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The Impact of a Culturally Responsive Approach in Science Education on Kindergarten Students

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Abstract

Classrooms today are more ethnically and linguistically diverse. Unfortunately, students of color demonstrate a history of marginalized educational inequities (Williamson et al., 2007). These marginalized educational inequities impact academic achievement across all content areas especially literacy, math, and science. To improve the academic performance of students who are culturally, racially, ethnically, and linguistically diverse, methods of instruction and pedagogy that better facilitate learning among diverse student populations must be instituted (Ladson-Billings, 2005). A mixed methods study was conducted in response to the need to examine the impact of using culturally responsive strategies on kindergarten student's attitudes towards science and their understanding of science content using semi-structed interviews and assessments.

Keywords: Cultural responsiveness, culturally responsive teaching, culturally responsive education

Dedication

To my amazing father, Leon Hite Sr. This dissertation is dedicated to you. I remember you always saying one day everybody would call me Dr. Hite. You were my motivation and inspiration for the past three years. I felt you every step of the way and I hope I made you proud. We did it Daddio!

Love, Mona

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Chapter 1

Introduction

What happens to a dream deferred? Does it dry up like a raisin in the sun? Or fester like a sore-

And then run? Does it stink like rotten meat? Or crust and sugar over like a syrupy sweet? Maybe it just sags like a heavy load. Or does it explode?

(Hughes, 1951)

I have always had a passion for science and learning. Growing up I can remember one of the most defining moments in my educational experience. During my senior year of high school my guidance counselor called me into her office to discuss my plans after high school. I expressed my desire to become a scientist or doctor. I will never forget her words to me, "Oh honey you aren't strong enough in math; maybe you should consider a different path." Those words deeply affected me more than I truly understood. Those words cut like a knife because they came from a white woman, who worked in a black school district. She clearly did not understand me or my culture. She did not know how to check her own bias to help guide me on a path of success. She failed to get to know my strengths and how math played an important role in my life. During my last semester of high school, I took chemistry and the conversation full of doubtful words began to fill my head all over again. I remember my first day in class and my teacher said, "you can do this, you have all the tools you need." He took the time to discover my strengths when it came to math, and he always provided me with an opportunity to see myself in science. I loved the hands-on learning, the presentation from people who looked like me and most importantly his ability to connect what I was learning to my life.

What happens to our culturally and linguistically diverse students when a teacher tells them to find other dreams? How many minority students' dreams of entering the STEM field have been deferred because an educator failed to provide content in a culturally relevant framework? As an African American woman, I understand the unique challenges scholars confront when often attending schools, in which resources are underfunded and offer lessons that are often culturally unrelated to their experience. I have become an advocate for providing students of culturally and linguistically diverse backgrounds with an education that alters the traditional method of instruction. I use this experience and more to guide my purpose in the classroom. I want to inspire marginalized and unrepresented students to engage in science education and change the way educators engage.

Educational theorists Gloria Ladson-Billings (2009) and Geneva Gay (2010) are conducting research to provide a design for cultural diversity in education. Ladson-Billings (1994) states, "culturally relevant pedagogy empowers students intellectually, socially, emotionally and politically using cultural referents to impart knowledge, skills, attitudes and a collective empowerment" (pp. 16-17). Gay (2010) describes culturally responsive pedagogy as, "the use of cultural knowledge, prior experiences, frames of reference and performance styles of ethnically diverse students to make learning encounters more relevant and effective for them?". Both educational pedagogies are often utilized in an interchangeable matter within a classroom. A culturally relevant teacher realizes that a student's culture is crucial to how students learn. Teachers that engage in cultural experiences, set high standards of achievement for all students, and position themselves as both a facilitator and learner are truly aligned with the purpose of culturally responsive teaching.

Culturally relevant/responsive pedagogy is grounded in the idea that if students are presented with content that allows them to incorporate their personal knowledge, skills, and experiences, then the academic success will be greater (Muniz, 2019). The ideology behind culturally relevant and culturally responsive teaching is to provide an instructional design to use with underrepresented students. This educational approach, therefore, encompasses the students' culture and validates their knowledge. Gay (2010) states. "Culturally responsive teachers simply teach the whole child" (p.32). Culturally relevant pedagogy provides an inclusive, comprehensive, and transformative approach for culturally and linguistically diverse students (Gay, 2018). While all students benefit from a classroom environment engaging in culturally responsive pedagogy, minority students who lack essential resources benefit the most because the pedagogy provides validation, affirmation, and collaboration in the learning process.

STEM Educational Experiences for Young Children

In early childhood classrooms science instruction often lacks the opportunity to experience inquiry, to explore the scientific and engineering processes and to participate in an experiment. Clements et al. (2016), states that toddlers and preschoolers can exhibit many characteristics of young scientists and engineers through their play, which includes desires to take things apart, figure out how they work, and how to put them back together. Most science instruction taking place during the early years lacks an instructional framework and curriculum that is aligned with the National Association for the Education of Young Children standards (NAEYC, 2002). Providing developmentally appropriate instruction combined with quality science learning experience can enhance the development of science skills, knowledge and lay a solid foundation for the development of scientific concepts children will encounter throughout their academic lives (Eshach & Fried, 2005).

Freeman et al. (2014) argues active learning engages students in the process of learning through activities and or discussion in class, as opposed to passively listening to an expert. Nguyen et al. (2016) states that active learning is a teaching method that focuses on student engagement and interaction. This method allows students to take their education into their own hands and allows them to "learn how to learn" (Akinoglu and Tandogan, 2006). Active learning in the classroom could present itself as student-led instruction, group discussions and problem-solving exercises. Many teachers in the early childhood setting lack the background knowledge and skillset to teach science concepts to younger children. A teacher's personal low science efficacy (Pell & Javris, 2003), along with the pressure to focus heavily on language and literacy (Greenfield et al., 2009) can impact the effectiveness of science instruction.

Examples of Culturally Relevant Lessons

Research continues to grow in supporting the benefits of utilizing cultural experiences to engage students and promotes positive learning and academic achievement (Aikenhead, 2001). The traditional science curricula and classroom lack the connection to culture, knowledge, and experiences of students. Culturally relevant pedagogy highlights specific pedagogical tenets and outcomes for students. Table 3.2 highlights pedagogical tenets and outcomes according to Gloria Ladson-Billings (1994).

Table 3.2

Culturally relevant pedagogical tenets and student outcomes

Pedagogical Tenets	Outcomes for Students
Conceptions of knowledge	Increased cultural competence
Social Competence	Development of social consciousness
Conceptions of Self	Increased academic success

Note: Culturally Relevant Pedagogy- Ladson-Billings (1994).

There is a need for culturally responsive science that is content specific and that is both relevant and reflective of students' knowledge. Continuing to support traditional science as is could create a learning environment where students are negatively impacted. School environments that create a learning environment where students play a role in their learning could increase achievement (Edmin, 2011). One way to provide students with culturally relevant experiences is by allowing them to see examples of science in action in their community and schools. Culturally relevant experiences should also provide students with an opportunity to see themselves in science by providing real life examples of leaders in the science field.

mySci Curriculum

Educators in classrooms today are looking for ways to engage students in the curriculum they teach, including science. The mySci curriculum created through The Institute for School Partnership with Washington University, "strives to develop the region's next generation of scientific thinkers by engaging elementary students in science (STEM) through interactive learning experiences and creative curriculum" (Institute for

School Partnership, 2023). The mySci model utilizes the 5E learning cycle (Engage, Explore, Explain, Elaborate and Evaluate). The model seeks to actively engage students in the learning experience, while incorporating and expanding students' prior knowledge.

Purpose

The study seeks to assess the academic outcomes of the traditional 5E model compared to the addition of a culturally responsive teaching strategy component. The practices and strategies in science lessons of two kindergarten teachers using two different instructional strategies were examined to determine the impact on students' learning and engagement in science. The design involves one teacher using the characteristics and practices of a culturally responsive science lesson serving as the treatment group and the second teacher using a standard model of instruction termed 5E that includes five phases: Engage, Explore, Explain, Elaborate and Evaluate, serving as the control. The control group lessons will be based on the same topic that was taught to the treatment group, without engaging in culturally responsive teaching strategies. Bybee (2006) describes the 5E model as a planned sequence of instruction that places students at the center of learning. It encourages all students to explore, construct understanding of scientific concepts and relate those understandings to phenomena or engineering problems. The study seeks to assess the academic outcomes of the traditional 5E model compared to the addition of a culturally responsive teaching strategy component. The investigation utilized both quantitative and qualitative methodologies applied in an action research approach grounded in constructivist theory.

The research design made it possible to compare the effect of two different pedagogical approaches on content achievement and student attitudes when engaged in kindergarten science lessons. The following research questions are were explored:

R_1: To what extent do culturally relevant experiences used in science lessons impact kindergarten students' understanding of content as compared to those lessons which do not include culturally relevant examples?

$R_{2:}$ To what extent is there a difference in the attitudes towards science expressed by students who experience culturally relevant science instruction and those that do not?

Null Hypotheses

$H_{01:}$ There is no significant difference between the achievement in science by kindergarten students experiencing culturally relevant science instruction and those experiencing traditional mySci curriculum as measured by the end of the unit assessment scores.

$H_{02:}$ There is no significant difference between attitudes toward learning science by kindergarten students experiencing culturally relevant science instruction and those experiencing traditional instruction as measured by interviews.

Directional Hypotheses

$H_{1:}$ There is a significant difference between the achievement in science conceptual understanding by kindergarten students experiencing culturally relevant science instruction and those experiencing traditional mySci curriculum as measured by the end of the unit assessment scores.

H_2: There is a significant difference between attitudes toward learning science by kindergarten students experiencing culturally relevant science instruction and those experiencing non-relevant instruction as measured by interviews.

Limitations

The sample selected for this study was specifically kindergarten students, who were experiencing a mySci unit for the first time. The results obtained may not be applicable for students outside of the study, which was restricted to kindergarten students unitizing mySci science curriculum. The instructional strategy utilized both a culturally relevant approach and therefore this methodology will require teachers to adjust their implementation, planning and role to increase the learning achievement of students during science instruction.

Delimitations

The mixed methods research design measured and identified student attitudes and academic achievement with the use of quantitative data, which provided holistic and personal experiences from a small sample of kindergarten students. The research is limited to kindergarten students who attend a Title I elementary school and receive science instruction with the use of mySci science curriculum. The sample size was small and can limit the ability to find a significant relationship between control and treatment groups. The teachers both have seven years or more of experience teaching science using the mySci curriculum.

Operational Definitions

The following operational definitions were used:

Cooperative or Collaboration Learning: Instructional use of small groups so that students work together to maximize their own and each other's learning (Johnson et al., p. 6)

Culture: A complex collection of values, norms, customs, ways of understanding and experiencing traditions passed from generations and serve as context for interpreting reality. (Howard, 2010)

Culturally Responsive Teaching: A methodological approach used in the context of fostering positive images of a group of people and the cultural offerings presented by that society. This approach makes use of cultural knowledge, prior experiences, frames of reference, and performance styles, such as hip-hop. (Emdin, 2010)

Culturally Relevant Teaching: A teaching approach where an educator uses a student's experiences, characteristics and cultural customs to engage a variety of perspectives in the classroom.

