EXPLORING DIVERSE RURAL ELEMENTARY STUDENTS' INTERESTS AND CONCERNS OF THE FOOD SYSTEM AFTER PARTICIPATING IN A VIRTUAL AGRI+STEM EXPERIENCE

by

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To My Village…

To my "Granny", Dorothy D. Flowers-Wilson:

My first Ag. Educator, teacher, biggest cheerleader, and friend... This work is dedicated to you as you are the basis of #MyAgStory and the inspiration behind the development of the curriculum I created for this study. Little did I know, those hours in the garden, those hours in the sun, and the experience of watching you can the goods we grew would turn into the very research that I designed to empower others… Those who don't have a MaDorothy or a SistaMae in their corner. You taught me culture through the love of family; community through your numerous engagements as a church secretary, executive board member, and overall servant to provide service in the corner of the world we call home; and career in the most hidden ways possible, by showing me how food is not only necessary FOR all but that it can be used to CONNECT all. While you may not have had the resources for a college degree, your life experience and work earned you a Doctorate in a few disciplines. You raised generations of children that weren't even yours, you kept homes while supporting your own, and you fed families to the point that years later they were still coming back for your famous dishes. I could go on, but I will end it here, you were a Southern Renaissance Woman, an agriculturalist in your own right, a business leader (if I ever saw one), an educator of all, a lover of God, Prayer warrior… But MOST of all, you were LOVE and you were my "Granny" and as 2021 marks what would have been 100 years of you, your legacy will forever live on through this work, through me, our family, and the lives that I touch with what you gave me.

"Ryan… get that education, because can't nobody take that from you or out of your head…. Learn as much as you can and make HOME (communities) better."

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ABSTRACT

STEM education is a top priority in the educational development of youth across the United States as the country tries to address the need of having a more well equipped, prepared, and educated workforce. Agriculture, food, and natural resources (AFNR) has the ability to provide a relevant context for engaging students in STEM education through experiential learning. Tragically, both STEM and AFNR struggle to reach and engage more diversified audiences, especially students of color. AFNR education provides an authentic avenue to center STEM engagement around addressing societal grand challenges like food and nutritional security, childhood-obesity, and climate change; issues faced by all communities. The approaches and steps taken to address these AFNR related grand challenges can all be explored through the lens of food systems. Food systems is a concept within AFNR that encompasses the interdisciplinary components of AFNR, STEM, and social sciences that provides a breakdown for the process and system involved in getting food from farm to fork. In an era where youth are more disconnected from understanding where their food comes from, food systems education has the ability to reconnect youth to the root of this issue and the potential to lead them to explore finding solutions to the grand challenges facing their generation. Furthermore, food systems education provides a context to engage youth in authentic learning experiences in nonformal and formal classroom settings around relevant issues with the potential to enhance their interests and concerns around these topics.

The purpose of this study was to explore and describe elementary school students' interests and concerns about the food system, and their overall engagement in the learning experience after participating in an authentic learning based Virtual Agri+STEM Camp focused on food systems education, AFNR, and STEM activities. The convenience sample for this study was made up of elementary school students between grades 3rd and 8th grade (*N* = 99) who were either in the classroom or participating in an at-home Agri+STEM session. The majority of these students were from rural communities and most of them were African Americans. Quantitative data was collected before and after participation in the Virtual Agri+STEM Camp experience that using the research developed Food System Interest and Food System Concern instrument. Previous AFNR related experiences were also reported by students. The researcher also used an adapted version of the Intrinsic Motivation Inventory (IMI) and STEM Semantics survey to measure student

engagement and attitudes after participating in the experience. Descriptive statistics were used to analyze the data, which included means, standard deviations, frequencies, and percentages. To explore the relationships between each of the variables, correlations were also computed.

There were four conclusions for this study. First, students that participated in the Virtual Agri+STEM Camp were motivated and engaged in the learning process while doing the Agri+STEM Camp activities. Second, students that participated in the Virtual Agri+STEM Camp were interested and concerned about the food system before and after participating in the Virtual Agri+STEM Camp. Third, African American student participants reported less previous AFNR experiences, yet they reported more interests and concerns in the food system than Caucasian American participants before and after completing the Virtual Agri+STEM Camp. Lastly, Students that felt more competent, saw the value, and were interested/enjoyed the Agri+STEM experience were more likely to be interested and concerned about the food system. Recommendations for future research and implications for practice and policy were discussed.

CHAPTER 1. INTRODUCTION

1.1 Introduction

Authentic learning strategies can be used to reconnect K-12 students who have been historically disconnected from the food system to be more engaged, interested, and concerned about the food system and food related issues in their communities. Knowledge, especially scientific knowledge, grounded in authentic experiences can be used to address societal challenges in students' communities and empower them to become collective agents of change in the food system. Three factors should be considered when engaging K-12 students in learning about the food system through science, specifically in the age of "social distancing". First, real-life and hands-on experiences in the food system are essential as consumers live in more industrialized world and are more likely to be removed from interacting directly with the food system (Cairns & Johnston, 2018). Second, the field of science education is constantly changing and ever evolving as new concepts, ideas, and methods of education emerge. Educators continue to experience an increase in the availability and capabilities of technologies. New challenges in the COVID-19 era, such as social distancing measures and virtual education has generated the need for increased technology and methods for reaching students beyond the walls of the classroom. Lee and Campbell (2020) pointed out that some of the effects brought to light and highlighted because of COVID-19 specifically "present opportunities to envision a new normal" for science education in the K-12 context (p. 942). COVID-19 makes it more challenging for placed-based and hands-on experiences with the food system, yet this is an opportunity for educators to envision hands-on learning in a new way. Finally, Kuhn (1970) defines science as "a human endeavor striving towards a better way of explaining scientific phenomena through experimental and theoretical investigations" (Lee & Butler, 2003, p. 923). The means of advancing science is connected to scientific inquiry, which acts a vehicle bringing about further knowledge and in-depth understandings of science itself. Within the past two decades, science education reform has called for the prioritization of scientific inquiry as a better mechanism to engage in teaching and learning about science in classrooms on the K-12 level (National Research Council, 2000, 2013). Since that time, there has been a plethora of efforts dedicated to promoting scientific inquiry in classrooms, specifically with regards for authentic learning methods (Israel et al. 2013; Lee & Butler 2003; Lederman & Lederman 2019).

Caseley (2004) explained that “authentic learning is a pedagogical approach that allows students to explore, discuss, and meaningfully construct concepts and relationships in contexts that involve real-world problems and projects that are relevant to the learner” (p. 12). It is within an authentic learning environment, students are engaged in learning problems that create connections between the information and materials being learned along with their prior knowledge (Knobloch, 2003). Newmann and Associates (1995) outlined standards for authentic pedagogy, which included: “1) Higher-Order Thinking, 2) Depth of Knowledge, 3) Connectedness to the World Beyond the Classroom, and 4) Substantive Conversation” (p. 3). With these standards, authentic learning is situated to provide a meaningful learning experience in a more relevant and engaging way.

These forms of relevant and engaging education strategies are needed even more for when looking at students with limited access to high quality educational resources and supports. Students from high poverty areas are often mainly exposed to teaching and learning that is often primarily focused on the drilling of information through lectures for regurgitation and based in low level curricula, leaving students with little to no opportunity for true application (Barton, Koch, Contento, & Hagiwara, 2005). To many students, the learning experience has been memorization and responding to a disseminator of knowledge which results in limited relevance of the content they are expected to learn (Zessoules & Gardener, 1991).

From a constructivist perspective, students learn by engaging with the real world outside the classroom and constantly analyze and reinterpret new knowledge and how it relates to the real world (Brown et al., 1989; Lave & Wenger, 1991). Instruction that brings the real world into the classroom through a meaningful context is key to promoting learning (Knobloch, 2003). When the teaching and learning of science becomes relevant to the lives of both students and teachers, science education then has the ability to empower those that it touches (Coleman & Leider, 2014). Basu et al. (2009) spoke of education as “a process of developing a critical consciousness with respect to context, with the power to transform reality, positioning the learner as a growing member of a community, with expanding roles and responsibilities” (p. 355). By taking on this task, educators not only make learning more relevant to students, but they position them to be potential agents of change in their community.

By giving learners the opportunity to build connections from their school learning and classroom experience to their lived experience in their everyday life, educators give students the agency and ability to enhance their world and their learning experience in school. John Dewey (1916) once said, “from the standpoint of the child, the great waste in school comes from their inability to utilize the experience they get outside while on the other hand they are unable to apply in daily life what they are learning in school. That is the isolation of the school—its isolation from life” (as cited by Caseley, 2004, p. 1). Instruction that truly builds on the prior knowledge of students and their values, interests, and concerns can be used as a way to give them buy-in and ownership of their own learning experience. This is what authentic instruction can look like. In order for science education to be authentic, instruction and other activities must bring practices normally seen outside of the classroom in the “real world” into the context of the science learning experience to help build community connections that will make learning more relevant to what students already know (Rahm et. al., 2003).

The use of food and food systems as an approach Food based education, including food systems related learning, can be used as a way to make learning authentic and as a means to make overall science instruction project-based. Furthermore, it has the potential to be meaningful to students by capitalizing on their lived experiences and connections to food. Survival is not the only thing that eating is good for, it is a sociocultural action that all people, including youth, engage in that gives people own unique experience and personal story. Science instruction centered around food-based issues and societal/community challenges that are relevant to youth has the ability to present an authentic learning problem while also catching the interest of students.

Barton et al. (2005), in their study on the thoughts of urban youth around the food system, pointed to the relevance and usefulness of utilizing food as a context to teach STEM in elementary grade levels, specifically science. Since the overall basis of food is rooted in being a hands-on and an authentic entity, it is a familiar to all people especially youth. Furthermore, the use of food as a context for STEM literacy, especially with regards to science, can make learning in these areas a more realistic goal by giving all youth the opportunity to experience scientific inquiry in a context that is relevant to their daily lives.

