items about taking steps to increase your self-efficacy. If you choose to use the prior version, you’ll have to administer it outside our online system. We are currently updating the technical report and will have reliability information within the next two months.

If you managed to get to the questionnaire without going through our main website, http://cccframework.org/resources.html, you might want to explore our additional resources including lessons with more than 50 instructional activities designed for middle and high school students; a book, The Skills that Matter (https://us.corwin.com/en-us/nam/the-skills-that-matter/book255639); literature reviews for the elementary and secondary levels; and a professional development process for embedding SEL instruction into content-area learning.

Best of luck and thanks for reaching out to us,

Amy

Amy Gaumer Erickson, Ph.D.
Associate Research Professor
University of Kansas
cccframework.org
ksdetasn.org/evaluation
### Appendix G

#### Self-Efficacy Survey Questions

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>Domain</th>
<th>Reversed?</th>
<th>(Not Like Me)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>(Very Like Me)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>If I worked at it, I could learn just about any skill.</td>
<td>Focus</td>
<td></td>
<td>0 0 1 5 4 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I feel discouraged when I'm told I did something incorrectly.</td>
<td>Focus</td>
<td>YES</td>
<td>1 1 2 4 2 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Once I've decided to accomplish something, I keep trying, even if it is harder than I thought.</td>
<td>Focus</td>
<td></td>
<td>0 0 0 6 4 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I believe that the brain can be developed like a muscle.</td>
<td>Focus</td>
<td></td>
<td>0 0 0 0 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I can always get better, even if I am really good at something.</td>
<td>Focus</td>
<td></td>
<td>0 0 0 1 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I think people should realize when they aren't good at something and quit.</td>
<td>Focus</td>
<td>YES</td>
<td>2 5 3 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I'm willing to work on something challenging, even if I know it will take a lot of effort and I may not succeed at first.</td>
<td>Focus</td>
<td></td>
<td>0 0 1 5 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I see making mistakes as a normal part of learning.</td>
<td>Focus</td>
<td></td>
<td>0 0 2 3 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>When I receive feedback that I didn't do well on something, I try even harder to learn it.</td>
<td>Focus</td>
<td></td>
<td>0 0 0 3 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>I want to quit when I'm told I did something incorrectly.</td>
<td>Focus</td>
<td>YES</td>
<td>5 4 0 1 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>When I'm struggling to accomplish something difficult, I focus on my progress.</td>
<td>Steps</td>
<td></td>
<td>0 0 3 5 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>When a task sounds very hard, I tell myself that I can do hard things.</td>
<td>Steps</td>
<td></td>
<td>0 0 2 4 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>I have negative thoughts about myself when I make mistakes.</td>
<td>Steps</td>
<td>YES</td>
<td>2 3 3 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>It helps me to learn from other people's stories of success.</td>
<td>Steps</td>
<td></td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>When facing a new challenge, I think about goals that I've accomplished successfully.</td>
<td>Steps</td>
<td></td>
<td>0 0 2 5 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Sometimes I give up when I'm afraid I can't do something.</td>
<td>Steps</td>
<td>YES</td>
<td>3 2 5 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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https://www.researchcollaborationsurveys.org/teachersurvey.names/view4testing/8010?pdf=yes
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<thead>
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<th>Question</th>
<th>Answer</th>
<th># Correct</th>
<th># Incorrect</th>
<th>% Correct</th>
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<tr>
<td>17 When I am having trouble learning a new skill, I get advice from people I know.</td>
<td>Steps</td>
<td>0 1 0 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 When facing a new challenge, I think about what I did to succeed in other difficult situations.</td>
<td>Steps</td>
<td>0 0 0 2 3</td>
<td></td>
<td></td>
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<tr>
<td>19 When I hear about how others overcame difficulties, I feel like I can succeed too.</td>
<td>Steps</td>
<td>0 0 2 3 5</td>
<td></td>
<td></td>
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<tr>
<td>20 I can calm myself down when I'm anxious about something.</td>
<td>Steps</td>
<td>0 1 2 4 3</td>
<td></td>
<td></td>
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<tr>
<td>21 When I'm told I did something incorrectly, I try even harder to get it right.</td>
<td>Steps</td>
<td>0 0 1 4 5</td>
<td></td>
<td></td>
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<tr>
<td>22 I use feedback to get better.</td>
<td>Steps</td>
<td>0 1 0 6 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 When given a choice, I usually take the easiest option.</td>
<td>Steps</td>
<td>0 1 2 4 3</td>
<td>YES</td>
<td>1 0</td>
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<tr>
<td>24 I like to challenge myself to learn new things.</td>
<td>Steps</td>
<td>0 0 0 1 9</td>
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Knowledge Test Summary