Science Inquiry: Science inquiry learners engage in an investigation of scientifically oriented questions, formulate explanations from evidence experienced, connect explanations to scientific knowledge and communicate and justify explanations. (Morrison & McDuffie, 2009)

Multicultural Education: A methodology to create a reformed system that creates equal educational platforms for all students, especially those of different racial, ethnical, and social- groups will have educational experiences equal to their white counterparts. (Banks, 2003)

5E Science Instructional Model: The 5E model of instruction utilized by mySci includes five phases: Engage, Explore, Explain, Elaborate and Evaluate. It provides a carefully planned sequence of instruction that places students at the center of learning and encourages all students to explore, construct understanding of scientific concepts and relate those understandings to phenomena or engineering problems. (Bybee, 2006).

Traditional Science Instruction Model: Instruction and content flows through a teacher. The teacher models it, explains it, and demonstrates it. Students absorb it and are expected to recall, repeat, or summarize facts. (Vigeant, 2016).

mySci Unit: Uses a project-based approach to encourage students to apply their knowledge to real-world problems, utilizing the 5E Learning Cycle. (Institute for School Partnership, 2022).

Significance

Minority teachers are underrepresented in the education field. With over 1,305,298 science teachers in the United States, only 10.9% or Hispanic or Latino and 7.8% are African American (Science Teacher Demographics and Statistics, 2022: Number of Science Teachers in the US, 2022). Research shows the unrepresented minorities are interested in pursuing STEM careers, but often face barriers during their educational careers. The American Council on Education reported the Black and Latino students begin college interested in STEM at rates equal to or higher than Whites peers but are 24 percent less likely to earn a bachelor’s degree in those fields (American

Council on Education, 2006). With the goal to increase underrepresented monitories students' persistence in pursuing careers in the STEM field, educators across the field need to gain a better understanding of the use various methods will cultivate positive learning environments for all students.

There is limited research on the impact culturally responsive teaching strategies have on kindergarten students' science achievement and content engagement. Current research provides an understanding of impact of culturally relevant pedagogy when combined with hands-on science curriculum, with respect to students' attitudes and provides a specific framework to describe designs for lessons focused on increasing student engagement and provides examples of creating effective science instruction.

Chapter Summary

If researchers, teachers, and community allies are working to close the educational deficits and increase engagement in science education, educators must address science education inequities. Creating a framework that allows students to bridge both culture knowledge and content knowledge, maybe successful. The following research adds to existing literature and seeks to address the lack of effective science education for minority students by enhancing engagement, attitudes, and increase knowledge of science outcomes in an early childhood setting by using culturally responsive strategies.

CHAPTER 2

REVIEW OF LITERATURE

Forty eight percent of United States student population came from an ethnically, culturally, and linguistically diverse family in 2011 (U.S. Department of Education Equity and Excellence Commission, 2013). Cultural and linguistic differences in classrooms can pose a problem for educators. In 2012, 84 percent of teacher were white, seven percent were African American, seven percent were Hispanic and less than two percent were Asian or Pacific Islander (Aud et. al., 2013). Data highlights the need for providing student with an educational experience supported by educators who share the same cultural backgrounds.

Culturally responsive pedagogy has become a focal point of research in the academic settings to find an effective approach to teach diverse populations of students. Ginwright (2000) claims that minority students who perform poorly in school do so in part because the curriculum they encounter has little relevance to their lives and culture. Claims, such as Ginwright stress the importance of providing culturally relevant and multicultural education. Both are needed in our urban schools to help close the achievement gap, decrease the loss of teachers of color, improve the current school climate, and to give a voice to students who feel their culture lacks a significant place in the educational system.

When educators discuss and suggest proposals to improve the achievement gap the main focus is on students' academic abilities to perform on standardized test. Ladson-Billings (2006) believes when educators are primarily focusing on student achievement without questioning the systems and structures in place that may account for disparities in achievement measures. By not recognizing that education needs to apply a pedagogy or framework, we are continuing to extend the achievement gap instead of creating a new outlook on achievement for minority students. Heissel et al. (2017) stated no intervention established by education reformers has been successful in closing the seemingly perpetual achievement gap to date. Pinkard (2001) believes the use of culturally responsive instruction based on a student's social situation and their culture will allow students to draw upon knowledge and strategies from their everyday lives. Culturally relevant teaching creates a community of learners where students, teachers and their families become active participants in the learning process and academic success. Review of literature will define culturally responsive teaching and effective practices; the role and impact culturally responsive teaching has on engagement and motivation of students; the impact culturally responsive teaching has on science education; and examine the theoretical framework guiding this study.

Barriers in STEM Education

There are several factors leading to barriers in STEM education among marginalized populations. The first factor is the connection academic achievement in science and the protectory to the STEM field. In 2020 the Missouri Department of Elementary and Secondary Education reported that 28% of Missouri's fifth-grade students are proficient in science and 21% proficient in math (p.13-15). Exposure to STEM is the early years of elementary education in vital for children to be able to develop interest in STEM and potential career aspirations (Mohr-Schroeder et al., 2014). Another factor is the availability of quality STEAM educational opportunities at an early childhood level. Missouri Early Learning Standards (MELS), along with the Next Generation Science Standards (NGSS) provide teachers with a framework of expectations for children as they grow and develop (Missouri Department of Elementary and Secondary Education, 2021), but most STEM programs and funding are focused on higher education. Missouri Governor Mike Parson recently signed House Bill 2 (HB 3). The bill allows a computer science credit to count towards a math, science or practical arts credit required for high school graduation (Missouri Governor Signs STEM Education and Science Bill, 2018). Grants like the one signed by Missouri Governor Parson invests in STEM education, but funding highlighting the importance of early childhood education science education remains an issue.

Another barrier in STEM is the lack of incorporating multicultural education. The purpose of multicultural education is defined as a way to create a reformed system that creates equal educational platforms for all students. Multicultural education provides students, especially those of different racial, ethnical, and social groups, with an educational experience equal to their white counterparts (Banks, 2003). Ladson-Billings (2006) suggests that educational deficits among minority students are due to the disparities in education over time. These educational deficits, which are deeply rooted in historical racial discourse, have made a major impact on the educational system of today (Landson-Billings, 1994). Students of color and underrepresented students benefit from a learning environment that is focused on community, active participation in the learning process and an educator that maintains high standards of excellence without compromising their cultural identity (Ladson-Billings, 1994).

Instructional Responsibility

Teachers must be able to recognize how race, ethnicity and culture shape the learning experience for many students. Teachers must employ a pedagogical framework that validates and affirms students' social and cultural influences (Howard 2003). Using an African-centered pedagogy can help reduce the resistance of learning when using traditional methods (Lee et. al, 1990). When teachers use traditional methods of instruction that lack cultural relevance, they reduce the pride, equity, power, and wealth of knowledge from students of color. Instruction and curriculum should allow for students to take ownership, provide appropriation and validation, while allowing students to connect in a way to make learning their own.

Problem Statement

In 2014, the National Assessment of Educational Progress administered a nationally representative assessment to 21,000 eighth-grade students that focused on technology and engineering literacy. The study found that 18 percent of Black students scored at or above proficient, while 56 percent of white students fell into the same category. The academic achievement gap of among minority and White students is an issue that has been researched for years. Along with the complexity of stigma, students of color are not seeing themselves in science education. If they cannot relate lessons to their community or identify themselves as a scientist these educational debts will just continue to grow.

As the population of culturally diverse students grows, the need for pedagogies and educational frameworks that effectively reach minority students in science education is becoming more important. While there has been quantitative and qualitative research on both culturally relevant teaching and science education achievement gaps, there is a gap in literature about the effects of providing culturally relevant science education in the early childhood setting. Providing early STEM education is imperative to develop STEM abilities, STEM identity and positive attitudes. Morgan et al (2016) examined general knowledge gaps in 7,757 kindergarten students. The study found that kindergarten knowledge is the strongest predictor of science achievement from first to third grade. The lack of science achievement will have a direct effect on the success of students until the end of eighth grade. As a kindergarten teacher in an urban elementary school, I noticed African American students lacked engagement during science instruction. At this same time, I noticed that culturally responsive teaching had a positive impact on student achievement. The lack of connectiveness to both types of pedagogies and science achievement led me to investigate the benefit of using culturally responsive teaching strategies as framework for teaching science kindergarten students. To engage in change regarding science education instruction, more research must be done to focus on the impact of active learning during science instruction, the use of family and community role models and the alignment of providing developmentally appropriate standards in the early childhood setting.

Current Science Learning and Teaching Impact on Diverse Student Populations

The Next Generation Science Standards (NGSS) provide educators with research-based standards. The NGSS standards were implemented by states to improve science education for all students (Next Generation Science Standards, 2019). Various strategies and reforms have been implemented in the classroom, but few have provided the science achievement wanted among students. The lack of success has led to confusion, frustration, and criticism about any reform effectiveness (Lynch, 2000; Rodriguez, 1997). Lee & Luykx (2006) support providing students with reform that provides academic achievement and integrates interdisciplinary knowledge with knowledge of their ethnicity, culture, language, and social class.

In 1993, the American Association for the Advancement of Science (AAAS) developed an initiative focused on improving science education and helping all Americans become scientifically, mathematically, and technologically literate (AAAS, 2013). Project 2061 Science for All provides a definition of science literacy, outlines a benchmark, and develops a framework for teacher education (AAAS, 2013). Terms like "science for all", "traditional science" and "reform" are complex and vague terms with little understanding and agreement about their definition. Without a clear understanding this can add to the frustration of how to proceed toward desired outcomes regarding science education (DeBoer, 2000). Aikenhead (2006) argues, "science curriculum, more often than not, provides students with a stereotype image of science: socially sterile, authoritarian, non-humanistic, positivistic and absolute truth" (p. 10).

Vigeant (2006) defines traditional science education as instruction and content that flows through a teacher. The teacher models it, explains it, and demonstrates it and students are expected to absorb, recall, repeat, or summarize facts. Unfortunately, this form of instruction is no longer feasible for instruction of current students. Entering the work field students will need skills that foster strong analytical skills in response to changing knowledge base. To make this shift of instruction, classrooms need to become environments in which students are encouraged to move beyond memorizing facts into taking responsibility for their own learning (Alberts, 2000; Gibson & Chase, 2002). Inquiry based instruction provides students with an opportunity to access those skills.

The Impact of Inquiry-Based Learning

According to the National Research Council (2000) inquiry-based learning encourages students to learn science, do science and learn about science (p. 15). The structure of inquiry-based instruction supports the flexibility of guided and structed lessons that traditional lecturing in the science classroom lacks. “sixty percent of instruction in an inquiry-based focused on student-centered activities, while traditional non-inquiry-based instruction consisted of students listening to the teacher talk 85% of the time” (Kogan and Laursen, 2013 p.185). Research has shown that inquiry-based learning has a strong impact on student learning, but it may limit other students. Research by Settlage (2003) implies the framework of science inquiry has essentially remained the same since mid-century, until current day. Following the current framework of inquiry-based learning as written without engaging student cultural or linguistic needs can limit the effectiveness of the lesson. Inquiry based learning utilizes a student’s prior knowledge base, which can be difficult for diverse learners. Students are often asked a question at the beginning of the lesson, which can be difficult for diverse students who lack prior knowledge or linguistic skills to fully engage in the learning (Royce & Holzer, 2003). Inquiry driven instruction without culturally relevant strategies is ultimately leaving some students behind. Research of students’ culture knowledge and language connected to scientific practices is limited. Lee (2002) research students’ cultural values and practices are relative to Western modern science. The research indicated that there is a disconnection between students’ values, knowledge, home, and science culture.