This is important to note because as science continues to be taught in an abstract way that is distant from the experiences of many young people, and not in contexts relevant to their sociocultural lived experiences students tend to become uninterested and unengaged in the learning experience and overall in their school experience (Rodriguez, 1997). Barton et al. (2005) also shared that it is critical that we have a "greater global awareness of the importance of teaching about food in elementary science education in ways that link food with its impact on both the body and the continued sustainability of the natural environment" (p. 1183).

Inquiry-based science education around food centered in authentic pedagogy has the capacity to engage students to learn, question, and develop competencies around issues of the food system like human health, food safety and processing, environmental issues and more. This is aligned directly with the Next Generation Science Standards (NGSS), which aims to help students learn ideas, practices and overall knowledge around scienc. (NRC, 2012). Ultimately, the best use of authentic learning is rooted in its how it is able to engage students and trigger intrinsic and innermost motivation (Casely, 2004). Even with these findings, there is not much to draw from the literature that gives insight to the understanding and potential concern of youth who live in high poverty areas. Furthermore, it has yet to be explored how youth process thoughts about food specifically in connection to food systems which encompasses the growing of food, it's post-harvest practices, product development, and distribution; furthermore, the effects of these practices on the environment have are not often explored by elementary audiences (Barton et al., 2005). Engaging youth in science education authentically in the context of food or food systems opens up the opportunity for students to be more concerned about and interested in the food system and where their food comes from.

This type of science education and instruction has the capacity to make learning more relatable and interesting through motivating, hands-on activities. It is becoming increasingly paramount to explore and analyze the success of educational strategies centered around developing student motivation, especially when it comes to STEM related topics (Rosenzweig & Wigfield, 2016). Therefore, the researcher believes that using an authentic learning based approach to Agri-STEM education can help increase student motivation and interest in STEM+Agriculture, Food, and Natural Resources (AFNR) subjects and increase their ability to think in an integrated way.

1.2 Statement of Research Problem

Over the past few decades, instruction in STEM related fields has increasingly become a top priority in American education because of the high demand for skilled professionals in these areas. However, few students are actually equipped and knowledgeable to fulfill this need

(National Science Board, 2014). When comparing the scientific and mathematical skills of U.S. students with those of students from other countries, the lack of proper education in these areas becomes more evident. While the U.S. has historically been known to be an educational powerhouse, current reports show that the country is lagging behind other developed nations. For example, when looking at international test scores among participating nations, it is noted that 15-year old students in the U.S. rank 35th in math and 27th in science when comparing literacy rates among countries (National Science Board, 2012; Organisation for Economic Co-operation and Development, 2014).

This is even more evident when looking at the existing achievement gap that negatively affects marginalized groups including female students, non-white students, and low socioeconomic status (SES) student populations (NCES 2007, 2009). This marginalization manifests itself as a boredom and, ultimately, little to no interest in disciplines with science at their core, which continues play a role in the limited representation of these marginalized communities in science related careers (Buxton & Lee, 2010). Furthermore, the causes of these issues seem evident when looking at the research on underrepresented groups. For example, most of the research that is done on students living in high rates of poverty has shown that these youth from these backgrounds are often limited in their educational opportunities as many educators in these areas revert to low-level curricula, grounded in a skill and drill approach to learning, with little to no access to laboratory activities and other hands-on learning experiences (Oakes, 1990; Oakes et al., 2000). In connection to these issues, reports from the National Center for Educational Statistics (2007) showed a trend that elementary aged students often lose interest around science in the later years of their elementary education and sometimes this interest is lost during the early years of middle school, particularly among African Americans and Hispanic students.

This is a multi-layered issue for marginalized students in rural America. Rural areas already have their own unique set of challenges, specifically with regards to poverty, funding towards education, and available resources in the community. Bryant (2007) talks about how the rate of poverty in many rural areas impacts every aspect of the school systems and the educational experience of rural children. For example, there is no secret that rural areas struggle to recruit and retain qualified teachers in their classrooms. As poverty impacts the amount of funding and resources available for teachers, Azano and Stewart (2016) points out that issues of low salaries, geographic isolation, and lack of amenities within the community are issues that overshadow some of the main advantages of working in a rural area (i.e., small class sizes & community closeness). The quality of education in rural school districts is exacerbated by: (1) high student teacher ratios; (2) overcrowding; and, (3) less qualified teachers who are not trained to help students achieve the national education standards (Gallo & Beckman, 2016). Lack of resources in these rural communities also contributes to the limited availability of educational resources, opportunities for teacher professional development, and ability to cultivate varied student interests (Crockett, Carlo, & Temmen, 2016).

For students of color in rural areas, all of these issues are commonly coupled with the complexities of being a person of color in rural America. Crockett, Carlo, and Temmen (2016) pointed out that for rural students of color, exposure to supports and activities that provide and/or push academic achievement and school engagement tend to be limited due to constraints like residential segregation, social capital, and resources within the community. Furthermore, researchers found that many students within these communities often feel disconnected and lack a sense of belonging during their enrollment in science based courses and thereby perform at lower levels and/or display low levels of interest and motivation within the specific STEM related courses (Chubin, May, & Babco, 2005; Frenzel, Goetz, Pekrun, & Watt, 2010). While these issues are yet prevalent, several educational researchers suggest authentic science activities as a way to improve science education through student engagement. These activities are noted as a pathway to improve the attitudes of students around science, promote learning, and increase motivation to pursue science related careers (Buxton, 2006; Feldman & Pirog, 2011; Sadler, Burgin, McKinney, & Ponjuan, 2010). Knowing this, there exists a need to explore the outcomes of implementing authentic food systems-based science education strategies in efforts to increase student interest, specifically in rural areas where students are impacted by educational barriers.

1.3 Significance of the Study

The significance of this study can be seen in three important points. First, this study is important for enhancing evidence-based knowledge available regarding science education interventions and how they can help foster student interest and motivation. Second, this study is important because it explores ways to educate students about 21st century grand challenges and how to potentially solve them. Third, this study has a wealth of relevance because it encourages students to draw relevant connections to science through their everyday lived experience via authentic learning strategies as a way to enhance engagement.

1.3.1 Enhancing Science Education

The first point of significance focuses on how this study is important for enhancing evidence-based knowledge available regarding STEM interventions and how they can help foster student interest and motivation within STEM subjects. More research is is needed on how to increase and sustain motivation and interest in the sciences among underrepresented students in an effort to fix the “leaky pipeline”; that is, the students each year on the prepared and track (pipeline) to pursue STEM related degrees (Alper & Gibbons, 1993). Commonly, marginalized students within science education are described as viewing science as irrelevant and boring, disengaged, and lacking self-efficacy about their scientific abilities (Chapman, 2013). Science education reform has called for instruction to focus on becoming more centered to the needs of students and based in inquiry that will allow for further development (NRC, 2001), but there is also a need to make student learning more authentic. In order to do this, students must feel comfortable in bringing in their own personal experiences and funds of knowledge into the classroom (Ryu, Mentzer & Knobloch, 2018). Rosenzweig and Wigfield (2016) conducted a study of literature on STEM interventions measuring motivation and concluded, after addressing limitations within the studies reviewed, that future intervention studies need to be more connected to a theory of motivation in efforts to push for the development of results that future research can base their studies on. Moreover, they also suggested that if new interventions address the limitations, their work will assist educators, legislators, and practitioners to place special emphasis on science and other STEM related areas of educational policy and practice (Rosenzweig & Wigfield, 2016). This study was framed using motivation theory and informed by the limitations cited from Rosenzweig and Wigfield. This study was positioned as a timely piece to exploring the effects of STEM interventions of student motivation. This point is directly tied to policy with the main goal of advancing STEM education in the United States.

1.3.2 Solving 21st Century Grand Challenges

The second point of significance focuses on how this study is important because it explores ways to educate students about 21st century grand challenges and how to potentially solve them. Understanding the importance and increasing need for professionals with skills and knowledge in STEM related disciplines further highlights the need to address current challenges nationally and globally. Societal challenges like environmental impacts of the climate, biotechnology, and food security, are some of the complex problems that need the interdisciplinary function of STEM to help solve them and federal agencies like the United States Department of Agriculture (USDA) consider them 21st century grand challenges. Moreover, the need to address these issues has also been made evident within across the federal government as it has been noted that the optimization and overall enhancement of existing structures, tech development and innovation, research based in strategy, and partnerships between the research community and private industry will be needed to address the grand challenges of this century (PCAST, 2012). The work of this study will contribute to educating the youth of today and tomorrow's scientists, engineers, and social agents of change who will tackle these issues that are being brought up within the realm of policy and practice.

1.3.3 From The Classroom to The Community

Lastly, the third point of significance is important and points to the relevance of this study because it focused on using authentic science instruction to help students bridge connections from the classroom to lived experiences outside of the classroom, and ultimately to their respective communities. Many researchers, educators, and policy makers agree a main priority of teaching science is preparing youth to deal with science-based issues as a citizen in their daily lives (Rudolph & Horibe, 2016). Furthermore, researchers of scientific literacy have pointed out for over 30 years that science education should prepare and ultimately equip students to engage and participate thoughtfully with members of the world to further advance and protect society (Rutherford & Ahlgren, 1989). The practice of science education should also take a deeper dive and better understand some of the more important topics to both youth, community citizens, and leaders within the community, which ultimately has the ability to open up the door and give students the chance to feel a sense of agency to work towards the advancement and development of their community (Eisenhart, 2001). Science education is applicable in students' everyday lives, but instructors frequently use traditional methods, including lectures and memorization strategies, to present scientific concepts. The nature of this study is based in something that all people encounter on an everyday basis, something that connects the world more than most teachers might imagine—food. It is through this authentic food systems-based educational intervention that students will make connections beyond the classroom into their local food system, while also learning that they have the tools to enhance their community and the world around them through science.