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<th>Answer</th>
<th># Correct</th>
<th># Incorrect</th>
<th>% Correct</th>
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<tbody>
<tr>
<td>25</td>
<td>Making mistakes (and putting in effort to learn from them) strengthens neuropathways in your brain.</td>
<td>True</td>
<td>10</td>
<td>0</td>
<td>100%</td>
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<tr>
<td>26</td>
<td>If you get straight A's in school, you automatically have strong self-efficacy.</td>
<td>False</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>27</td>
<td>Self-efficacy is something you're born with. Either you have it or you don't.</td>
<td>False</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>28</td>
<td>You can use strategies to increase your self-efficacy when approaching a challenging task.</td>
<td>True</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>29</td>
<td>Self-efficacy is important for academics, but isn't relevant to things like sports or music.</td>
<td>False</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>30</td>
<td>Choose the best definition of self-efficacy.</td>
<td>Believing in your ability to accomplish specific, challenging tasks, including understanding that your ability can grow with effort.</td>
<td>10</td>
<td>0</td>
<td>100%</td>
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<tr>
<td></td>
<td>Question</td>
<td>Response</td>
<td>Agree</td>
<td>Disagree</td>
<td>Total %</td>
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<td>---------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>31</td>
<td>When talking to a friend, which of the following statements would support them in building their self-efficacy?</td>
<td>Ability grows with effort</td>
<td>8</td>
<td>2</td>
<td>80%</td>
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<tr>
<td>32</td>
<td>Which of these helps build self-efficacy?</td>
<td>Learning from others</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>33</td>
<td>You know that succeeding at a challenging task helps increase your self-efficacy. Select the choice that best describes why this is the case.</td>
<td>Succeeding at a challenging task shows that your effort helped you become more skilled, which reinforces your growth mindset.</td>
<td>9</td>
<td>1</td>
<td>90%</td>
</tr>
<tr>
<td>34</td>
<td>Which of these things is NOT likely to be a result of improving your self-efficacy?</td>
<td>Increased ability to succeed at new tasks on the first try</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>35</td>
<td>Which best describes how self-efficacy can make someone a better learner?</td>
<td>Students with higher levels of self-efficacy understand that they have to put in effort in order to learn, so they will work harder.</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>36</td>
<td>Which of these behaviors helps build self-efficacy?</td>
<td>Before approaching new challenging tasks, thinking about similar tasks that I've successfully completed.</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>37</td>
<td>Using what you've learned about self-efficacy, choose the best option for how Florence should proceed.</td>
<td>Florence decides that she can succeed with effort. She starts going to the weekly study sessions the teacher offers, doing more practice problems, and asking questions when she doesn't understand something.</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>38</td>
<td>Skills/abilities are something you're born with or you're not.</td>
<td>Fixed Mindset</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>39</td>
<td>Attempting challenging tasks is how we learn.</td>
<td>Growth Mindset</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>40</td>
<td>&quot;I'm good at reading, but I just can't do math.&quot;</td>
<td>Fixed Mindset</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>41</td>
<td>&quot;My friend is so smart, I'll never be that smart.&quot;</td>
<td>Fixed Mindset</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>42</td>
<td>Honest, constructive feedback helps you identify areas where you need to improve.</td>
<td>Growth Mindset</td>
<td>10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>43</td>
<td>Be open to new challenges but admit when you just aren't good at something and move on to a new challenge.</td>
<td>Fixed Mindset</td>
<td>10</td>
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Appendix H

Interview Questions

The interview questions will be open-ended, follow the interview protocol, and be similar to these:

1. Describe your experience with teaching elementary gifted students.

2. What activities in the current County School District’s curriculum do you think promote STEM enrichment/success?

3. Describe an example of a visual spatial activity.

4. What is your perception and/or experience with visual spatial intelligence and ability?

5. What are some ways that the curricula promotes visual spatial instruction?

6. In what ways can technology be used for teaching visual spatial skills?

7. Describe your strengths and weaknesses with using technology in your classroom.

8. Describe your strengths and weaknesses with teaching the problem-based units within the curriculum.

9. What are some things a gifted program can do to expose elementary gifted students to visual spatial skills?

10. What are some things a district could do to further equip and support GT teachers in their efforts to teach visual spatial skills?