Providing students with both science inquiry and culturally relevant science instruction can ensure that all students have a chance for success.

Characteristics of a Culturally Responsive Teacher

With the increasing interest in providing culturally responsive instruction, researchers are investigating the characteristics that make an educator culturally responsive. The work of Villegas and Lucas (2002) developed six characteristics of a culturally responsive teacher. They are the following:

- socially conscious
- they affirm the views of their students
- they assume responsibility for making schools responsive to all students
- they possess an understanding of how learners construct their knowledge and the ability to encourage their process of learning
- they understand their students' lives within their community
- they use this knowledge to incorporate it into the design, implementation and learning environments.

Ladson-Billings (2006) research found that teachers who were most successful with African American students were aware of the position African Americans play in society

A study conducted by Sullivan (2009) examined five teachers use of culturally responsive pedagogy on 25 African American seventh and eighth-grade males. She focused on providing culturally responsive instruction and classroom management strategies that educators can utilize to support the communication and cognitive styles of African American male students. The study used classroom observations, teacher and students interviews and questionnaires. The teacher questionnaire focused on questions surrounding their personal backgrounds, teaching experiences, philosophies about teaching, instructional and classroom management strategies used regarding African American male students.

Students completed a two-part questionnaire focused on their learning experiences, feelings, and perceptions about the effect their teachers' instructional and classroom management practices had on their learning. According to Sullivan (2009), 21 students were successful when the teachers affirmed and appreciated their students' cultural identities and implemented instructional strategies accordingly. The study revealed teachers' perceptions about how their African American students impacted their instructional and classroom management practices, but also encouraged concern for the academic success of the students. Sullivan's study demonstrated that culturally responsive teaching practices have a direct effect on student academic achievement.

Milner (2010) explored non-minority teachers' incorporation of culturally relevant pedagogy into their teaching practices. Milner (2010) states, "as an analytical tool, culturally responsive pedagogy insists that teachers think carefully and deliberately about why they are teaching it in a sociopolitical context" (p.421). The study explores the classroom dynamic when a white science teacher implements culturally relevant teaching practices in his classroom. It illustrates successful gains in student achievement that can be obtained when teachers incorporate the tenets of culturally relevant pedagogy into their teaching practices.

The research study provided the following themes centered around the success surrounding culturally responsive practices. The first theme looked at finding a way to create and maintain real genuine teacher-student relationships that allowed the teacher to learn from and alongside his students. The second theme focused on building cultural competence by recognizing students' diverse identities and challenging socio-political race issues if they emerged during classroom discussion. Finally, teaching was treated as a community effort and sought ways to engage students in the learning process (Miner, 2010). Milner's article supports the argument that connections with students foster validation and can impact the way students perform, engage, and behave in the classroom setting.

Effective Culturally Responsive Practices in Science Education

There is a push in education to move from an educational pedagogy that focuses on teacher-centered objects and moves to a student centered, inquiry-based approach. The National Science Education Standards suggest that inquiry-based instruction is a powerful way to engage students in scientific inquiry and content (NRC, 2015, pp. 8-9). Colburn (2000) completed work to identify three forms of inquiry-based instruction: structured inquiry, open inquiry, and guided inquiry. When providing students with structured inquiry it provides them with step-by-step instruction, questions, and methods for collecting data without expected outcomes. Open inquiry puts students in control of how they investigate the problem, what procedures they take, and how the data can be interpreted. While guided inquiry is a semi-structured approach because students may or may not have influence on the methods used to pursue answers and results. (Colburn, 2000).

In research from Brown (2017) her meta synthesis highlighted the current "inquiry-based science education" utilizing the Committee on a Conceptual Framework for New K-12 Science Education Standards (NRC 2012) as a current illustration of what is expected to be taught in science classrooms across the United States. Brown offers three shared viewpoints that call out the Framework for not achieving goals of equity and diversity within the curriculum. "Given that inquiry continues to be heralded as the gold standard for meaningful science learning experiences, but that engaging in it may produce competing discourses for culturally and linguistically diverse students (Moje et al., 2004), it stands that inquiry-based science may marginalize aspects of these students, including their identities as science learners (Carlone et al., 2011)" (Brown, 2017, p.1146). Brown also states that more must be done in this area of science learning to better accommodate culturally diverse learners if the science-related achievement gap is to shrink.

Civil and Khan (2001) conducted a study with a large sample of low income, Latino and English Language Learners. The research looked at how to determine how well the students learned the math concepts of area and perimeter with the incorporation of culturally responsive instruction. The researchers incorporated the use of a garden with students and families to teach the new mathematical concepts. Civil and Khan (2001) definition of culturally responsive instruction is, "instruction that links home and school by building on experiences shared by most students in the class" (p.400). The students and their families were provided with journals, plants, and resources to help with the learning process of creating a garden. While the students develop their garden space, they increase their understanding of mathematical vocabulary and concepts like perimeter and area. Students' abilities, knowledge and inquiry about those mathematical concepts increased because of the connection between community and a connection to their everyday lives.

Delgado-Gaitan (2006) performed an ethnographic study to gain an understanding of culturally impacted classroom learning by incorporating the cultural perspectives of parents, teachers, students, and family members of students. Data collected included observations of students in schools and their homes, interviews with teachers and parents and recordings from students. Delgado-Gaitan (2006) found that teachers did the following things when providing students with a culturally responsive curriculum. The teachers provided (a) curriculum focused on cultural diversity, human justice, and equal treatment of all students; (b) incorporate heritage languages; (c) create equity in math and science for boys and girls; (d) provide interdisciplinary curriculum that incorporates students' lives; and (e) provided a learning environment that explains the importance of learning English. By using these themes teachers could make the current curriculum relevant to students and increase teachers' cultural perspective by understanding the significant role of diversity in students' lives. The studies above offer some guidance in researching my question further. With the inclusion of a culturally relevant framework students' understanding of science content should increase. The question remains how many other factors play a role in increased academic achievement in science education in an early childhood educational setting?

Culturally Responsive Impact on Student Engagement and Motivation

Engagement has increasingly become a focal point of student achievement. Defining and providing indicators about student engagement is a complex topic. When teachers provide students with relevant classroom experiences and instruction it encourages intrinsic motivation. To provide students with instruction that is relevant, teachers must provide real life experiences and text that speaks to the culturally and linguistically diverse student population. Appleton et al. (2008) research defined engagement into three categories: behavioral, emotional, and cognitive. They defined behavioral engagement as participating in or resisting learning. Emotional engagement is focused on students' attitude towards being receptive towards school and finally, cognitive engagement involves student's devotion to completing educational tasks. indicators should be in the forefront of providing students with a curriculum or educational framework.

Yazzie-Mintz (2010) had key findings from a survey that highlighted engaging instruction and instructional methods excite and create engagement for students. Lessons that fail to incorporate the culturally relevant pedagogy increase the chances of creating frustration and lack of engagement in student learning. In a study by Norman et. al (2001) found that cultural conflict between the African American students, teachers, and lack of culture in science affect learning and impact teacher effectiveness. In a similar study Tobin et al (1999) students were presented with a relevant chemistry curriculum, but the students' engagement and score showed no improvement. He found that students were not interested in the lessons because they were focused on their interests, but the interests he thought his students would respond to. Both studies provided evidence of what intentionally and unintentionally cultural practices could do to African American students' engagement in learning science.

Inquiry-based instruction helps students gain more academic knowledge and success, but some research suggests there is a disconnect to the culture differences that appear in today’s classrooms. A study from Kanter and Konstantopoulos (2010) investigated the impact of an inquiry-based science curriculum on minority student achievement. The results showed that students' science achievement improved with project-based learning, but their attitudes towards science did not change. The results from Kanter and Konstantopoulos tie directly to the research of how incorporating a culturally relevant inquiry-based curriculum impacts my students' engagement in and motivation in science. There continues to be a gap in research focused on what impact engagement, motivation and culturally relevant strategies have on the early childhood setting. My study seeks to encourage more research and to encourage closer collaboration with early childhood curriculum.

Family Involvement Model

The No Child Left Behind Act (2001) describes that parent involvement has engaging in two-way meaningful communication about student academics and activities. A parent’s involvement in their children’s education has consistently been associated with higher student achievement (Hill & Tyson, 2009). As the diversity and classroom environments evolve the push for a better understanding of parent or family involvement has increased. Parents are looking for ways they can support their child and incorporate the strategies used by educators to facilitate learning in the home environment. Powell (1998) believes that a teacher’s belief about family engagement is influenced by educators current and past experiences and cultural understandings. Teachers' negative experiences with families, such as strong advocates for their children or dealing with families who were defensive when concerns were addressed can impact what strategies are used in the future for relationship building.

Souto-Manning & Swick (2006) created a new paradigm regarding parent and family involvement. The key elements are: (1) family and child strengths (2) an inclusive approach where all families are validated and engaged in a relationship (3) the recognition and valuing of multiple venues and formats for involvement (4) a lifelong learning approach in which the teachers learns alongside children and families and (5) trust-building through collaborative schemes and through recognition of multiple family involvement definitions and paradigms (6) linguistic and cultural appreciation, recognition and reflective responsiveness (pg. 191). Their research highlighted the importance that culture, diversity and relationship play with engaging with families and their children. Souto-Manning & Swick (2006) research purposefully worked to avoid providing teachers with another framework, instead provided real experiences, opportunities to rethinking personal teaching pedagogy and spoke to the importance of making families partners within the classroom. The complexity of this problem does not end with having a teacher who provides a rigorous active learning approach. Not only should the teacher have a strong science efficacy, but the families and the community surrounding the student's science educational experience should too. Teachers and families must have the opportunity to have open communication to discuss academic success, failures and the learning objectives taking place in the classroom.

Constructivism Approach to Science: A Theoretical Framework

The introduction of cognitive development begins with interactions between a child and knowledgeable others, along with social interactions that are internalized and utilized during mental processes (Vygotsky, 1978). Vygotsky's theory highlights the importance of scaffolding and recognizes the developmental level of students. The student teacher relationship is key in the fact that the teacher plays the role of guiding social interactions and providing students with educational experiences that can foster both independent problem-solving skills and problem-solving skills with some guidance. The teacher creates a cooperative problem-solving learning environment between students and the teacher.