1.4 Purpose of the Study

The purpose of this study was to explore and describe elementary school students' interests and concerns about the food system, and their overall engagement in the learning experience after participating in an authentic learning based Agri+STEM education unit focused on food systems education, AFNR, and STEM activities.

1.5 Research Questions

1. To what extent:
    a. Did students report their level of concern regarding food system related issues before and after the food system education lesson?
    b. Did students report their level of interest in food system related activities before and after the food system education lesson?
    c. Did students report their level of activity engagement (i.e., interest/enjoyment, competence, value) after experiencing the food system education lessons?
2. What were the relationships among the following variables?
    a. Food System Concern (pretest and posttest)
    b. Food System Interest (pretest and posttest)
    c. Activity Engagement (i.e., Interest/Enjoyment, Competence, Value)
    d. Food System Activity (Semantics Scale)
    e. Previous Youth Experiences
    f. Demographics/Personal Characteristics (i.e., race/ethnicity)

1.6 Limitations

The following were limitations within this study:

1. This study was exploratory-descriptive with a pre-experimental design, which limited this study from making causal claims (Schutt, 2012).
2. The researcher developed the curriculum lessons used for this study which could have played a role or influenced the outcomes (Shields, 2010).
3. The demographics of the schools within this study may differ in comparison to other schools across the nation, which makes the results generalizable only to the sample of this study.
4. Teachers and parents who chose to participate did so based on their interest in the topic and approach. This convenience sample is not representative of any other population. Further, teachers and parents could have self-selected to participate in the study, and students may have been interested in the content because of their teachers and parents.
5. Participants could have given responses that they believed were more appropriate instead of a response that more closely represents their feelings known as the Hawthorne Effect.
6. This study used a positivist paradigm which has limitations including no focus on social aspects (Sultana, 2020)

1.7 Definitions

Food Security: *"when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (World Food Summit, 1996, p.1).*

Food System: "*the interactions between and within biogeophysical and human environments, which determine a set of activities; the activities themselves (from production through to consumption); outcomes of the activities (contributions to food security, environmental security, and social welfare) and other determinants of food security" (Ericksen, 2008, p. 234).*

Science: *"a human endeavor striving towards a better way of explaining scientific phenomena through experimental and theoretical investigations" (Kuhn, 1970; Lee & Butler 2003, p. 923).*

Authentic learning: *"a constructivist approach to learning based on some common assumptions of constructivism (Driscoll, 1994): (a) complex, challenging learning environments and authentic tasks; (b) learning through social negotiation and shared responsibility; (c) multiple representations of the content; (d) understanding that knowledge is constructed; and (e) student-centered instruction" (Knobloch, 2003, pp.1-2).*

Interest: "*a relatively enduring predisposition to reengage with specific content over time; a preference for certain topics, subject areas, or activities" (Hidi & Renninger, 2006", p.111; Schiefele, 1991, p.302)).*

Food System Concern: *an awareness of [food system] problems and a commitment to the protection of valued food system components (derived from Berns & Simpson, 2009 definition of "environmental concern").*

Intrinsic Motivation: *Engaging in or doing a specific an activity for the general purpose of experiencing pleasure and to achieve ultimate satisfaction during the process of said activity (Ryan & Deci, 2000).*

1.8 Assumptions

1. This research was carried out using a positivist approach as the paradigm. Because of this, the researcher ulitmately assumed that "an external, objective reality exists apart from human perceptions of it" (Schutt, 2012, p. 611).
2. Participants in school settings voluntarily participated in this study, understanding that their school performance would not be affected because of their participation.
3. Students participated in a synchronous virtual environment and actively participated in the activities. Parents and teachers assisted with the use of the Zoom platform and hands-on activities.
4. Surveys were used to collect data and each of the responses accurately reflected participants' views and beliefs.

5. Participants responded to the questionnaires truthfully.
6. Valid and reliable instruments were utilized to collect the data.
7. Age appropriate materials were utilized to collect data, specifically for 4^{th}-8^{th} grade participants.
8. Bias on the part of the researcher was minimized, leading to the study being conducted objectively.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of key topics that helped frame this study, including food systems, science and STEM education, rural education, and authentic learning. The conceptual and theoretical frameworks are also be presented in this chapter. Finally, the last section in this chapter explains the need for this study.

2.2 Statement of Purpose

The purpose of this study was to explore and describe elementary school students' interests and concerns about the food system, and their overall engagement in the learning experience after participating in an authentic learning based Virtual Agri+STEM Camp focused on food systems education, AFNR, and STEM activities.

Research Questions

1. To what extent:
    a. Did students report their level of concern regarding food system related issues before and after the food system education lesson?
    b. Did students report their level of interest in food system related activities before and after the food system education lesson?
    c. Did students report their level of activity engagement (i.e., interest/enjoyment, competence, value) after experiencing the food system education lessons?
2. What were the relationships among the following variables?
    a. Food System Concern (pretest and posttest)
    b. Food System Interest (pretest and posttest)
    c. Activity Engagement (i.e., Interest/Enjoyment, Competence, Value)
    d. Food System Activity (Semantics Scale)
    e. Previous Youth Experiences
    f. Personal Characteristics (i.e., race/ethnicity, gender, grade level)

2.3 Literature Review Methods

The literature that informed the researcher in framing this study came from several different fields of study and through different methods of search. Google Scholar, the Purdue University library direct search, and the Purdue University e-Journal Database were utilized to find references. Some examples of phrases search terms used in the process of finding relevant literature included: *food systems education, food education, science education*, *STEM education*, *youth food systems concern, youth food systems interest*, *science education reform, environmental education, environmental concern, environmental awareness rural education, rural science education, rural food systems education authentic learning, self-determination theory*. Approximately 36 journal articles were identified. Articles were reviewed and 21 articles informed the review of literature if they addressed any of the following topics: K-12 audiences; nonformal and formal education regarding science, STEM, agriculture, and food; authentic learning, experiential learning, or learner-centered teaching; and, motivation, engagement, and making community connections.

2.4 Review of Literature

2.4.1 Food Systems

Food systems encompasses all of the interactions and interconnections across time and geographic space among food, people, natural resources, economy, government, climate, and the distribution system (Garnet et al., 2016). Food itself affects the moral, social, economic, and environmental concerns of the world in complex ways, leading researchers to look at food in an interconnected system. Dynamics of the food system usually include social, economic, and biophysical interactions that span multiple dimensions (Garnett, 2016). Food systems can also be viewed and impacted in negative and positive ways. Specifically, in relation to the environment, food systems are often a major source of greenhouse emissions, air and water pollution, and even deforestation. However, if the food system is centered around being sustainable, it can bring forth less harmful environmental impacts (Garnett, 2016). Food systems also encompasses providing food for the world, which involves food (in)security. In 2010, 17.2 million households (14.5% of households within the U.S.) found themselves facing food insecurity (Coleman-Jensen et al., 2011). Homes that are specified as being food insecure are defined as households that have difficulty being able to provide an adequate amount of food for all household members at some point during the year. Food (in)security and hunger are recognized as a 21st century grand challenge because this is a major problem not just here in the U.S., but globally. Food systems provides a context for authentic learning in science education because food is deeply rooted in science, it is familiar to students, and it provides a venue to explore ways to make the food system more sustainable. The Next Generation of Science Standards (NGSS Lead States, 2013) and the Framework for K-12 Science Education by the National Research Council (NRC, 2012) both highlight “systems” as a way to approach and frame science. Specifically, they both provide frameworks for teaching and assessing knowledge and understanding of systems for learning. NGSS (2013) looks at a system as a group of organized related components or objects, and if students are to investigate these systems, they must define the boundaries and analyze the inputs and outputs and use models to predict system behaviors. The NRC (2012) framework’s approach to systems highlights that students should be able to understand and analyze complex systems and the inputs and outputs including their interactions within a system. Furthermore, they point to the importance of learning about how one thing affects another within a system, and realize that a system biological, physical, chemical, and social interactions. Because of the versatility of food and it’s overall nature of being oriented in a system, it creates a context to help students learn in a systems way while also making learning more relevant. Barton et al. (2005) stated that they believe that it is critical to have “a greater global awareness of the importance of teaching about food in elementary science education in ways that link food with its impact on both the body and the continued sustainability of the natural environment” (p. 1183). Recognizing this, food systems is situated to serve as a model context to use in educating elementary and middle school students.

2.4.2 Science & STEM Education

Advancement in the fields of STEM are at the forefront of educational goals for schools throughout the United States and globally. One of the major reasons that STEM is so important to the U.S. educational system of today is because the STEM workforce has a major impact on the national security, standard of living in the U.S., and it has the ability to solve larger issues like terrorism and global food insecurity (Hira, 2010). There is a growing need for the United States to put more focus on strategies to engage students through STEM because the number of scientists and engineers has continued to diminish in recent years, resulting in a decline in research and development (Denney, 2011). This can put the U.S. at risk for competing globally, and it also puts the advancement of society at risk by limiting the number of resources available to citizens through STEM and related disciplines. According to Nunan (2015), researchers believe that there are four main influences on student career decisions: “personal interest, parents, earning potential, and teachers” (p. 15). For some educators, agriculture has been identified as a relevant context to teach STEM and other core related subjects. Two specific studies showed that elementary teachers would integrate agricultural activities into their classroom experience if it helped them teach core subjects like science, math, and reading, was relevant to students (Knobloch, 2008), and if it provided connections and authentic learning contexts for their students (Knobloch, Ball, & Allen, 2007).

The aim of this study was to utilize the findings to further improve education efforts of students in rural communities by exploring factors that might play a role in their motivation, interests, and concerns around their food system and the science involved in their activities. Recognizing the needs in science and STEM as a whole, it is important that mechanisms are found to enhance science and STEM education that utilize more engaging approaches and contexts like authentic learning.