11. How do you feel about gaming in the classroom?

12. How are today’s perceptions about gaming different than the perceptions of gaming 20 years ago?

13. What benefits can be gained from playing video games?

14. What are some enrichment activities that you do with your students that are outside the GT curriculum that may be encouraging visual spatial skills? Please describe the activity and why you selected this one to share.

15. In what ways does a teacher’s self-efficacy affect and influence his students?

16. How important is fixed and growth mindset in education, and in particular, how does a teacher’s mindset affect his students?

17. What do you consider to be the best practices for teaching visual spatial skills in the gifted classroom?
Appendix I

Field Notes

- STEM in [redacted] currently
  - Figure it out
  - I definitely need to mention
    - COVID
    - Some of curriculum was changed
    - Curr. team worked hard to
  - Persevere — noting it as important
  - Using technology too much
    - See this as a negative!
  - Things about their current curriculum
    - Most think more could be done
  - Any similarities in the way they describe & define U.S.?
  - Any similarities in what they consider to be best practices?
  - Confidence levels in tech in U.S.
    - Any similarities/differences
  - Fixed mindset
    - Growth mindset — evidence of?
    - How many times they expressed uncertainty
**Enrichment**

- Landy - brain teasers
- game - mindtrap
- I need to look this up

Franchise - add entire units, enrich math websites.
  - Interactive Math Challenges, Epic books, enrichment units.
  - Change the world - K-nex, magna tiles

Zone - pixel art, multi-games, mystery picture

Austen - website, thinkable puzzles

Finley - brain teasers, logic game

Artie - cafe chat, fun room

Blair - whole school, technology - 3-D printers

Riley - videos, Mystery Science

Jackson - brain-based things, for explorers, grid puzzles.

Yoda - logic problems, elimination, art
Self-efficacy Statements

Fixed vs growth mindset statements

Suggestions for V.S.

Landy - creativity - Landy
Hands on - Landy
Movement

Keda - More time
More STEM - In-supples
Immersed

Issues - time constraints - Landy

Frank - More building, real world problems create
Longer units, more time, Prof. Development
Book Study, Share when other

Audre - Carving out a chunk of time for it.
Hands on activities, puzzles, brain games - but when you say game - doesn't seem important, having enough supplies!
She stresses the imp of teacher training
Landy + Frankie both said GT kids hate to hit obstacle

* Some of them didn't feel qualified to teach GT.

Lacked confidence

Mindset: Self-Efficacy

Sees a connection between Teacher + Student - Landy

Frankie - willing to try new things, shows kids how to meet a challenge.

Teaching kids about growth mindset; improved here.

2. Need to know your material + content in order to be confident

Risk - Must be confident in front of students

Finley - Doesn’t like gray area. A struggle. Hard to grade. Feels he’s confident. But says not good at things. Points out it’s imp. not to say this in front of students.

Artie - They take their cues from us. Huge impact.

Quote her

Blair - Trickles down. Quote her. Kada definitely impacts student.

Riley - Kids mimic what they see.

Sees as a strength that she teaches her kids to trust her in grading and about attitudes.

Jockey - If kids see you happy + competitive:
Mindset

Zane - Quote her

Trash - not an age or experience thing
   person by person thing
   Quote her!

Fenley - Quote him. Feels kids have it or they don't. (p. 3)

Arkie - Quote her - p. 8

Koda - quote her! p. 9
Best practices

Landy: incorporate visual things - Landy

Thinking in different ways - using different ways to do things - Landy

Frankie: Always offer a way to use U.S. to scaffold the learning. Incorporate those skills daily in all units.

Aster: consistent, different materials, mix it up, work in different groups, conversations.