Elliott (2000) states that constructivism is an approach to learning where people actively construct or make their own knowledge and reality is determined by the experiences of the learner (p.256). For example, having students ask their own questions and seek answers to their questions through research or hands on labs in the classroom. Constructivism puts the student's prior knowledge and learning at the center of the learning process. Lawson work (1995) implies that the "5E Learning Cycle" Engage, Explore, Explain, Expand and Elaborate is aligned with the constructivist model. The engagement phase of the lesson grabs the student's attention and poses the question the investigation is centered around. Engagement is a critical piece of the lesson because it provides a framework for the next steps in the lesson (Bybee et al., 2006). When students are engaged in the activity teachers can begin to facilitate students' learning through investigations or a variety of activities. Bybee (2006) explains during this phase students form a hypothesis, test those hypotheses and record data.

Through engagement students are introduced to the science objectives explored during the lesson. The next stage is to explain where the skill or concept is shared. Students apply their prior knowledge and develop their own explanation to answer questions they have about the concept. Once students have their explanations to questions teachers can have students elaborate concepts learned during the lesson. The last phase of the lesson is to evaluate the students' work. At this stage teachers give students feedback and a formal evaluation to determine the students' level of achievement (Bybee et al., 2006). Boddy et al. (2003) conducted a unit study looking at the impact the 5E model had on 3rd grade students' engagement and science achievement. The investigators conducted observations, interviews and students completed an end of the unit projected. The study found that students found class to be more fun and the 5E model helped develop student's higher level thinking ability and higher-level behaviors. Data was compared from both videos and interviews of the ten participants. Three students scored less than a 20%, six students scored 21-40% and one student scored a 40% difference in higher level thinking scores (Boddy et al. 2003).

The National Science Teacher Association (NSTA) explains students who engage in science curriculum based on inquiry develop the ability to describe, ask questions, share ideas with others and construct their own explanations (National Science Teachers Association, 2002). The use of inquiry-based learning provides younger students with an opportunity to investigate science with curiosity and the ability to search for new knowledge. According to Turkmen and Bonnstetter (1998) students' education should be built on their curiosity and problem-solving skill by experiencing hands-on science projects.

Research by Bulunuz (2012) explored the motivational qualities of hands-on science activities for preservice Kindergarten teachers. 47 students took the same course taught by the same instructor, but one group of students received the course with an emphasis of using hands-on activities to engage kindergarten students in science. Once the students completed the course, they rated the activities based on their likeness to use them in the classroom. The results showed the activities they planned to use within their classroom were significantly high in fun and interest. While this study highlighted the importance of creating activities that are fun and engaging it also highlighted the importance of preserving teacher professional development. Teachers' inability or discomfort from their past experiences with science can impact how they engage with science within their own classroom. Hawkins (1990) calls this "a loop in history by which some children grow to be teachers, who were taught little and poorly, and they then teach little and poorly (p. 97). The research suggests that providing preservice teachers with methods classes focused on inquiry-based science can promote higher engagement and success in kindergarten classrooms.

Active Learning Theory in the Classroom

Educators like Dewey (1916) and Vygotsky (1978) have stressed the importance of providing children with hands-on student-centered instruction. Vygotsky (1978) suggested that children are constructors of their knowledge from social interactions. In other words, a successful learning environment is student-centered, engages students and allows students to have a responsibility in their learning choices. The idea of utilizing a teaching strategy centered heavily on student influence can be challenging for some educators. A study conducted by Djulia et. al. (2011) investigated how the implementation of active learning strategies could improve the quality of instruction and learning in three elementary schools' grades kindergarten through sixth. The action research design collected data from classroom observations, interviews with teachers, and a focus group that provided insight from school community members. The data collected from the observations and focus groups identified the need for supporting teachers with creating developmentally appropriate assessment strategies, as well as opportunities to see active learning in the classroom and useful inventions (Djulia, pg.92). The data also revealed a struggle that many early childhood teachers face, when approaching active learning in the classroom. For example, one struggle is to determine how to effectively use the teaching strategies and the other is to how create and to analyze assessment data when using active learning strategies.

Teachers' lack of understanding of active learning strategies and buy-in can also have a lasting impact on effective implementation. One teacher stated, "that she felt like the students just played games and the use of active learning strategies are unrealistic" (Djulia, pg.94). Educators who understand the importance of implementing active learning theory in their classroom must be willing to relinquish some control. Classroom management, student-teacher interaction, and the learning environment will shift and that takes some adjusting. The research team found that the students responded well to the implementation of active learning strategies, but there was a need for teachers to receive more support in understanding the concrete factors that facilitate or impede implementing active learning to improve quality science instruction (Djulia, pg. 95). Active learning provides all students with an opportunity to understand, apply and approach science education in a positive meaningful way.

Chapter Summary

Research suggests an inquiry-based approach to teaching students' science curriculum without the inclusion of a cultural relevant focus is not appropriate for all students. The current research highlights some characteristics such as inquiry-based learning and real-life experiences that can help with the formulation of a working framework for future science instruction. Unfortunately, the research gap affects the early childhood education setting. Most research focused on providing culturally relevant science instruction is directly tied to a positive effect in higher education. It is beneficial for researchers to focus on engaging younger students in science instruction with the use of culturally relevant instructional strategies. Research presented has also provided the need for more teacher professional development surrounding the use of culturally relevant pedagogy with science education. Teachers need to learn the how, why, and when aspects culture when engaging culture in science education and also how to teach 5E curriculum.

CHAPTER 3
METHODOLOGY

A mixed methods study was used to investigate the effects of implementing culturally responsive teaching strategies into the mySci program for science instruction with kindergarten students. A mixed methods design involves collecting, analyzing, and "mixing" both quantitative and qualitative research methods in a single study to understand a research problem (Creswell, 2012). The attitudes and understanding of a mySci unit were compared between students who receive culturally relevant experiences to students who did not receive a culturally relevant method of instruction. Student interviews were used to gain an understanding of why and how students engage in science instruction. Qualitative data, pre and post science assessments were used to find changes in student content knowledge. The quantitative and qualitative data from the study was guided by two research questions.

Research Questions

To measure and compare the results of the impact of culturally relevant science lesson comparted to the impact of the lessons taught with a non-relevant focus, the following questions were posed:

R_1: To what extent do culturally relevant science lessons impact kindergarten students' understanding of content as compared to those lessons which do not include a culturally relevant focus?

$R_{2:}$ To what extent is there a difference in the attitudes towards science expressed by students experiencing culturally relevant science instruction and those experiencing non-relevant instruction?

Setting and Participants

The participative student subjects were recruited through purposive sampling. The participants were all kindergarten students who participated in the mySci kindergarten science curriculum at the same school. Purposeful sampling is a technique widely used in qualitative research for the identification and selection of information-rich cases for the most effective use of limited resources (Patton, 2002). The research took place in a Midwest public elementary school located in a suburban neighborhood serving students in grades K-5. There were 20 kindergarten students (10 students per group) participating in the study. Both teachers implementing the control and treatment groups have more than 12 years of experience teaching, in an early childhood setting.

The treatment group received instruction using mySci with a culturally relevant approach. The control group received instruction using mySci curriculum with a non-culturally relevant approach. Each teacher would teach his or her own students during the experiment to ensure a comfortable learning environment for the students.from a different teacher. Instruction of lessons took place three days a week for thirty minutes, over approximately ten weeks. The curriculum was part of the regular school day, and the unit followed the scope and sequence of the district. Both groups were provided parental consent forms to document (Appendix A) that families are aware of their students' participation in the study and the collection of their student's data. Participants that did not have parent consent for the data to be used still completed lessons. As part of the curriculum. Parents of participants were required to sign an assent form and participate in a parent meeting outlining the study and learn how to return the assent form (Appendix B). Before the start of the study participants were informed that they would complete the mySci assessment and participate in two interviews. Participants were notified that their names would not be used for identification during the study and participation or non-participation in the study would not affect their grade in science.

Research Design

A mixed methods approach was used to examine the impact of culturally relevant learning experiences on students' attitudes and learning outcomes. End of unit assessments were used pre-intervention and post-intervention to measure the changes in students gains in content knowledge. Individual interviews were used to describe changes in students' attitudes towards science experiences and content knowledge. The intervention took place over 10 weeks with a focus on plants and animals. Both groups participated in lessons focused on science outcomes for the unit of study.

Data Collection Methods

A variety of methods were used to gather data, such as an interview, were used to capture students' attitudes and interests towards science education. Students were questioned about their feelings towards science knowledge, interest in science and how they see themselves with respect to participating in science. (Appendix C). Identical pre and posttest mySci assessments were used to record quantitative achievement results. The questions were a combination of multiple choice, written response, and performance tasks. During instruction the control group received lessons as instructed by mySci, while the treatment group completed the same lessons with the addition of culturally relevant activities and examples not included in the mySci curriculum. Both groups were interviewed during the school day and questions for both interview sessions were given in the same order to see if any attitudinal changes occurred due to the treatment (Appendix E). Having questions in the same order allowed the interview to be more consistent and less prone to errors. Questions were created by the researcher based on the research questions and objectives stated in the curriculum. Face validity was used to ensure the interview questions effectively capturing the topic. A group of early childhood professionals provided input and feedback on questions to screen for items that may be confusing or misleading. The valid questions were used in the interview. Students were given the final interview (Appendix E) and posttest at the end of the unit. Interviews were recorded and transcribed verbatim using in vivo coding, which allowed for participant authentic dialogue to be used in data collection. After transcribing the interviews, a deductive approach was used by starting with codes based on the research questions and then finding excerpts that provided an example of those codes.

Community Fieldtrip

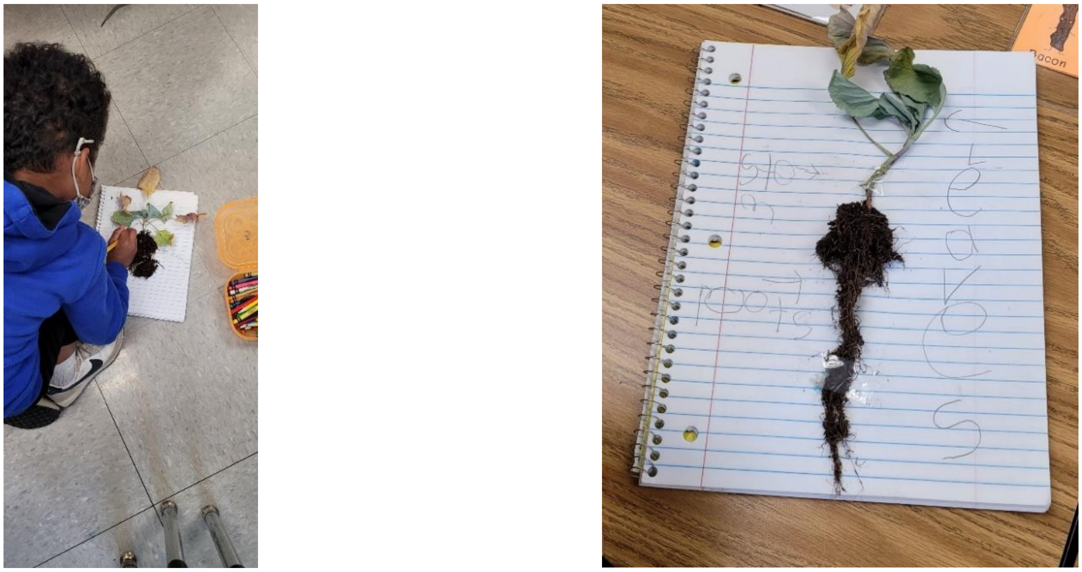
The local gardening club that works with the school district took participants for the treatment group outside for a hands-on tour of the butterfly garden outside the school. Research highlights the impact that fieldtrips have on student development. Field trips that provide an opportunity to experience science can increase student interest and engagement in science (Bonderup Dohn, 2011). The community garden leaders introduced students to the needs of plants, parts of a plant and the purpose behind the use of native plants found in front of the school. The field trip provided students with an opportunity for students to make tangible connections with their community, engage with professionals within their own community and make connections to their learning within the classroom.