2.4.3 Challenges Facing K-12 Education & Communities

While different communities and school districts have their own unique identities, there are also some challenges facing the entire system that need to be addressed. Coffey, Cox, Hillman, and Chan (2015) pointed out current and future challenges in education that are evident within education-based literature that educators, communities, and administrators should be addressed. These issues included: 1) diverse student populations, 2) technology development, 3) curriculum organization, and 4) instructional approaches (Coffey, Cox, Hillman, & Chan, 2015). With regards to diverse student populations, it is pointed out that the ethnic make-up of the U.S. population is rapidly changing which directly correlates to the rising increase in diverse student enrollment. Coffey, Cox, Hillman, and Chan (2015) explained schools need to be prepared for these changes by making strides to better understand diverse cultural backgrounds and the educational needs of students. Furthermore, they highlighted the need for curriculum specialists and teachers to design curricula that are more culturally responsive and meet the needs and interests of students (Coffey, Cox, Hillman, & Chan, 2015). Regarding technology development, the need for schools to better integrate technology into their curriculum was highlighted. Furthermore, issues of equity with regards to the digital divide and student technology access were also addressed. The recommendations for addressing this issue included: (1) training sessions for teachers to prepare them for effective technology use; (2) ensuring that student technology and software are up to date; and, (3) more integration of technology within the classroom (Coffey, Cox, Hillman, & Chan, 2015). Regarding curriculum organization, schools should find a way to departmentalize subjects to limit the burden of teachers teaching all subjects in elementary settings to ensure that students have the chance to learn from the best teachers in their respective subjects. This notion is relative to the issue of teacher self-efficacy. It has been documented in research the negative attitudes towards science and, in some cases, the limited science content background of elementary teachers (Knaggs & Sondergeld, 2015). Lastly, they pointed to instructional approaches as an area in need of development in education. Differentiated educational programming is needed for educators to meet the needs of diverse students. More specifically, Coffey, Cox, Hillman, and Chan (2015) explained that framing education with student interest in mind is at the core of addressing educational approaches, which would allow for students to be motivated within the learning process. The aim of this study was intended to showcase how implementing research-based strategies focusing on student interest and motivation in science education cannot only help students gain knowledge, but how it can also potentially help limit the effects of challenges facing our education system. All of the challenges addressed here can be seen across the educational system. However, there are also some issues that affect specific types of communities as well, especially rural communities with limited resources and underserved and underrepresented populations.

For one, there remains a dire need for the enhancement of education in rural areas. Robert Gibbs (2005) in his USDA article on “Education as a Rural Development Strategy” shared that rural schools face not only financial challenges but geographic isolation issues and, ultimately, are less likely to offer advanced math and science classes. An issue more than likely caused by their financial inability to attract quality educators. Sadly, the very issue of funding for teacher salaries in rural areas is just one of the main issues that these communities have to confront in the classroom with regards to their students and resources to meet needs in the classroom (Bryant, 2007). According to Bryant (2007), “Rural schools are having extreme difficulty meeting the bare minimum needs of their students, and with the federal and state government continuing to mandate additional programs for special needs each year, these schools have been stretched well beyond their ability to function" (p. 8). Unfortunately, rural students are often not the focus in studies involving more student-centered researched-based educational strategies. These issues further exemplify the need for more of a focus on engaging rural communities in research that utilizes educational strategies as a means of student development. When it comes to authentic learning, rural areas have the capacity to serve as models of how to build connections beyond the classroom, especially with regards to food systems, because these areas are often agrarian in nature.

While rural communities have their own struggles with financial resources, urban communities also suffer from gaps in funding. Low-income minority students in urban areas are subject to inferior facilities, struggles with curriculum, and less adequate educators in comparison to their suburban counterparts (Wright, 2012). Furthermore, Wright (2012) also points at how standardized testing has forced teachers to teach for memorization in place of application within the classroom. All of these issues are relevant because they showcase the issues faced in education today. The state of education today is a primary indicator for future generational action, research, interactions, and potential implications in a variety of fields both nationally and internationally.

2.4.4 Environmental Concern

Just as food systems provides an authentic context for educating youth, so does environmental education as it connects people to nature and the environment around them. The United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1976 defined goals for what environmental education is around developing a world of people who are aware and concerned about the environment and the problems associated with it (UNESCO-UNEP, 1976). Furthermore, they wanted to ensure that people have the knowledge, motivations, and commitment to work collectively and individually to find solutions to current and future environmental problems (UNESCO-UNEO, 1976). This statement serves as a basis for what environmental education is today. Environmental concern is a concept within the realm of environmentalism and is utilized to assess values and attitudes towards the environment as well as the connections between the ecosystem and humans (Bao, 2011; Stern & Dietz, 1997). Brehm, Eisenhauer, & Stedman (2013) shared that environmental concern looks at specific attitudes that determine intention and general attitudes/values. It is often looked at as a worldview, covering deeply held beliefs regarding the natural world (Brehm et.al. 2013). Stern and Dietz (1994) summarized that literature has based environmental concern around "three classes of valued objects: other people, nonhuman objects, and the self" (p. 66). In Schultz's (2001) study on the structure of environmental concern, his results strongly suggested that values underlie environmental concern. Environmental concern has been used to assess consumer behaviors within environmental advertising (Bao, 2011). Bao (2011) pointed to environmental concerns as being viewed as proactive attitudes toward the ecosystem and nature, and even a behavioral script towards environmental preservation.

When looking within the agri-food system, environmental issues and food systems issues are two components that are interrelated. To this point, however, environmental concerns have been heavily researched, however, food system concern is a concept that has not been explored as much. Curt Ellis, CEO and Co-Founder of the national FoodCorps program, stated on an environmental literacy blog that "food education is environmental education," pointing out the connection between food, nature and the environment as being part of a system. Furthermore, food is highlighted as being inextricably linked to environmental issues, among other social issues, in an NSF-funded framework on environmental literacy (Hollweg, Tayor, Bybee, Marcinkowski, McBeth, & Zoido, 2011). Because of these factors, environmental concern makes for a great basis to situate and explore what food system concern research could look like.

2.4.5 Virtual Education Delivery in a Pandemic

Technology development within K-12 schools has already been highlighted as a challenge facing the education system (Coffey, Cox, Hillman, & Chan, 2015). However, the novel coronavirus pandemic has further exacerbated this issue due to the almost instant conversion of educational delivery to a virtual format (Black, Ferdig, Thompson, 2020) during the nationwide lockdown. This shift in education has called for parents to become "co-teachers" as teachers deliver instruction both synchronously and asynchronously. Ultimately, this shift has also caused many students, parents, and educators to become overburdened because of the lack of preparedness and other constraints to this shift towards technology and virtual engagement (Black, Ferdig, Thompson, 2020). This additional responsibility was added to already existing issues of inequity regarding limited access for specific communities, mostly rural and poverty stricken, to resources like bandwidth and technology access (Mishnick, 2017). Furthermore, this fatigue has further identified the need for a focus on identifying new pedagogical approaches for educators during this time of virtual engagement (Ferdig, Baumgartner, Hartshorne, Kaplan-Rakowski, Mouza, 2020). Vegas and Winthrop (2020) pointed to this time of virtual education as an opportunity for education innovation. They specifically argued that new innovations and pedagogical approaches should be calling for students to become lifelong learners who develop skills and knowledge to help them ultimately become problem solvers. Moreover, they highlighted points from their book on "Leapfrogging inequality: Remaking education to help young people thrive," where they shared ideas for what these educational innovations would look like. One of which was "innovative pedagogical approaches alongside direct instruction to help young people not only remember and understand but analyze and create" (Vegas & Winthrop, 2020, Para. 11). These approaches have the capacity to be more authentic in nature.

2.5 Conceptual Framework

The conceptual framework model created for this study was adapted from the Food & Garden engagement model that Amonte Martin (2017) used in his master's thesis. He adapted his model based on Skinner and Chi's (2012) Process Model of Garden-Based Engagement. Martin's model specifically looked at students' future educational aspirations, school engagement, and activity engagement for food and gardens before participating and after participating in gardening and food learning experiences. He also measured their food and garden activity motivation which looked at autonomy, competence, and intrinsic motivation (Martin, 2017).

This study's model assessed student interests and concerns about the food system before and after going through an authentic learning-based food systems lesson. It also measured students' activity engagement directly after completing the lessons which looked at their perceived competence, value/usefulness, and interest/enjoyment (Figure 2.1). Authentic learning strategies were embedded into the Virtual Agri+STEM Camp (noted on the conceptual framework) to bring relevance to the learning experience.

2.5.1 Authentic Learning

Authentic learning was selected to operationalize the type of instruction of the study. Newmann and Associates (1995) defined authentic academic achievement with three criteria: "(a) construction of knowledge, (b) disciplined inquiry, and (c) value of learning beyond school" (p. 4). Authentic pedagogy seeks to bring about a deeper connection and understanding to the learning process. The overall culture and sense of understanding of science in the classroom is believed to be supported by the use of authentic tasks(Casely, 2004) and, furthermore, authentic activities represent issues and problems faced by students at home and in the real world (Knobloch, 2003). The theory behind learning authentically is based around an educational strategy focused on encouraging students to construct meaningful concepts and relationships, discuss different dynamics and to explore further around contextual issues centered around projects and problems that are based in the real-world and everyday life relevant (Donovan, Bransford, & Pellegrino, 1999). Newmann and Associates(1995) posed four standards that outlined authentic learning: (1) Higher order-thinking which looks specifically at having students to engage with and orchestrate ideas and specific info through transformative methods ; (2) Depth of knowledge, which looks directly at the basis of the ideas explored within a lesson and to the level at which students demonstrate a level of understanding as these ideas are brought to their attention for consideration (3) Connectedness to the World Beyond the Classroom, which is basically focused on gauging the level to which students in the classroom perceives meaning beyond the instruction and the value of thew concepts explored; and, (4) Substantive Conversation, which addresses the importance of having dialogue to better understand the substance of a subject and spark further learning.