Finley: Natural learning - but not sure how it fits in curriculum. But can reach more kids.

Arthe: incorporate it thru many things - not just a unit.

Blair: Student interest, multiple modes.

Riley: Baby steps. Start with mazes. Getting hands-on.

Jesse: Constant challenge then - build dendrites again.

Koda: Consistent.
Artifact

Lundy - 5 Squares - Creative, physical aspect

Frankie - Shakespeare, Acting

Austen Keva Blocks - her son

Finlay Counting off on floor tiles - Pos / Neg #s

Arnie Design Space, Tangrams

Riley Hot -

Blair - Grief Cube

Sarita - YouTube videos - pyramids

Reda - Chinese Art
Our current curriculum - STEM

- Bridges - Landy (hates it)
- Coding - Landy
- Rubie - Landy - (loves it)

Frankie: Figure it out. HOE. Eng./Design proc. Skyscraper

Zane: 4th - STEM units, bridges.
5th - monuments, skyscrapers, Mt. Rushmore.
3rd - not so much. More focus on Art, less STEM.

Bridge Building - Kid favorite, too.
Prefers shorter things like Structures.

Finley: 4th - Bridge - Structures, Eng./Des. Process
3rd - Acting out the plays.
5th - More research based.

Arne: 4th grade engineering

Blair: STEM in all 3 grade levels. First, Rubie Goldberg, bridges, engineering.

Riley: HOE, F10, Engineering


Kaela: 4th - Structures, Bridges, 5th - Skyscrapers.
Describe Vis. Sp.

Frankie put thoughts in pictures/design
 Manipulate things in mind - Tangrams
 Drawing, making a picture

Landy - puzzles, Tangrams, Creative, Scamper
 Red string book
 Howard Gardner

Zane - kids who need visual representation

Austen - Tangrams - problem solving, fitting pieces

Finley - Not sure it's something you can teach.
 Watched on NMAH - Some kids have it,
 Some don't. Could push it in our program more. [Quote him!]
 Blocks w/hidden blocks underneath
 He doesn't get when the students miss these
 Logic

Urike - visualize properties of space - Tetris!!

Blair - Learning by doing vs. seeing, hands on

Riley - picturing what they are trying to solve

Jackie - No idea

[Nota - Refer to Gardner Choice]
V.S. in Current Challenge Curriculum

Frankie - Visual - Art, Tableaus
Spatial - Bridges

Laney - H2E - Placement, Movement - Warehouse Theater

Austen - No, doesn't like we do, bits and pieces, but not spelled out well.
Hands-on Equations

Finley - Figure it out - Act it out. Seems real to them.
Otherwise, reading from our curriculum.

Arthur - Building, engineering. Not so much in 3rd and 5th grades. Maybe the art
needed, necessary? - Note.

Blair - Art in 5th grade, virtual/learning

Riley - Needs more

Jackie - 4th grade - the best. Not enough

Kada - Not permeated them out. 3rd/5th but
heavily in 4th grade
Technology - V.S.

Frankie - infographics, digital art, Google Slides + comics, illustrate vocab.
Manipulatives virtually, Tangrams virtually

Landy - Tangrams, digital

Jaxen online manipulatives
'she sees this as less than actual manipulatives
online games, drag & drop

Husten Coding, tangrams, moving things to solve puzzles

Finley - websites, Math playground, Games w/ blocks

Arrie - tangrams, making things game-based, design space, puzzles

Blair - innovative platforms, kids manipulating objects,

Kiley - Coding unit, Hot electronically

Jacqui - YouTube: look for activities

Koda - interactive games & activities
Best Practices Code Words

- Create chart

- Consistent, consistency, consistently
  - Manipulatives
    - Computer Apps
    - Computer websites
  - Gaming
  - Drawings
  - Communicating what you visualize
  - Constantly challenge them
  - Rigor
  - Brain things
  - Baby steps
  - Mazes
  - Hand-eye coordination
  - Student interest

- Scaffold, the learning, incorporated throughout, weaving it up, teacher training
Gaming - Koda, coding, manipulating

OK w/ it - Landy sees it as V.S.

Frankie - Scratch. She thinks gaming is fun.

Riley - Loves coding unit. Great for critical thinking.