Flower Laboratory

The flower laboratory provided students with an opportunity to explore science in a direct way and to envision personal academic success in science. Students were given a real plant and a plastic knife to cut open the flower. Students glued the plant to a piece of paper inside their science journals. The first day of the laboratory students talked about what they saw and noticed about the plant. On the second day of the lab students were instructed to label the parts of their plant in their journal. Figures 3.1 and 3.2 provide an example of the work students produced during the Flower Lab. The lab invited students to share their prior knowledge of plants and a way to connect their learning from a prior presentation in a way that made sense for them.

Figure 3.1

Example of Student Working During Flower Lab



Note: Student working in science journal on labeling flower during lab experience and an example of a student’s science journal entry.

Garden Research

During the unit of study students in the treatment group participated in a research project lead by a local university professor. Students spent two weeks conducting a variety of experiments and investigations surrounding the impact of shade, bugs and fungus has on the growth of weeds. Students helped with the development of an observation sheet to assist the researchers with data collection. The researcher project provided students with an opportunity to meet and engage with STEM professionals of different genders and races. The connection between research and community allowed students to see themselves as scientists and connect content taught inside the classroom.

mySci Assessment

The mySci assessment (Appendix D) was administered pre and post to participants in both the control and treatment groups. To prevent bias during the assessment the control group was assessed by the teacher from the treatment group and treatment group was assessed by the control group teacher. This method ensures that teachers would have no personal connection or influence on how students answered the questions. Students were assessed through the learning management system, Canvas, which provided automatic scoring data. The assessment consisted of eight questions, including multiple-choice and performance tasks. The questions assessed the students' understanding of science content knowledge material before and after the mySci curriculum unit. The assessment measured students' content knowledge over three topics, living or non-living, plant adaptation, and animal adaptation.

Student Interviews

The control and treatment groups each participated in two interviews. The first interview took place a week before the study and the post interview took place during the last week of the study. Students were interviewed one at a time for approximately ten minutes length each time during pre and post sessions. The semi-structured interviews were recorded and transcribed for coding and analysis purposes by the researcher. The semi-structured format allowed for open-ended questions and encouraged two-way communication. Interviews focused on students' perspectives of how culturally relevant experiences made them feel and if they gained an understanding of the unit's objectives. To ensure validity questions were submitted and viewed by a panel of educators in the

Early Childhood Education field and curriculum and instruction specialists. Students were asked the following questions during the interview:

<u>Pre and Post Interview:</u>

1. Do you like science? Why or why not?
2. What is your favorite thing about science? Why?
3. What does an animal need to survive?
4. What does a plant need to survive?
5. If you could change anything about your science learning experience, what would it be and why?

Data Analysis

A mixed method of data analysis was used. Utilizing quantitative and qualitative data sources allowed determination of the impact culturally responsive approach has on student achievement and attitudes from different data points. Interview data was analyzed using the following process: (1) transcribing the interviews; (2) line by line coding; (3) open coding; (4) development of theme/concept map; and (5) finalization of themes. The interviews of individually were transcribed without the use of software. This allowed for the opportunity to gain a more meaningful understanding of the participants' feelings.

The interviews were coded line by line. Each line was analyzed to look for initial codes and whose initial codes were placed in the margins of the transcripts. Open coding was completed to highlight the participants view, note certain words and or phrases that occurred multiple times that assisted in narrowing down themes. Once the emerging themes were developed, a code book was utilized to capture the complete data analysis process used for the interviews.

Paired t-tests were used for comparison of understanding of unit concepts among groups before and after the completion of the unit. The test was used to determine the difference between the control and treatment group. Pre and post test data were analyzed utilizing SAS software.

Chapter Summary

This chapter provided synopsis of the mixed-method study which was designed to gain an understanding of how culturally responsive experiences impact students' achievement and interest in science education. The chapter presented procedures, participants, data collection and how the study was conducted.

Chapter 4

Findings and Results

A mixed methods research design was utilized to compare the results of teaching kindergarten science with culturally responsive instructional. Data was collected from twenty kindergarten students at a suburban, Midwestern elementary school. Both the control and treatment group consisted of ten students each. Students were taught using science instruction through two different teaching techniques. Qualitative data was collected using semi-structured interviews. Quantitative data was collected from pre and post mySci assessments. Participants in the study were given no incentive and identified by random number selection. In this chapter, the quantitative and qualitative results are presented addressing the research questions.

Research Questions and Hypotheses

R_1: To what extent do culturally relevant experiences learned in science lessons impact kindergarten students' understanding of content as compared to those lessons which do not include culturally relevant examples?

$R_{2:}$ To what extent is there a difference in the attitudes towards science expressed by students experiencing culturally relevant science instruction and those experiencing non-relevant instruction?

Null Hypotheses

$H_{01:}$ There is no significant difference between the achievement in science by kindergarten students experiencing culturally relevant science instruction and those experiencing traditional mySci curriculum as measured by the end of the unit assessment scores.

$H_{02:}$ There is no significant difference between attitudes toward learning science by kindergarten students experiencing culturally relevant science instruction and those experiencing non-relevant instruction as measured by interviews.

Directional Hypotheses

$H_{1:}$ There is a significant difference between the achievement in science conceptual understanding by kindergarten students experiencing culturally relevant science instruction and those experiencing traditional mySci curriculum as measured by the end of the unit assessment scores.

$H_{2:}$ There is a no significant difference between attitudes toward learning science by kindergarten students experiencing culturally relevant science instruction and those experiencing non-relevant instruction as measured by interviews.

Quantitative Results

Research Question 1: To what extent do culturally relevant experiences learned in science lessons impact kindergarten students' understanding of content as compared to those lessons which do not include culturally relevant examples?

Students' growth of science content was assessed by using the mySci end of unit assessment. The assessment was a combination of multiple-choice questions and performance tasks that ask questions in the following three categories, "Is it living, what is a plant and what is an animal" (Institute for School Partnership, 2022). Paired t-tests were performed to determine if there was a statistical difference between the two groups regarding their understanding of the concept in the mySci unit. The use of paired t-test provided an opportunity to view the difference between two variables at the same time. A measurement was taken two separate times, that being the pre-test and post-test assessment to compare the effect of the invention. Those scores were then compared Table 4.1 shows the results of the group assessments before and after the intervention. The average or mean score for the treatment group was 0.7090, while the control group has a mean of 0.7700. The mean score posttest for the treatment group was 0.9430, while the control group had a mean score of 0.9180. The mean scores for the pretest for the treatment and control group were similar, indicating that the participants in both groups had the same basic understanding of the concept. The posttest scores of the treatment, while not statistically significantly different indicated some growth in understanding of concepts taught during the unit after the intervention.

Table 4.1 Descriptive statistics for treatment and comparison groups: Pre-test and Post

	N	M			SD		
		Pre	Post	Difference	Pre	Post	Difference
Treatment Group	10	0.7090	0.9430	0.234	0.2413	0.0419	0.1994
Control Group	10	0.7700	0.9180	0.148	0.1938	0.1996	0.0058

Both groups demonstrated some growth after the unit was taught. Figures 4.1 and 4.2 highlight the growth of the groups after the unit of study was completed.

Figure 4.1

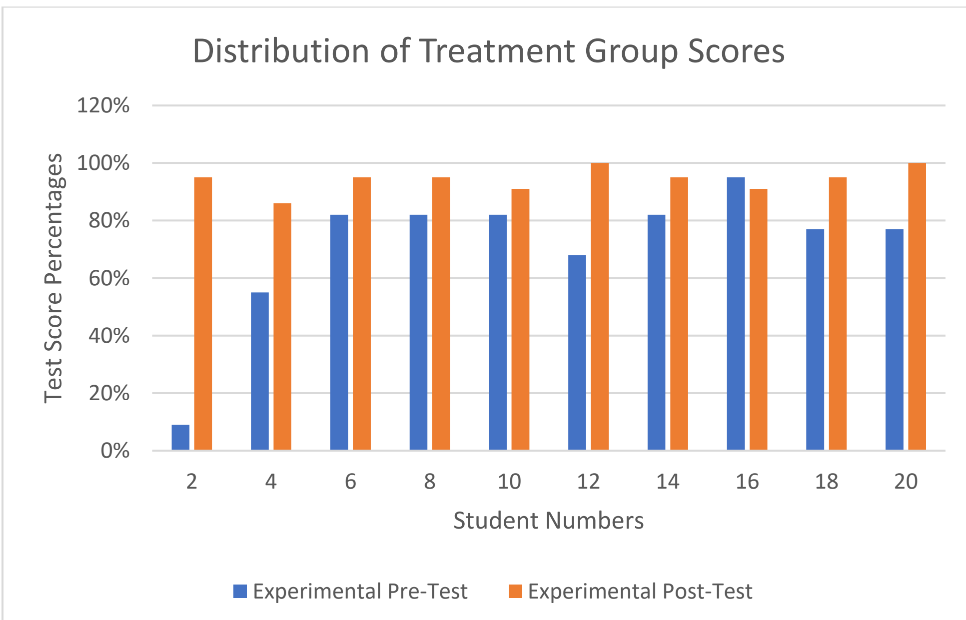
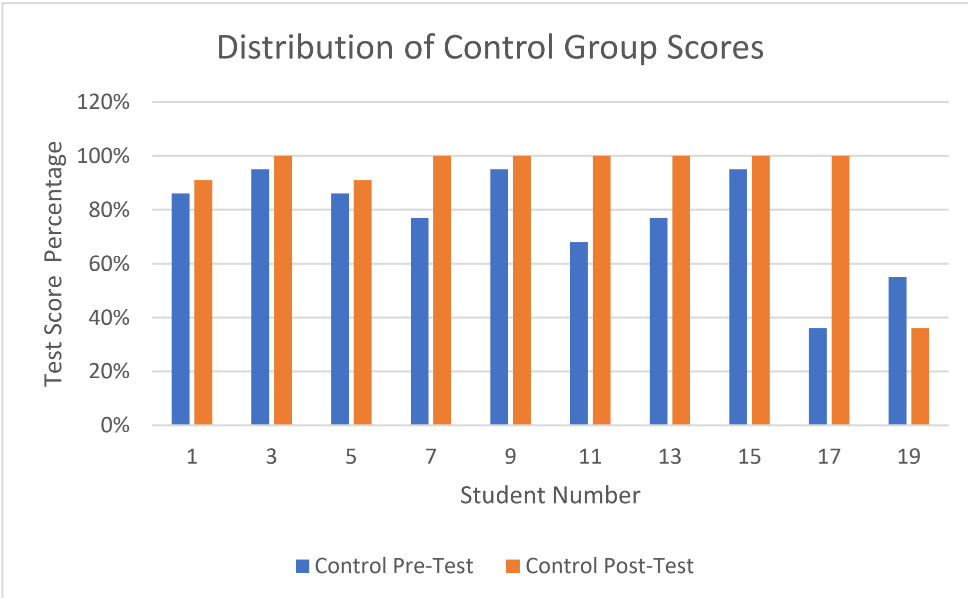