2.5.2 Conceptual Framework Model

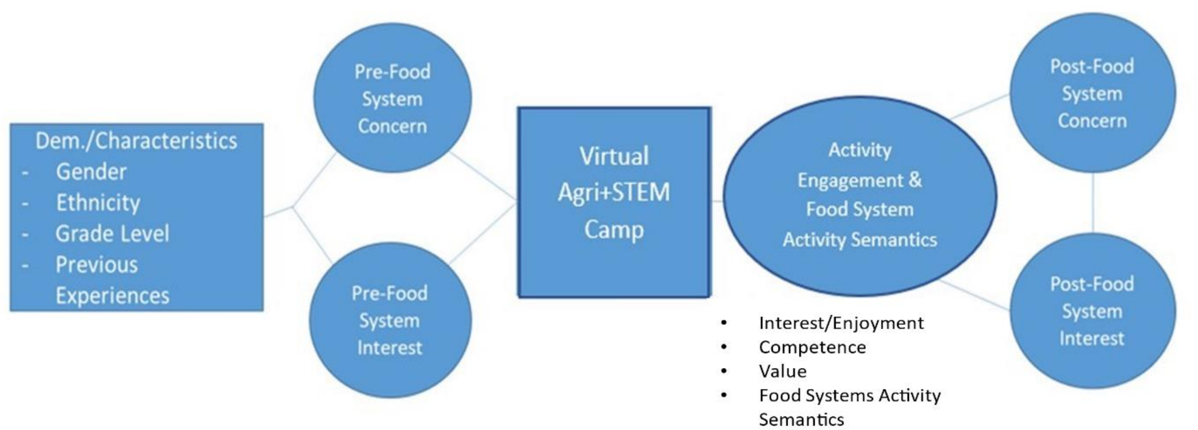


Figure 2.1

Conceptual Framework

2.5.3 Demographics

For the purpose of this study, demographic data were collected have a better understanding of the background of participants. The researcher was interested in exploring the relationships between gender, ethnicity, and grade level within this study. In efforts to get a better understanding of activities that students may have already been engaged in that might inform their responses, previous experiences were also assessed.

2.5.4 Food System Concern

Food system concern is a concept not currently found in the literature but that was researcher developed. Food system concern was adapted based on the concept of environmental concern. As shared earlier, environmental concern is used to assess values and attitudes towards the environment along with looking at connections between the ecosystem and humans (Bao, 2011; Stern & Dietz, 1997). While environmental education and issues have been extensively researched and multiple scales have been created to assess concern, there have been limited studies that assessed concerns about the food system. It is because of the interrelatedness between food and the environment that the researcher utilized environmental concern as a basis to create a food system concern instrument. Curt Ellis, CEO and Co-Founder of the national FoodCorps program, stated on an environmental literacy blog that "food education is environmental education," pointing out the connection between food, nature and the environment as being part of a system. Furthermore, food is highlighted as being inextricably linked to environmental issues, among other social issues, in an NSF-funded framework on environmental literacy (Hollweg, Tayor, Bybee, Marcinkowski, McBeth, & Zoido, 2011). Food system concern was utilized within the context of this study to first understand and to measure the level of concerns that participants have for the food system before and after going through the food system lesson and activities.

The Nourish (2010) curriculum and food literacy rubric helped to formulae a better organization of food system topics for the development of the food system concern concept. The Nourish curriculum guide is a food system centered curriculum developed in partnership with the Center for Ecoliteracy (Green Schools National Network, 2015). The curriculum is made up of several food centered lessons and learning activities with the purpose of engaging students in discussions around food, sustainability, and community with the ultimate goal of getting students to engage in more sustainable food practices and linking what they learn to relevant action. The three categories on the Nourish food literacy rubric (i.e., core concepts, values-food issues, practices).

2.5.5 Food System Interest

Food system interest is another concept that was researcher developed for this study in efforts to be utilized to understand the interests of participants around food system-related concepts, topics and activities throughout the food system lesson and activities. Interest for food systems was developed using intrinsic motivation around the food system as a basis. Deci and Ryan (2020) explained that interest is the base for intrinsic motivation, such that people engage in these actions they speak to their sense of fun and engagement. Along with the food system concern concept, the food system interest concept was also created using the Nourish (2010) curriculum as a basis. Items were created utilizing the nourish food literacy rubric.

2.5.6 Activity Engagement

The Activity Engagement instrument was used to assess participants level of engagement after going through the food system lesson activities. Engagement looks at “the extent of a students’ active involvement in a learning activity” (Reeve, 2012, p. 3). This instrument was adapted from the Intrinsic Motivation Inventory (IMI), which was created using the theory of self-determination (Deci & Ryan, 1985). Zepke and Leach (2010) pointed out that students that are engaged are ultimately intrinsically motivated. Furthermore, they state that SDT, which the IMI is based on, is a well-supported theory that is well equipped to point out the level of motivation and ultimate sense of agency needed for engagement (Zepke & Leach, 2010). Three scales were utilized from the IMI for this instrument which included “Interest/Enjoyment, Perceived Competence, and Value/Usefulness” (Deci & Ryan, 1982, p.1.). The researcher only wanted to assess the value that students saw in the activities, their interest (intrinsic motivation) within the activity, and how competent they felt during the activity. The interest/enjoyment variables looked at intrinsic motivation (Deci & Ryan, 2000); perceived competence is theorized as a positive predictor of behavioral measures of intrinsic motivation (Deci & Ryan, 2000); value/usefulness looks at the extent to which people find an activity valuable for themselves (Deci & Ryan, 2000).

2.5.7 Food System Activity Semantics Rating Scale

Food system activity semantics rating scale measured participants' attitudes and perceptions of the food system lessons within this study. These items were developed using the STEM Semantics instrument (Tyler-Wood, Knezek & Christensen 2008) as a base. The researcher chose four adjective pairs (meant nothing vs. meant a lot; boring vs. interesting; exciting vs. ordinary; and fascinating vs. unappealing) from the STEM semantics. These pairs served as descriptors for target statements regarding the food system lessons and activities.

2.6 Theoretical Framework

This study was framed utilizing Richard Ryan and Edward Deci's Self Determination Theory (SDT) of motivation as theoretical framework. Ryan and Deci (2020) defined SDT as "a broad framework focused on helping researchers, educators, and even the general public have a better understanding of the elements that stimulate or impede intrinsic motivation, autonomous extrinsic motivation, and psychological wellness" (p.1). SDT characterizes between different motivation types by focusing on individual goals or reasons that eventually catalyze into action. The variation between extrinsic motivation and its opposite, the internalized intrinsic motivation, is the most basic distinction within this theory. Intrinsic motivation is based on doing a thing because one finds enjoyment and inherent interest, based on internal stimulus (Ryan & Deci, 2000). On the other hand, extrinsic motivation looks at being motivated to do something based on an expected outcome rather than for inherent satisfaction, usually stimulated externally (Ryan & Deci, 2000).

While extrinsic motivation is perceived to be guided by external factors, Ryan and Deci (2020) actually describe four regulatory subtypes of "external motivation, which include external regulation, introjection, identification, and integration" (p.3.). To make this more specific, Ryan and Deci (2020) place SDT on a continuum that further breaks down the motivation types from more external to internalized. Extrinsic motivation is the broken down into four regulatory subtypes on this continuum – external regulation, introjection, identification, and integration – each increasing in internalization, respectively (Ryan, Deci, 2020). Within this study, the researcher focused on the two most internalized subtypes on the continuum, identification and integration, to inform this study while also looking at along with intrinsic motivation. Identification is attributed with personal level of importance, the conscious act of valuing an activity, and self-endorsement of goals. Integration is closest to intrinsic motivation on the continuum, and it is attributed with not only valuing an activity but finding it to be in agreement with other core values and interests. Ryan and Deci not only shared that these two subtypes are more internalized, but they also refer to these subtypes as being more autonomous. These two subtypes, along with intrinsic motivation, share the ability of being more instinctual and of one's own will in nature.

When looking within the context of education, Ryan and Deci (2020) hypothesized that "more autonomous forms of motivation will lead to an enhancement of student's engagement, learning, and wellness" (p. 3). SDT has a major focus on developing the interests of students around learning, an overall appreciation at large for education, and a sense of confidence to perform well academically and within their overall abilities (Niemiec & Ryan, 2009; Deci & Ryan, 1985). For the purpose of this study, the researcher primarily framed the research to explore the intrinsic motivation of students based on their interests around food system-related activities, and their interest and engagement in a food systems curriculum based in authentic learning. The researcher also utilized SDT to explore the variable of student concerns around food system related topics.

The variables of food system interest and the food system activity semantics were informed by SDT specifically in looking at intrinsic motivation based on interest. Interest is related directly to intrinsic motivation in that intrinsic motivation refers to activities people would take part in for their own accord, based on their internalized enjoyment and overall interest (Deci & Ryan, 2000). Intrinsically motivated activities don't conform to external pressures or incentives, instead they provide their own personal joys and satisfaction (Deci & Ryan, 2020). SDT views interest as a personally derived idea. Not only is this form of motivation internally stimulated but, in the long run, intrinsic motivation is said to likely be responsible for the bulk of learning over the span of life instead of learning that is forced externally (Ryan & Deci, 2017).

Food system concern was informed by SDT through the more autonomous extrinsic motivation subtypes based on their ability to address value. Specifically, within identified and integrated regulations, people personally identify with and endorse the value of a topic or activity (Ryan & Deci, 2020). These specific forms of motivation are centered around a sense of value; essentially, people find these view these ideas as worthwhile. Integrated regulation goes a step further and internalizes these activities further by not only recognizing the value, but by finding it to be consistent with other interests and core values (Ryan & Deci, 2020).

Food system activity engagement was also informed by SDT specifically around the connection between intrinsic motivation and engagement. While the overall IMI is used to assess intrinsic motivation, this variable utilized the subscale of at interest/enjoyment, competence, and value. Research points to intrinsic motivation as the predictor of student engagement and, in turn, engagement is said to predict academic achievement and performance (Froiland & Worrell, 2016). Furthermore, Nayir (2017) shares that students that are intrinsically motivated are engaged at an authentic level, which relates to the conceptual framework of authentic learning.