Austen - Against it unless it's gaming with a purpose.

Finley - Likes it. Good for brain.

Artie - Hail Fan: Video Game Generation. Quote

Blair - All for it. Quote her.

Riley - Yes

Society - There's a place for it. Quote

Benefits of Gaming - Artie: Yes, appreciate

Landy - Vocabulary - Landy - V.S. Blair: Tetris == Fargo

Riley - Expanded

Frankie - Use it in careers, spatial, perseverance, creativity. More involved. Can be creator, not just player.

Maxing - Way of life. Part of who they are. Collaborative, social time.

Austen - With structure + purpose.

Finley - Yes. Promotes healthy competition, problem solving, learn to fail, try again.
Appendix J

Site Approval Amendment

Department of Accountability and Quality Assurance
Ph.D., Director

4/14/2021

Company Name
Sandy Young

Sandy Young,

SUBJECT: AMENDMENT- A Case Study of Teachers of Elementary Gifted Students and their Best Practices with Teaching Visual Spatial Activities in the Gifted Classroom

Original RDSA Approval Date: 12/15/2020

All terms and conditions of the original Research and Data Sharing Agreement are in full effect. You are reminded that the approved research design and procedures are to be followed. NO change in protocol is allowed without prior written approval from the District. The amendments to the original RDSA are described and include only those listed below.

AMENDMENTS:

Page 8:

Section G: Change the title of the research from “A Case Study of Teachers of Elementary Gifted Students and their Best Practices with Teaching Visual Spatial Activities in the Gifted Classroom” to “A Case Study of Teachers of Elementary Gifted Students and Their Perceptions of Best Practices for Teaching Visual Spatial Activities in the Classroom”

Pages 12 & 13:

Section L: Remove focus groups from the methods and add a survey with teachers

The signature of the primary contact/requestor is required as indicated below. This document, once signed, may be returned via mail, email...
RESEARCH AND DATA SHARING AGREEMENT AMENDMENT:

I, [Redacted], on 4-14-21 have read, reviewed, responded, where applicable, and agree to the changes outlined in the AMENDMENT and further understand that my signature signifies this understanding in regards to the protocol and procedures of the original Data Sharing Agreement between Sandy Young and [Redacted] County Schools.

Sincerely,

[Redacted]

Director of Accountability & Quality Assurance
# Appendix K

## Participant Progress Checklist

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Appendix L

Permission Request and Approval for Use of Images from Website

https://www.avimegiddo.com/

From: Young, Sandra <syoung89@liberty.edu>
Sent: Friday, July 30, 2021 7:41 AM
To: Avi Megiddo <megiddo@gmail.com>
Subject: Permission to Visual Spatial Activity Images from Website

Hi Avi,

I am a doctoral student at Liberty University completing a dissertation in education: curriculum and instruction. I am writing to ask written permission to use images of activities from your website in my research study. My study is on the perceptions of best practices of teachers of gifted elementary education with using visual spatial activities in the classroom. My theoretical framework is based on the growth mindset theory and self-efficacy, regarding teachers. My research is being supervised by my professor, Dr. Rebecca Harrison.

As part of my study, participants were asked to provide an example of a visual spatial activity they use with their students. One of my participants discussed some of your tangram activities and I would like to mention these and include pictures in my discussion of the findings.

The dissertation may be deposited in the ProQuest Dissertations & Theses database.

I would like to use your images under the following conditions:

- I will use the images only for my research study and will not sell or use them for any other purposes.
- I will include a statement of attribution and copyright on all images used. If you have a specific statement of attribution that you would like for me to include, please provide it in your response.
- At your request, I will send a copy of my completed research study to you upon completion of the study and/or provide a hyperlink to the final manuscript.

If you do not control the copyright for these materials, I would appreciate any information you can provide concerning the proper person or organization I should contact.

If these are acceptable terms and conditions, please indicate so by replying to me through e-mail at [masked email].

Sincerely,
Sandra Young
Hello Sandra,

Thank you for reaching out to me.

Sure, you can use them.
Please attribute the copyright to me and include my name, Avi Megiddo.

I would appreciate it if you send a copy of your completed research study to me upon completion of the study and/or provide a hyperlink to the final manuscript.

Cheers,
Avi