Figure 4.2

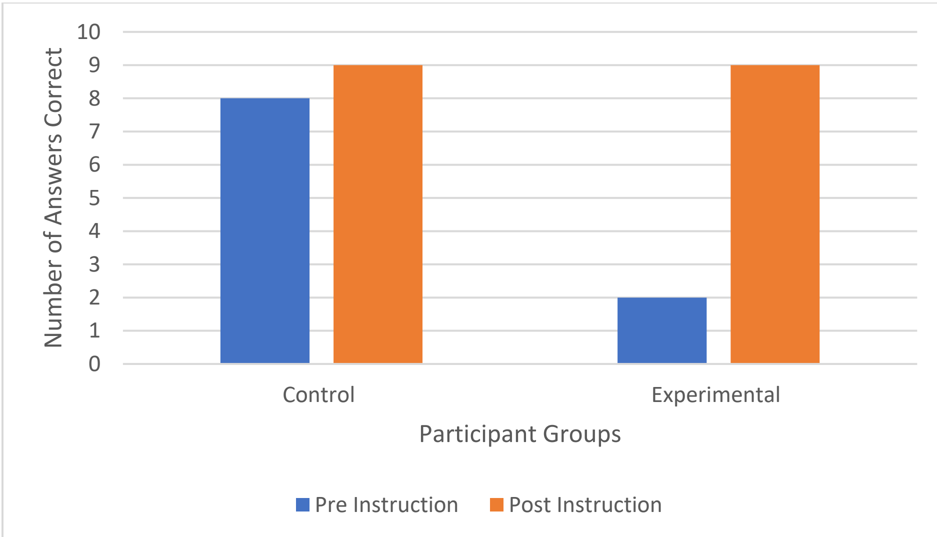


Though there were no statistical significance differences, the treatment and control pre-test scores displayed growth on their post-test assessment. Figure 4.1 highlights that after participating in the culturally relevant science lessons each student in the treatment group made academic growth, while the control group experienced both growth and loss of understanding on the posttest assessment.

During the interviews students in both the control and treatment groups were asked questions pertaining to the focus of the unit. Figures 4.3 and 4.4 show the participants' understandings pre and post intervention. The treatment group demonstrated growth in academic understanding after receiving the intervention.

Figure 4.3

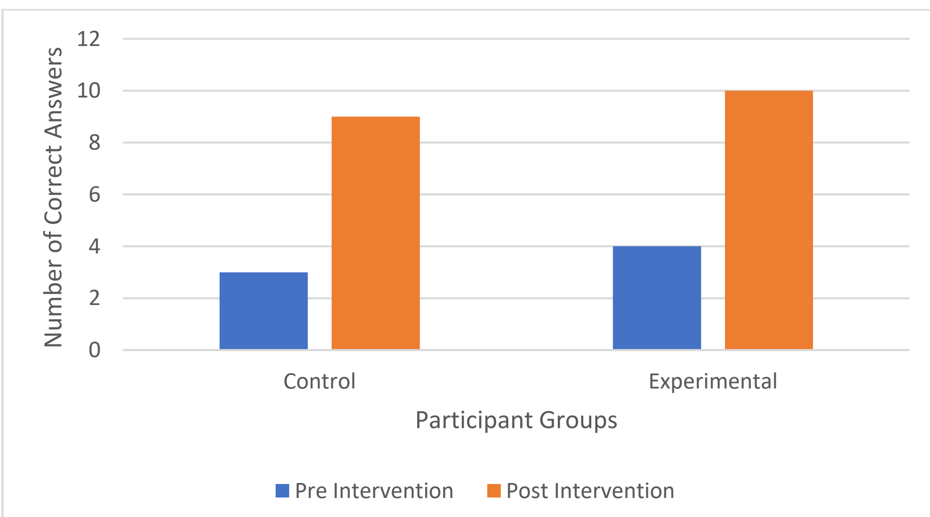
Participants Response Regarding Plant Needs



Note: Interview question read as follows, "What do plants need to survive?"

Figure 4.4

Participants Response Regarding Animal Needs



Note: Interview question read as follows, "What do plants need to survive?"

Table 4.2 Descriptive Shapiro-Wilk's statistics for treatment: Pre-test and Post-test

	N	M			SD		
		Pre	Post	P-value	Pre	Post	P-value
Treatment Group	10	0.7090	0.9430	0.234	0.2413	0.0419	0.1619

To ensure that assumption of normality was not violated the data was assessed using the Shapiro-Wilk's test. The treatment group pre-test p-value was p=0.0023 and post p-value p=0.1619, both p-values were less the 0.05, which indicates no statical difference. The treatment post science content assessment scores were higher M=0.9430 and SD=0.0419 after the implementation of culturally relevant science instruction compared to before the intervention M=0.7090 and SD= 0.2413. The mean increase indicates there was a change from the pretest assessment scores with the implementation of culturally relevant experiences. While quantitative results indicate no significant difference between groups science content knowledge, the qualitative results provided insight on how culturally relevant experiences positively impacted their learning experiences.

Qualitative Results

Research Question 2: To what extent is there a difference in the attitudes towards science expressed by students experiencing culturally relevant science instruction and those experiencing non-relevant instruction?

The utilization of student interviews provided an opportunity for candid discussions and self-reflections about student learning experiences on both science content knowledge and attitudes towards science learning. The pre and post student interviews were conducted with both the treatment and control groups. Both groups were giving the same set of questions during both the pre and post interviews. The data was coded, placed in a codebook (Appendix E) and analyzed to recognize themes connected to student attitudes and changes in science learning experiences. The predominant themes that emerged during the interviews with students were struggles in science and joys of science.

Joys in the Science Classroom

The first theme involved students sharing the joys of their science experiences. During the interviews students were comfortable with sharing the learning experiences during science and how those experiences impacted their attitudes towards science instruction. Many participants shared the importance of “playing” during science lessons and experiments with a hands-on approach. These experiences were shared with both the control and treatment groups. Students in the treatment group expressed their excitement about “doing” the Flower Lab. One student from the treatment group shared, “I like cutting open the flower and seeing what was inside.” Another student from the control group stated, “I like when we played with the animals during the sorting game.” Another student shared, “We did paper stuff, but we also got to touch real stuff.”

Providing students with the opportunity to engage in active science that is hands-on, meaningful, and relevant was significant because it created a space for students to become part of science instead of science happening to them. A student shared “we got a chance to help Dr. P. with her research.” Another student shared the importance of having the experience of working with the community garden club was, “fun because we helped the flower outside the school.” In early childhood the importance of “doing” was highlighted during these interviews with the students. Students from the control expressed their enjoyment doing the activities, but wanted more chances to pick what they did. A student from control said, “I watched you go outside in the garden with the plants, and I wanted to dig in the dirt to see roots too.” Another student shared, “We had some fun in the classroom, but outside and playing in the dirt would have been fun too.” It was powerful to hear from students who these small opportunities to make relevant connections to the unit increased attitudes, engagement and feeling towards science. Those statements highlighted how relevant experiences and opportunities to participate in relevant experiences can impact how students feel about science.

Struggles in the Science Classroom

The first theme connected to student attitudes towards science was the struggles students faced both inside and outside the classroom. Struggles in science included repetitive lessons, the desire for a home school connection, and teachers giving a lecture with little to no time to explore materials. Several students shared that they enjoyed science, but they did not like it when lessons were repetitive with no clear connections to prior knowledge or learning. A student shared, “I don’t like when we do the same lesson over and over again because it makes class, so boring.” When asked to elaborate on what that would look like the student stated, “When the teacher reteaching something we learned the day before, but we don’t get chance to do anything new.” This honest answer highlights the importance of two things: one making relevant and meaningful connections to the review of a lesson. It is important to ensure that students understand how the learning from the day before will impact the learning happening currently. Whereas giving students a brief overview of previous learning, make sure time is allowed to connect with materials in new and relevant ways.

During the interviews the topic of family support and lack of confidence when completing science activities was stated several times. Students said they wanted to do more science activities at home with their families, but often were told no because of the lack of experience of parents. With little opportunity to connect science learning at school with home, many students stated they were not sure if they would be good at science, but they expressed how much they liked science class. One student shared, "I wanted to science at home with my mom, but she has to work and said she does not know how to do science." When the same student was asked if they like science he replied, "Yes, but I don't know if I am good because no one does science at home with me, like we do math or reading." Tenenbaum and Leaper (2003) suggest that parent beliefs about science can significantly influence a child's interest and motivation in science. These findings suggest that attention should be given to educating families on how they can integrate science conversations and activities into their daily lives to encourage positive attitudes towards science.

Chapter Summary

While the quantitative data did not indicate a significant statical differences from the pre-intervention to the post intervention between the control and treatment groups the qualitative data validates the importance of culturally relevant experience in science classrooms. The qualitative data suggests that students' negative experiences with science provided them with language to express what they want science to look and feel like in the classroom. They stated that the lack of family support, repetitive lessons and no choice negatively directly affected their attitudes towards science.

Providing students with culturally relevant experiences such as working with real scientists in the field increases positive attitudes towards science. Students in the treatment group stated they felt validated and affirmed through the culturally relevant experiences. One student shared, “I like science because I can do science now.” Another shared, “I saw real scientists and she was a girl, like me!” Results also indicate that students prefer to be engaged with their science education by “doing” or “playing” with the material being presented. The students found the most connections to learning when they were allowed to “do” the science instead of the science being done to them. The culturally relevant focused experiences allowed the treatment students to see themselves in the science content and curriculum, which allowed the opportunity to highlight their strengths and weaknesses when participating in the science classroom.

Chapter 5

Chapter 5 discusses the connections between the literature review and research findings, the possible implications of the research, limitations of the research and a conclusion regarding the research questions. Using mixed methods, the impact of a culturally relevant approach on science education in a kindergarten classroom was examined. The qualitative component captured the learning experiences of students, experiencing culturally relevant instructional strategies and provided them with an opportunity to see themselves in the science field.

Data collection included a knowledge-based pretest, post-test and twenty semi-structured interviews that helped to find out elementary students attitudes toward science. Participants were selected because they were a sample of convenience, all participants were kindergarten students in the same school experiencing the mySci curriculum. All semi-structured interviews followed the same protocol and utilized the same question before and after the invention. The study attempted to answer the following questions:

1. To what extent do culturally relevant experiences learned in science lessons impact kindergarten students' understanding of content as compared to those lessons which do not include culturally relevant examples?
2. To what extent is there a difference in the attitudes towards science expressed by students experiencing culturally relevant science instruction and those experiencing non-relevant instruction?