2.7 Need for Study

While the literature speaks to many different components regarding science education and AFNR literacy related topics, including food systems education, there a few specific gaps that still exist, limiting what we know about how these educational interventions can be used to address concerns and interests of different audiences. STEM education, agricultural literacy, and often times a combination of both (STEM through AFNR education), including food systems education, have all been all been used as a context for multiple studies. There have been multipple studies that have looked directly at components of food systems education, other topics related to AFNR literacy, and science/STEM education – in some cases a combination – with regards to K-12 students. Much of this research has focused on assessing motivation, engagement, interests, career aspirations, ability to think in a systems way, and community connections of most students, but also parents with specific regards to food systems, AFNR, and STEM related activities.

With regards to STEM, Peters-Burton et al. (2014) conducted a study which found that they could enhance the STEM education activities of high school students by getting them more locally engaged through the use of community-based resources and making connections to the community. Some studies looked at factors to potentially increase student interest around food and agricultural related topics through STEM, more specifically, underrepresented students who participated in summer pre-college program experiences (Ortega, 2011; Scherer 2016). Ortega (2011) used a precollege life science experience (USDA-Ag Discovery Camp) to describe middle school students' interest, self-efficacy, and career intentions after participation. He found participants: (1) expressed more awareness of agricultural careers and potential consideration of these careers a year after participating in the program; (2) were self-efficacious with regards to science learning; and, (3) were interested in science careers after the precollege experience (Ortega, 2011). Scherer (2016) looked at motivations, educational aspirations, career interests and views of high school students in two separate precollege programs that both had an emphasis on agriculture and STEM related subjects, one of which had more ethnically diverse participants. This study concluded and showed that participants: (1) were motivated to engage in the agriculture & STEM based precollege program; (2) reported a higher interest in agricultural careers after participating; and (3) had more positive views of agriculture after their participation (Scherer 2016). From another viewpoint, the parent perspective, Pettigrew (2018), explored how urban African-American middle school parent's motivations played a role on their child's interest in STEM and agriculture related activities. Ultimately, part of her findings in this study found that urban parents thought that their child would benefit from agriculture and STEM education (Pettigrew, 2018).

When it comes to food, garden, and agricultural literacy/education, there have been a considerable number of studies focused on how these topic can be integrated into elementary classroom curricula because of its authenticity (Knobloch, Ball & Allen, 2007), its connection to science standards, the creation of agricultural literacy assessment tools for elementary classrooms, and how to use agricultural literacy as a context for STEM education (Graves, Hughes, & Balgopal, 2016; Longhusrt, Judd-Murray, Coster, & Spielmaker, 2020; Vallera & Bodzin, 2020). Furthermore, student engagement and motivations regarding AFNR related activities and learning experiences have also been an area of focus in some of the research studies with middle and elementary students (Martin, 2017; Van Tine 2005). Martin (2017) looked at using contextual teaching and learning through school gardens and garden-based activities to explore the relationships among "food and garden experiences, school engagement, future educational aspirations, activity engagement, and activity motivation of urban middle school students" (p. 15). He found that: "(1) food and garden-based activities were not only engaging to students, but also motivating; (2) food and garden-based activity participation was a variable associated with higher levels of reported school engagement by participants; (3) students reported higher levels of future educational aspirations after participating in the garden-based experiences; and, (4) there were positive relationships among food and garden activity engagement, activity motivation, school engagement, and future educational aspirations" (Martin, 2017, p. 15). Van Tine (2005) investigated motivation outcomes of suburban elementary students engaged in an experiential agricultural and environmental unit. She found that: (1) students were motivated to learn about agriculture and the environment through the experiential and authentic methods used; and, (2) students were cognitively engaged through the experiential agricultural literacy unit, leading to awareness and then appreciation for agriculture and the environment, which students helped students apply knowledge in the learning activities.

Even more specific, food systems education has been also a growing area of research due, in part, to it falling under the umbrella of agricultural literacy along with its ability to address sustainability, nutrition education and food choices, and food waste behaviors (Avila, 2018; Prescott, Burg, Metcalfe, Lipka, Herritt, & Cunningham, 2019). For example, Prescott et.al. (2019) implemented a food systems curriculum with 6th grade science classrooms that found that food systems education within a middle school classroom improved fruit and vegetable consumption of students and limited their food waste during school meals. Increased food and vegetable consumption was also a finding in Kararo, Orvis, and Knobloch’s (2016) study exploring the effects of a garden-based nutrition education program. Further, Charoenmuang (2020) used food systems education as a way to assess suburban high school students’ level of systems thinking after going through an online sustainable food systems program. The findings from this study suggested that after going through the online sustainable food system lessons, students recognized the benefits of thinking in a systems way.

While the literature speaks to many different components regarding science education, AFNR literacy related topics, and food systems education, there are specific gaps that still exist. As shared, there have been a number of studies that have looked at the motivations of interests of students, and even parents, regarding STEM and AFNR related topics, however a focus on students’ concerns for AFNR and the relationships between their concerns and their interest needs further exploration. Specifically, the researcher wanted to know if students’ activity interest was related to their interest and concern regarding the food system. Furthermore, most of these studies were focused on students from urban and suburban areas, and while participants from these studies are mostly from underrepresented ethnic groups in agriculture, there is an existing need to study what this looks like in a rural context with diverse underrepresented students. This study was focused primarily on reaching students participants in rural communities who are from more underrepresented racial/ ethnic groups in agriculture.

CHAPTER 3. METHODS

3.1 Introduction

This chapter will provide an overview and understanding of the procedures and overall methods of research for this exploratory study. Moreover, this chapter will cover the research questions, research design, and participants within this study. Furthermore, a description of the instruments used in this study and the items selected to be used to develop it along with the reliability and validity measures. Lastly, this chapter will provide an explanation for the data collection and data analyses procedures used in this study.

3.2 Statement of Purpose

The purpose of this study was to explore and describe elementary school students' interests and concerns about the food system, and their overall engagement in the learning experience after participating in an authentic learning based Virtual Agri+STEM Camp focused on food systems education, AFNR, and STEM activities.

3.3 Research Questions for the Study

1. To what extent:
    a. Did students report their level of concern regarding food system related issues before and after the food system education lesson?
    b. Did students report their level of interest in food system related activities before and after the food system education lesson?
    c. Did students report their level of activity engagement (interest/enjoyment, competence, value) after experiencing food system education lessons?
    d. Did students report their previous experiences?
2. What are the relationships among the following variables?
    a. Food System Concern (pre and post)
    b. Food System Interest (pre and post)
    c. Activity Engagement (Interest/Enjoyment, Competence, Value)

d. Food System Activity (Semantics)
e. Previous Experiences
f. Personal Characteristics (i.e., race/ethnicity)

3.4 Research Design

The researcher conducted this study utilizing a positivist approach, which is focused on the basis that experimentation and/or observation are used to gain knowledge objectively through (Scott & Morrison, 2005), as a lens to guide this study. Positivism was as it is understood that statistics can be used as a way of explaining social facts (Hasan, 2016). Positivist researchers utilize research strategies that help to establish internal and external validity, which assists in allowing the study results to be generalizable to the larger population being studied (Denzin & Lincoln, 2005). Positivism aligned with the virtual venue of the educational program. The researcher anticipated a larger number of participants (estimated to be 150 – 200) and the participants to be familiar with completing a questionnaire after participating in the virtual learning experience.

This study was a pre-experimental design that utilized a deductive approach where the researcher sought to explore and describe the outcomes of a food system-based science unit on elementary and middle school students' concerns about their food system, their interests in food system related activities, and their activity engagement after completing the lessons. The researcher used quantitative research methods to address the research questions, an assumption supported by a theoretical and conceptual framework that were based on existing theories and literature. Pretest and posttest surveys were used to measure the participants' level of concern for the food system and their interest in food system related activities before and after the intervention. Demographic questions were given with the questionnaires to collect background data on participants. The activity engagement using the IMI questionnaire and food system activity semantics rating scale were also given to the participants after completing the intervention as part of the post-questionnaire.

The survey design was utilized to help further describe what participants perceived regarding their interests and concerns upon completion of the study. The pretest and posttest survey design were the most effective methods to gauge outcomes of students' interests and concerns over the course of the intervention. According to Pinsonneault and Kraemer (1993), "The purpose of survey research in exploration is to become more familiar with a topic and to try out preliminary concepts about it" (p. 79). Survey methods are used to "discover and raise new possibilities and dimensions of the population of interest" (Pinsonneault & Kraemer, 1993, p.79). Working to discover new possibilities and dimensions for a population is related to how the researcher wanted to use the findings from this study to describe elementary and middle school students' interests regarding food system based concepts and their concerns about the food system after participating in an engaging method to science education, using an authentic learner-centered unit of instruction.

The researcher originally planned to implement the authentic learning-based lessons by going to 5th and 6th grade classrooms in rural areas for five days of 45-minute sessions centered around food systems and food science education. Unfortunately, due to the effects of the COVID-19 pandemic, face-to-face research was halted and creative approaches to research had to be implemented to address the plight of the "new norm" being experienced. To make up for these new challenge of social distancing limitations, the researcher converted the "Food Systems lesson plans" into a virtual format thereafter referred to as the "Virtual Agri+STEM Camp" with the focus on food and food systems.

3.5 Participants

Within this study, participants came were made up elementary and middle school students in grades 3-8. The researcher originally had approval to carry out this research with all 5th and 6th grade students in the school system of Madison County, FL. However, due to social distancing limitations in the middle of the research process, the researcher was limited with the classrooms that were available to participate.