Implications of Culturally Relevant Approach Toward Learning Science Content

Current research suggests that providing students that are linguistically and ethnically diverse with culturally relevant opportunities can increase academic achievement (Gay, 2000; Ladson-Billings, 2009). While this sentiment is being shared in the educational field there is little literature to demonstrate how to utilize this approach within the early childhood classroom regarding science education. The control group began the unit with higher scores than the treatment group and there could be several factors that led to that. One factor that may be the prior knowledge of the students in the control group was greater than the treatment group. Students in the control group may have had more experience and exposure to the objectives covered in the unit. Another factor that may have contributed to the difference was the distribution of the test. Students took the test using the platform Canvas and some extra directions or redirection may have been given to the control that were not given to the treatment group. The quantitative statistical results indicate that a culturally relevant approach does not significantly increase students' science achievement. The results of the qualitative interactions, suggest that more research focused on culturally relevant approaches in science education in an early childhood setting may reveal a need for incorporation of culturally relevant strategies to increase student interest and attitudes toward science.

Implications of Culturally Relevant Approach on Student Attitudes

The qualitative component focused on the impact a culturally relevant approach has on kindergarten students' science education. Culturally relevant teaching provides students with an opportunity to affirm and bridge their culture within their educational experiences (Gay, 2000; Ladson-Billing, 2009). Teachers who utilize the culturally relevant teaching pedagogy provide students with an educational experience that really reaches the whole student. Gay (2000) shares that the pedagogy cultivates cultural integrity, individual student abilities and academic success (p. 46). The current literature is limited as to how this instructional approach affects kindergarten students' attitudes towards science education. The qualitative results of this study support students in the treatment group's attitudes towards science education were overall more positive than the control after receiving culturally relevant instruction. The control shared some positive experiences, while also expressing the need for more choices during science learning opportunities.

During the interviews students expressed the joy and importance of "playing" or "doing" science. The opportunity to engage in relevant hands-on science allowed students to find real world connections to what they were learning. Completing the flower lab lesson and working with a scientist in the garden provided experiences that resonated with students and positively affected their attitudes towards learning science. Students also shared how their teacher impacted how they felt about science class. One student shared, "I got excited about science because my teacher was excited about science." Figure 4.4 highlighted the understanding of what plants need to survive. Pre-intervention, the control and treatment group add similar prior knowledge connected to the content. Post-intervention, both groups grew and had equal growth when answering questions pertaining to animal needs, but the treatment group grew more, but not statistically significantly different. A reason for this could simply be that the control population had strong prior knowledge of the topic. Teachers must realize their negative attitudes and bias about science directly impacts students' attitudes. It is important for the effort to be made to ensure that there is an investment in instructional strategies, like culturally relevant teaching to help foster positive relationships with science for both students and teachers.

Implications for Future Research

Upon the completion of research three main takeaways presented themselves. The first takeaway involves responsive instruction and planning. Using responsive instruction within the classroom setting requires educators to actively plan for responsive opportunities for scholars. The second takeaway involves having a responsive classroom climate. This requires educators to change their mindset and language when engaging scholars within the classroom. Lastly, responsive teacher leadership is key to providing a responsive environment. It would be beneficial for educators to have leadership within the building who can support and assist with planning and creating an environment that focuses on responsive teaching.

Support for the takeaways needs to happen at both the district and classroom level. The district level can support educators by creating more opportunities for relevant PD centered around relevant science experiences. Investing in STEM and science education in the early childhood setting and making science instruction a priority for all students and each grade level. At the classroom level, educators can engage families in science instruction often. This could be as simple as having science nights or include easy to do science engagement kits for families to complete at home. Integrating scholars in the planning process can provide educators with insight on their misconceptions and current interests. Lastly, using the science curricula as a resource to help guide the science instruction within the classroom. Science curricula can be used support to outline the objectives needing to be taught, but should not limit providing scholars with an opportunity to engage in additional learning experiences not outlined in the curricula.

Currently there is research that shares results supporting the use of culturally relevant science in secondary and college education, but limited research on the impact of the instruction strategy on kindergarten students. It is important to note that culturally relevant teaching is often considered an instructional strategy historically used for students of color. Studies in the future should explore the impact of culturally relevant teaching in several kindergarten classrooms across various districts. This would provide a better opportunity to have a larger sample size and an opportunity to see the impact in a variety of educational settings, such as urban, rural, and suburban schools.

In addition to culturally relevant lessons inside the school it can be beneficial to engage students' families in their science education. Providing families with an opportunity to see evidence based instructional strategies with relevant hands-on experiences with their children can positively influence attitudes and academic achievement.

Conclusion

The goal of using culturally relevant pedagogy in science classrooms is not to just increase a diverse population of scientists. The goal is to develop scientists who are affirming and making conscience decisions about providing students with relevant hands-on science. The idea of providing all students with relevant science demands the implementation of new strategies and pedagogies that challenge not only the students, but also the way teachers see themselves in the science classroom. The use of a culturally relevant approach in the science classroom validates and affirms, while transforming students' learning experiences. As a teacher, need to see a physical manifestation of your students' dreams and the use of culturally relevant teaching allows students to make their manifested dreams into reality.

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Appendix A

Parent Letter

LETTER TO PARENTS

Dear Parents/Guardian:

This letter is to inform you that a research study is being conducted in your child's classroom as part of a doctoral dissertation. My research study is titled The Impact of a Culturally Responsive Approach in Science Education on Kindergarten Students. The purpose of this research is to examine the impact of teaching strategies that incorporate a student's culture. This research will explore the effective practices of two Kindergarten teachers and their approach to teaching science to kindergarten students. The study seeks to gain a deeper understanding of how to approach educational challenges students face as well as gain a framework detailing how culturally responsive teaching can provide an effective strategy to increase engagement and achievement of students in science education.

To gather data regarding the effectiveness of the strategies and instructional practices used by the teachers in the classroom, students will take a survey, be interviewed, and take science assessments aligned with the current science curriculum. The surveys and interviews will take place during the regular school day and will last 5-10 minutes. Students will answer questions about their interests/attitudes towards science, and STEM careers. The control group will participate in science instruction as written in the mySci teacher manual. The intervention group will receive mySci science instruction with the addition of culturally responsive strategies, such as discussion protocols and movement. Students in Mrs. Rice will be part of the control group and students in Ms. Hite's class will be in the intervention group.

I will take multiple precautionary measures to protect the privacy of participants. As part of this effort, the identity of participants will not be revealed in any publication or presentation that may result from this study. All identifying information will be removed from the data. The data will be stored securely for a period of up to three years on password protected computers that operate behind a firewall and are only accessible by the researcher. After three years, all data will be permanently deleted. The online survey will be taken anonymously on a secure network with no collection of identifying information, therefore, individual responses to specific survey questions will not be identifiable.

Student participation is voluntary, and they may choose not to participate in this research study or withdraw consent at any time. They will NOT be penalized in any way if they choose not to participate or withdraw. Some of the activities used during the research are part of a normal classroom routine. While those activities are not voluntary the use of student's data for research purposes is voluntary. The results will serve as an opportunity to gain knowledge and an understanding about the benefits of using culturally responsive teaching practices in science education.

If you agree to allow your child to participate in the study, please sign the parent consent form. Please place the signed consent form in the provided envelope and return it to your child's teacher. If you do not consent to allow your child to participate in the study, you do not need to return the form. Your child will receive no penalty for not participating in the study and their grades will not be impacted.

If you feel that you need more information or if you have any questions regarding the study, please contact Monique Hite-Patterson, research investigator at hitemj@umsytstem.edu or my research advisor, Dr. Helene Sherman at shermanhe@umsystem.edu.

Thank you,

Monique Hite

Researcher

Appendix B

Informed Consent for Participation in Research Activities (Parent Letter)

UMSL

Department of Education

One University Boulevard
St. Louis, Missouri 63121-4499
Telephone: 314-516-4970
E-mail: hitemj@umsystem.edu

Informed Consent for Participation in Research Activities

The Impact of a Culturally Responsive Approach in Science Education on Kindergarten Students.

Participant ________________________ HSC Approval Number ____________________

Principal Investigator: Monique Hite PI's Phone Number: 314-290-xxxx

Summary of the Study

This is a brief description of the project:

This research will explore the effective practices and approaches to teaching science to kindergarten students. There is no compensation for participation in the study. Your participation is voluntary, but your participation will contribute to the academic literature focused on teaching pedagogy and strategies' impact on student achievement and engagement. Your child will be asked to participate in two surveys (pre and post) and two interviews (pre and post) lasting between 5-10 minutes. Additionally, your student will engage with the district science curriculum for 30 minutes 3 times a week. Participation will also include classroom observations during science instruction. Additionally, I am requesting permission to obtain pre- and post-test scores and work samples from his/her teacher. The researcher is the only person who will have access to the information collected from the study. All data and observational notes will be stored in a password-protected file and paper files will be locked in a cabinet. Upon completion of the study, collected data and other information will be destroyed. Numbers will be used for identification purposes when generating written material because of the study. Our student may experience "minimal risk" due to participation. The U.S. Department of Health & Human Resources defined "Minimal Risk" as: the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily lifer or during the performance of routine physical or psychological examinations or tests". Some of the activities used during the research are part of a normal classroom routine. While those activities are not voluntary the use of your child's data for research purposes is voluntary.

1. You are invited to participate in a research study conducted by Monique Hite for a doctoral dissertation under the supervision of Dr. Helene Sherman. The purpose of this research is to examine the use of culturally responsive teaching during science instruction in kindergarten

classrooms. This research will explore the impact of using a student's culture, experiences, and knowledge during science instruction. The study seeks to gain a deeper understanding of how to approach educational challenges students face as well as gain a framework detailing how culturally responsive teaching can provide an effective strategy to increase engagement and achievement of students in science education.

2. a) Your participation will involve

Assessments: Students will take a pretest and posttest after completing the mySci unit. This completion of assessment follows the district's guidelines in conjunction with the science curriculum.

Surveys and Interviews: Students will participate in pre- and post-survey surveys and interviews. Surveys and interviews will take place during the academic school day during an agreed upon time with both classroom teachers. Interviews will take place during the academic school day during an agreed upon time with both classroom teachers. Both the surveys and interviews will take 5 to 10 minutes to complete. Interviews will be audio recorded to translate for further coding. Surveys and interviews will be conducted in the conference located in the main office at Jackson Park. All surveys and interviews will be conducted by lead researchers.

Classroom Instruction: Students will participate in weekly mySci lessons during the school day. The lesson will last approximately 30 minutes and occur 3 days a week. Students will complete lessons within their assigned classrooms.

Participant assignment: Students who are assigned to Mrs. Rice's classroom will participate in mySci science curriculum without any instructional changes this will be the control group. Students who are assigned to Mrs. Hite's classroom will participate in mySci science curriculum with the addition of culturally responsive instructional strategies this will be the intervention group. Some of those strategies include, but are not limited to a workshop model, discussion protocols and movement during instruction.

End of Unit Task: All students will complete an end-of-unit project. Students will complete their project following the rubric provided.

Approximately 40 kindergarten students may be involved in this research at the University of Missouri-St. Louis

The amount of time involved in your participation will be 5-10 minutes for surveys and interviews, 5-10 minutes for assessments and 30 minutes of science instruction 3 times a week for approximately 10 weeks and you will receive no compensation for your time.