3.5.1 Research Context: Virtual Agri+STEM Camp – At Home Group

Because of the limitations with classroom access, the researcher decided to host virtual sessions to collect data with random samples of youth that were interested in doing the "Virtual Agri+STEM Camp." The researcher conducted independent group at home sessions where he marketed the Virtual Agri+STEM Camp to students and parents from grades 3-8, opening up the opportunity to have students participate from different states across the U.S. including, but not limited to, Georgia, Florida, North Carolina, Illinois, Texas, Missouri, Mississippi, and Virginia.

In efforts to reach more students, criteria for participation was opened up to allow for any students in grades 3-8 with virtual capabilities (i.e. computer, phone) to participate in this study. After the researcher worked with the first group across multiple states, there were then two at home afternoon sessions for students in Lafayette, IN, one specifically for afterschool students and another that consisted of students engaged in home-schooling and those who were doing virtual school due to social distancing. There were ultimately three sessions offered as independent at home opportunities for engagement. Over 90 students registered for these camp sessions altogether, however, when these registrants were directed to complete the pre-questionnaire for participation less than a third of them did so, which reduced the number of participants to seven. The participants from these groups were primarily diverse in nature, consisting of African American, White, and Latino/Latin-X students. The main requirement was for students to be within the range of 3rd to 8th grade. When it came to collecting the post questionnaire data from these participants, there was even more strain in getting students to complete these questionnaires on their own time in a virtual setting. Ultimately, there were a limited number of students who completed the necessary online pre and post questionnaire, limiting the number of participants. This prompted the researcher to look into other ways to increase the number of participants.

3.5.2 Research Context: Virtual Agri+STEM Camp – In School Groups

Recognizing the need to reach more students in a way that would ensure completion of both pretest and posttest questionnaires, the researcher reached out to teachers from the Madison County, FL school district to complete the data collection. Madison County, FL is considered a rural county as identified by the Florida Department of Health (2018). According to the Florida Department of Education (2018), 83% of students throughout the county were eligible for free/reduced lunch. Currently, all of the schools in the Madison County School District are classified as Title 1 schools. Title 1 is federal program aimed at providing assistance to low-income students based specifically on the number of students who qualify for free or reduced lunch (Glewwe, West, & Lee, 2018). Furthermore, to qualify for Title 1 status, the student population of a school must be made up of at least 40% low-income students. There were two schools in the county that participated in this study, Greenville Elementary School (GES) and Madison County Central School (MCCS). Greenville Elementary School services students from Kindergarten to 5th grade, with a total population of 135 students; 74% Black/African American, 23%

White/Caucasian, and 3% reported as Other. GES participants included grades 3-5. There were 48 students in total among the classrooms from GES: 19 students in 3^{rd} grade, 14 students in 4^{th} grade, and 15 students in 5^{th} grade. Madison County Central School services students from Kindergarten to 8^{th} grade and serves as the only public school in the county for middle school grades. They have a total population of 1,131 students; 65% Black/African American, 26% White/Caucasian, 7% Hispanic, and 2% reported as Other. MCCS participants included grades 4-5. This is displayed in Table 3.1. There were 101 students in total among the classrooms from MCCS: 45 students in 4th grade, and 56 students in 5th grade.

The rationale behind choosing the participants in this grade range was embedded in addressing critical needs in STEM education. According to Mohr-Schroeder et al. (2014), "before students enter the eighth grade, they conclude many of the STEM subjects are too challenging, boring, and/or uninteresting, which in turn, limits their participation in STEM subjects and activities" (p. 291). This problem is even more complex for students and schools who live in low poverty and/or rural areas, due to the financial, educational, and environmental constraints that impact their educational journey. Understanding this, these participants represent a population that could potentially benefit well from an intervention using a more student-centered pedagogical approach such as the one in this study. They also represent a population of people that further research needs to be done on in relation to Food & Agricultural Literacy and STEM interventions. This diverse convenience sample was not generalizable.

Participant consent and assent forms were approved by the Institutional Review Board at Purdue University (Appendix A, Item 1). Due to the virtual nature of engagement, the researcher included the consent and assent with the prequestionnaire through an online Qualtrics link. Before students could complete the survey questionnaire, they first had to get consent from their parents and complete the assent form for their approval of participation. With feedback from the teachers in the Madison County School District, the researcher worked with the schools to provide a printed copy of the consent form to parents. This was due to concerns about internet/technology access at home including limited broadband access within the community. All assent forms were completed through the Qualtrics link by students as they began their pre-questionnaire.

Table 3.1

Demographics of Participating Madison County Schools

School	Total Population	Race/Ethnicity
Greenville Elementary School	135	Black/African American – 74%, White/Caucasian – 23%, Other – 3%
Madison County Central School	1,131	Black/African American – 65%, White/Caucasian – 26%, Hispanic – 7%, Other – 2%
School District Total	2,785	Black/African American – 47%, White/Caucasian – 44%, Hispanic – 6%, Other – 3%

Note: This table highlights overall student demographics for Madison County Schools to provide more of a research context to the participants from these schools.

3.5.3 Demographic Characteristics of Participants

The following section will present an overview of the demographic characteristics of the participants who completed this study. When breaking down the demographics of the 99 total students that participated in this study, 48 (48.1%) of the students were male, and 51 (51.5%) were female (Table 4.1). With regards to race/ethnicity, there were 69 (69.7%) students that identified as Black/African American, 18 (18.2%) that identified as White, three (3%) that identified as Hispanic, 1 (1%) that identified as Native Hawaiian or other Pacific Islander, 2 (2%) that identified as Native American/American Indian, and 6 (6.1%) that identified as Other. Most of the students that identified as other self-reported being bi-racial or mixed (Table 3.2)

Table 3.2

Demographic Characteristics by Race/Ethnicity and Sex

Race/Ethnicity	*f*	%	Sex	*f*	%
Black/African American	69	69.7	Male	48	48.5
White	18	18.2			
Hispanic/Latino	3	3	Female	51	51.5
Native American/American Indian	2	2			
Native Alaskan	1	1			
Native Hawaiian/Pacific Islander	0	0			
Asian/Asian American	0	0			
Other	6	6.1			
Total	99	100.0		99	100.0

Note: This table highlights the demographics of the participants within this study based off of race/ethnicity and sex.

Out of the 99 participants in this study, thirty-seven (37.4%) were fourth grade students, forty-seven (47.5%) were fifth grade students, one (1%) were sixth-grade students, one (1%) were eighth-grade student, and there were thirteen (13.1%) that identified as other. Because this study was originally focused on reaching students in grades 4-8, the students who identified as “other” at Greenville Elementary School (GES) were made up of students from the third-grade group as shown in Table 3.3.

Table 3.3

Total Demographic Data for Grade Level and for Schools

	Totals by Grade Level		Totals by School		
	f	%		***f***	%
Grade 4	37	37.4	MCCS	60	60.6
Grade 5	47	47.5	GES	32	32.3
Grade 6	1	1.0	AHG	7	7.1
Grade 8	1	1.0			
Other (Grade 3)	13	13.1			
Total	99	100.0		99	100.0

Note: This table highlights demographic data for study participants based on grade level and school/group.

Of the 99 total students, there were sixty students (60.6%) that attended Madison County Central School (MCCS). Thirty-eight students were in 5th grade and twenty-two students were in the 4th grade. Out of the 99 total participants, there were thirty-two students (32.3%) that participated at GES. Of those thirty-two participants, twelve were 4th grade students, seven were 5th grade students, and thirteen were 3rd grade students. Lastly, there were seven total students (7.1%) in the "At Home Groups" (AHG); three in 4th grade, two in 5th grade, one in 6th grade, and one in 8th grade. This is detailed in Table 3.4.

Based on gender, at MCCS there was a majority of male participants in the 4th grade (59.1%) compared to the 5th grade classes where students who identified as female made up the majority (52.6%). At GES, there was a majority of male participants in the 3rd grade group (61.5%) compared to the 4th and 5th grade classes where students who identified as female made up the majority (75% & 57.1%, respectively). For the AHG, participants who identified as female made up a slight majority compared to male participants (4 female students at 57.1% compared to 3 male students at 42.9%). Gender varied across grade levels for the AHG with 4th grade having two female students and 1 male student; in 5th grade there were two male students; 6th grade there was one female student; and in 8th grade there was one female student. This is detailed in Table 3.4.

Table 3.4

Demographic Characteristics of all students by School, Grade Level, and Gender

Population Breakdown						
School	Grade Level	***f***	%	Sex/Gender	***f***	%
MCCS	Grade 4	22	36.7	Female	9	40.9
				Male	13	59.1
				Total	22	100.0
	Grade 5	38	63.3	Female	20	52.6
				Male	18	47.4
	Total	60	100.0	Total	38	100.0
GES	Grade 4	12	37.5	Female	9	75.0
				Male	3	25.0
				Total	12	100.0
	Grade 5	7	21.9	Female	4	57.1
				Male	3	42.9
				Total	7	100.0
	Other (Grade 3)	13	40.6	Female	5	38.5
				Male	8	61.5
	Total	32	100.0	Total	13	100.0
AHG	Grade 4	3	42.9	Female	2	66.7
				Male	1	33.3
				Total	3	100.0
	Grade 5	2	28.6	Male	2	100.0
	Grade 6	1	14.3	Female	1	100.0
	Grade 8	1	14.3	Female	1	100.0
	Total	7	100.0	Total	7	
	Overall Total	99	100		99	

Note: This table highlights demographic for all participants based on school, grade level, and gender.

With regards to community type, only 97 out of the 99 participants reported the type of community they live in. Participants were presented with three options: 1) Rural, 2) Urban, and 3) Suburban. Seventy-Four Participants (76.3%) reported that they live in a Rural community, six participants (6.2%) reported living in an Urban area, and seventeen (17.5%) reported living in a Suburban area (Table 3.5). At MCCS, 49 students (84.5%) reported living in a Rural area, five students (8.6%) reported living in an Urban area, and four students (6.9%) reported living in a Suburban area. At GES, 23 students (71.9%) reported living in a rural area, one student (3.1%) reported living in an Urban area, and eight students (8%) reported living in a Suburban area. Lastly, for the AHG, two students (2.6%) reported living in a Rural area, and five students (71.4%) reported living in a Suburban area. It should be noted that while some students from both MCCS and GES may have reported living in an urban or sub-urban area, Madison County is more than 25 miles from any metropolitan area and is considered rural according to U.S. News & World Report (2020).