3. There is a loss of confidentiality risk. The risk will be minimized by using a randomized number system to identify participants instead of names.

4. There are no direct benefits.

5. Individual research results will be disclosed to participants in the condition of receiving their pre and post data via Canvas, progress reports and report cards. No other research results will be disclosed to participants.

6. Your participation is voluntary, and you may choose not to participate in this research study or withdraw your consent at any time. You will NOT be penalized in any way should you choose not to participate or withdraw. Some of the activities used during the research are part of a normal classroom routine. While those activities are not voluntary the use of your child's data for research purposes is voluntary.

7. We will do everything we can to protect your privacy. As part of this effort, your identity will not be revealed in any publication that may result from this study. In rare instances, a researcher's study must undergo an audit or program evaluation by an oversight agency (such as the Office for Human Research Protection) that would lead to disclosure of your data as well as any other information collected by the researcher.

8. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Monique Hite 314-290-xxxx or the Faculty Advisor Dr. Helene Sherman at 314-650-xxxx. You may also ask questions or state concerns regarding your rights as a research participant to the Office of Research, at 516-xxxx.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I hereby consent to my participation in the research described above.

Participant's Signature	Date
Signature of Investigator or Designee	Date

Appendix C

Minor Assent

UMSL

Department of Education

One University Boulevard
St. Louis, Missouri 63121-4499
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Assent to Participate in Research Activities (Minors)

The Impact of a Culturally Responsive Approach in Science Education Kindergarten Students.

1. My name is Monique Hite.

2. I am asking you to take part in a research study because we are trying to learn more about how to make science more fun.

3. If you agree to be in this study, you will take a test before we start science and after we finish our science unit. You will also be asked to complete a survey and interview. During the survey you will select an emoji that matches how you feel about the question. During the interview you will answer questions that I asked you. I will record your answers, so there is nothing for you to write. Lastly, you will participate in science lessons during the school day and complete a project after we finish the unit.

4. There are no known risks (things that can harm you) associated with this research other than the potential for mild boredom or fatigue.

5. The possible benefits to you from this research are feedback (help) while completing or participating in science instruction.

6. Please talk this over with your parents before you decide whether to participate. I will also ask your parents to give their permission for you to take part in this study. Even if your parents say "yes," you still can decide not to do this.

7. If you don't want to be in this study, you don't have to participate. Remember, being in this study is up to you, and no one will be upset if you don't want to participate or if you change your mind later and want to stop.

8. You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me at 314-290-xxxx or ask me next time.

Appendix D

Interview Questions

Pre-Interview Protocol

Interviewer: (insert name here)

Student's Name: __________________

Date of Interview: _________________

Introduction:

Hello, my name is Ms. Hite, and I am a Kindergarten teacher here at your school. Today you are going to talk to me about your science learning experiences. Your ideas will be used to help with my research and help with gaining more information about types of things that increase student learning during science lessons.

Guidelines:
We are taping the interview because we don't want to miss any of your ideas about science.

Do you have any questions?

Interview Questions:

1. Do you like science? Why or why not?
2. What is your favorite thing about science? Why?
3. What does an animal need to survive?
4. What does a plant need to survive?

Wrap-Question:

5. If you could change anything about your science learning experience, what would it be and why?

Post- Interview Protocol

Interviewer: (insert name here)

Student's Name: ___________________

Date of Interview: __________________

Introduction:

Hello, my name is Ms. Hite, and I am a Kindergarten teacher here at your school. Today you are going to talk to me about your science learning experiences. Your ideas will be used to help with my research and help with gaining more information about types of things that increase student learning during science lessons.

Guidelines:
We are taping the interview because we don't want to miss any of your ideas about science.

Do you have any questions?

Interview Questions:

6. Do you like science? Why or why not?

7. What is your favorite thing about science? Why?

8. What does an animal need to survive?

9. What does a plant need to survive?

Wrap-Question:

10. If you could change anything about your science learning experience, what would it be and why?

Appendix E

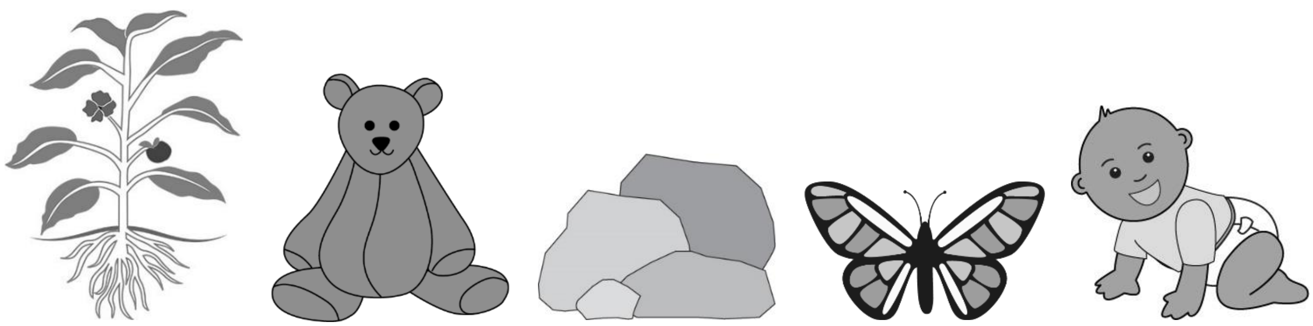
mySci Assessment

Section 1 Pre/Post Assessment

Unit 1 | Section 1: Is it living?

Name: Date:

1. Put a circle around the pictures of things that are living.



Plant Toy Bear Rock Butterfly Baby

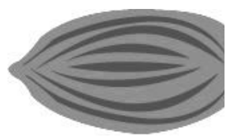
Section 2 Pre/Post Assessment

Unit 1 | Section 2: What is a plant?

Name: Date:

1. Circle all the pictures of the things that are seeds.





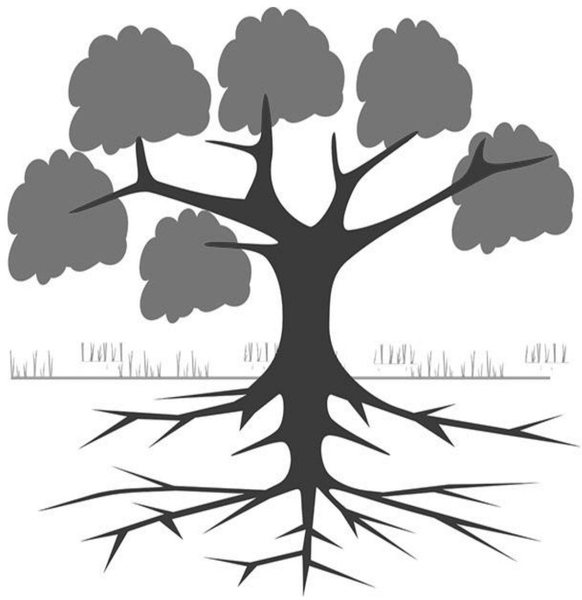
Marble Popcorn Nut Penny Beans

2. For each picture draw a line from the word to the part of the plant:

STEM

LEAF

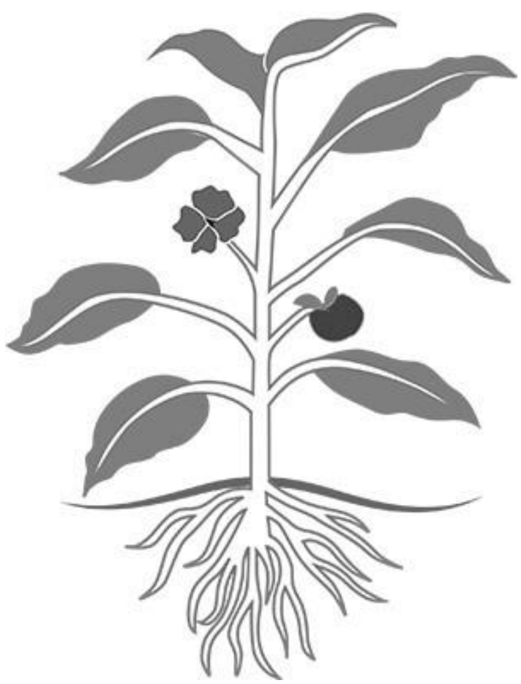
ROOTS



STEM

LEAF

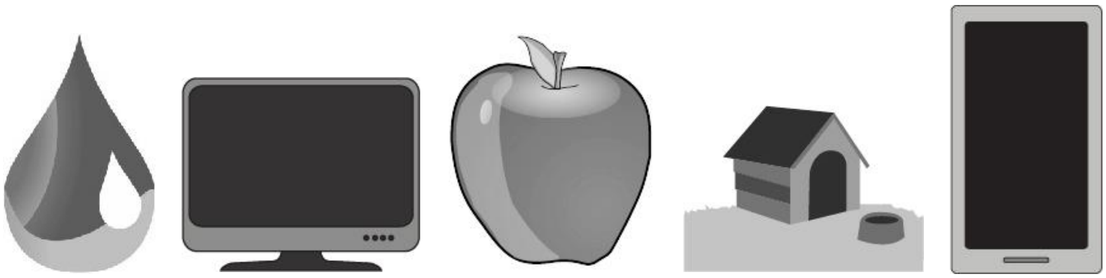
ROOTS



Section 3 Pre/Post Assessment

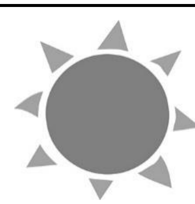
Unit 1 | Section 3: What is an animal?

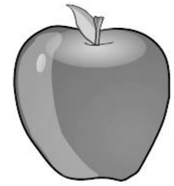
1. Circle the pictures of the things that animals need in order to live and grow.



Water TV Food Shelter Phone

2. The data table below shows what different things need to live and grow.

	 Needs water?	 Needs light?	 Needs food?
 Plant			

 Animal			
 Toy Bear			

Circle the things that animals need to live and grow.

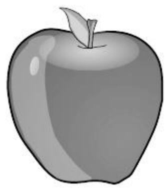
FOOD WATER LIGHT

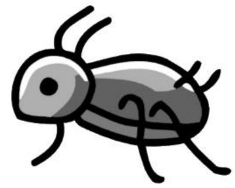
Circle the things that plants need to live and grow.

FOOD WATER LIGHT

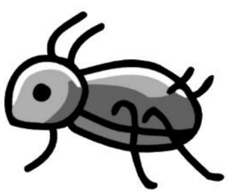
3. Jenelle did an experiment to see what kind of food her cricket liked best.

She set two different types of food out and wrote an X each time the insect ate the food. Here is what she saw:

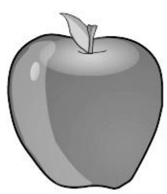
 APPLE			
X	X	X	X
X	X	X	

 APHID			
X	X	X	

Circle the food the cricket liked the best.



APHID



APPLE

Circle the sentence that says what the cricket eats.

a. Crickets eat only plants. 

b. Crickets eat only animals. 

c. Crickets eat plants and animals.