Table 3.5

Demographics by Community Type Classification

	Community Type	
	f	%
Rural	74	76.3
Urban	6	6.2
Suburban	17	17.5
Total	97	100.0

Note: This table highlights the reported community types by participants. Two participants did not self-report, therefore the total number is 97.

3.6 The Research Setting

Due to the limitations of research caused by COVID-19, the researcher conducted this study virtually using the Zoom platform instead of working face to face with students in the classroom. The instructor set up Zoom to be a secure space for students by incorporating security measures, including pre-registration and the waiting room feature. The platform allowed for the researcher to connect with students in any location across different states and time zones to participate in the camp. This allowed for the researcher to connect with participants across a range of diverse locations. The Zoom platform allowed for the campers and the instructor to engage in a way that was as close to “face-to-face” as it could be in a virtual setting by utilizing the video features. The instructor aimed to make the virtual camp environment a model of what an in-person camp would be like by incorporating music, graphics, and activity breaks that were in line with a science camp theme.

3.6.1 Virtual Agri+STEM Camp

Each of the participants in this study engaged in a 5-day science program focused on food systems and agriculture (known as the Virtual Agri+STEM Camp). The Virtual Agri+STEM camp consisted of daily lessons that focused on teaching students about the food system, the science behind it and how it connects to the world and their respective community. Each lesson included hands-on activities and experiments with the intention of making the learning experience more engaging and authentic for students. The main activity in this camp was centered around students making their own flavored pickle products. Music was utilized at the beginning of each session to bring students in, break the ice and get them excited for the activities of the day. The researcher presented the activities of the Virtual Agri+STEM Camp to the participants as if they were going through a training experience to create their own small business that specializes in product development around pickles. Students were tasked to come up with their own slogan, jingle, skit, or other marketing strategy to present to the group on the final day during the taste testing activity.

The breakdown of each day was as follows: Day 1 was and Introduction to the Food System; Day 2 focused on Food, History, & Culture; Day 3 was focused on Product Development (making pickles); Day 4 was focused on The Science behind the Product Development; Day 5 wrapped up with students marketing their own created products and doing a sensory analysis test (i.e., taste test) with their families. The researcher also used Day 5 as a congratulatory “graduation” for students from the Virtual Agri+STEM Camp. Each camp day was tailored specifically to share quality information about the food system in a way that was broken down to allow for students better understand and build relevant connections to the content (Table 3.6).

Table 3.6

Virtual Agri+STEM Camp Lesson Breakdown

Camp Sessions & Descriptions:	
Day 1: Introduction to The Food System	
	This session focused on introducing students to the food system and the components that make up the system from production to consuming. Students were given an orientation to the virtual camp as well. Students were able to track the journey of their own favorite foods/dishes and create a model that showed each step in the food system. Students learned about food miles and calculated the distance that their food had to travel to reach them. The 4 different types of food systems (Global, Regional, Local, & Community) were also introduced to students, which then led to a discussion on food (in)security, hunger, and food waste. The session ended asking students to think about solutions to this issue, pointing to food preservation as on possibility to be discussed in Day 2.
Day 2: Food, History, & Culture	
	Day 2 focused on connecting students to some of the sociocultural connections to food and also on food preservation and how it has evolved throughout history. The instructor introduced the idea of "food stories," which was an overview of one's earliest connections to food and what it means to them. The instructor shared their personal food story and opened up for students to share their own. This session included an experimental activity on oxidation in apples and how food science can be used to maintain a certain quality. Students then learned 7 different types of food preservation, their historical connections, and how they are best used on certain food products. The session ended by asking students to show their apple experiment results. The instructor highlighted that an edible acid was used to maintain the quality of the apple, a topic that would be discussed further in Days 3 and 4.
Day 3: Product Development	
	In this session, students were able to be more hands-on and engaged through activities. This day focused on students developing their own food products. Utilizing knowledge on the different preservation types from Day 2, students created their own pickles. This activity was created to allow students to make their own choices, so each student had the opportunity to choose the design, flavor, and marketing strategy for their pickle products. The instructor guided the students through the process of creating their own pickle brine and gave instructions on storing until Day 5. Students had the ability to choose their own flavors, and additions to include in their pickles. This session ended with the instructor asking the students what their thoughts were on the science behind pickles, a topic that would be further discussed in Day 4.

Table 3.6 continued

Day 4: The Science Behind It All	
	This session focused on connecting students to the science behind pickling. Students first learned about the role that bacteria and microbes play on food spoilage when controls are not set in place to combat them. They then learned about the pH scale and the role that acidity plays in creating barriers to limit spoilage. The instructor then engaged them in an activity that where they tested the pH of different edible substances together using litmus paper. From the discussion on acids, the instructor then engaged them in the next activity of the day which was the rubber egg experiment. The instructor prepared rubber eggs prior to the session to share in class and to use for the next discussion topic of osmosis. The instructor shared that pH and osmosis are two important scientific concepts that play a role in developing pickles and preserving them for a longer shelf life. This session on science ended with the instructor sharing careers in food and food science that use some of the techniques discussed throughout the camp.
Day 5: Taste Testing & Product Presentation	
	The final camp session began as an overview of some of the things that students learned. While the instructor recapped with students throughout each day, this was an opportunity to look at the full picture of what was discussed and accomplished over the last few days. Once this was done, then student presentations began. Students first presented their jingles, skit, song, or other method of marketing their products and then they tasted the products along with a family member. After all students completed their presentations, the instructor wrapped up by thanking everyone and congratulating the students for "graduating" from the Virtual Agri+STEM Camp.

Note: This table gives an overview and breakdown of the daily lessons for the Virtual Agri+STEM Camp.

Each session of the Virtual Agri+STEM camp followed the above themes, respectfully, and each of them were directly bridged into the session following it. The instructor made sure to recap each previous lesson before going into the daily sessions in efforts gauge what students picked up on, refresh their knowledge for each stage, and to bridge the connections between topics. Students used the knowledge learned in each session on the daily experiments and other science-based hands-on activities within the camp.

3.7 IRB Approval

This study's protocol was reviewed by the Human Research Protection Program Institutional Review Board (IRB) at Purdue University and was approved on June 3, 2020. The approval letter is attached in Appendix A, for the research entitled, *"Exploring Elementary & Middle School Students' Interests and Concerns Regarding the Food System"* (IRB-2019-768). Prior to protocol submission, the researcher completed the proper IRB trainings including courses on the Protection of Human Subjects online training to ensure proper protection of participant rights.

3.8 Instruments

The instruments used for data collection in this study consisted of 1) a pre-questionnaire that assessed students' interests and concerns about the food system and their prior experiences before participating in the Virtual Agri+STEM Camp, and 2) a post-questionnaire that assessed students' interests in the food system their concerns about the food system, their activity engagement during the camp and their activity semantics after completing the camp. The researcher also measured demographics within the instruments.

3.8.1 Food System Concern

The first section of the pretest and posttest questionnaire was composed of the Food System Concern items. The Food System Concern questionnaire was a 12-item component of the pretest and posttest questionnaire that was developed by the researcher and his mentor and reviewed by an expert panel. These items elicited information regarding student concerns about food system related topics before (pretest) and after (posttest) the Virtual Agri+STEM Camp. As a base to structure this instrument, the researcher adapted the items from Bao's (2011) environmental concern measure, which he developed based on the environmental involvement scale Schuhwerk and Lefkoff-Hagius (1995). Items such as "I am concerned about the environment" were used to build the food system concern items. The food systems content that was used to inform the topic area of these items came from the Nourish (2010) curriculum and food literacy rubric. Topic areas on the rubric that informed the researcher included: Core Concepts (Food Systems, Ecological & Industrial Agriculture, Food & Health), Values (Ecological Farming, Access to Healthy Affordable Food, Personal & Public Health), and Practices (Growing Food, Storing & Composting, Healthy Eating & Active Living). The food system concern items included items such as "I am concerned about people wasting food" and "I am concerned there are not enough grocery stores in my community." These items used a 4-point rating scale: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, and 4 = *Strongly Agree*. Post-hoc reliability was assessed on these items after data collection with a coefficient of 0.83.

3.8.2 Food System Interest

The Food System Interest questionnaire was a 13-item component of the pretest and posttest questionnaire that was developed by the researcher and his mentor and reviewed by an expert panel. The goal for these items was to elicit information regarding student interests in food system related activities and ideas before (pretest) and after (posttest) the Virtual Agri+STEM Camp. The food systems content that was used to inform the topic area of these items also came from the Nourish (2010) curriculum and food literacy rubric. Topic areas on the rubric that informed the researcher included: Core Concepts (Food Systems, Ecological & Industrial Agriculture, Food & Health), Values (Ecological Farming, Access to Healthy Affordable Food, Personal & Public Health), and Practices (Growing Food, Storing & Composting, Healthy Eating & Active Living). The food system concern items included items such as "I am interested in learning about the health problems that come with limited access to healthy food" and "I am interested in making sure everyone has equal access to food in my community." These items used a 4-point rating scale: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, and 4 = *Strongly Agree*. Post-hoc reliability was assessed on these items after data collection with a coefficient of 0.89.

3.8.3 Food System Activity Engagement

The 12 items in the section of the post-questionnaire measuring activity engagement came from the Intrinsic Motivation Inventory (IMI), an instrument developed based on the self-determination theory from Deci and Ryan (1982). While the IMI consists of six subscales, only three of them were used for this questionnaire. These subscales included: 1) intrinsic motivation (interest/enjoyment), 2) value/usefulness, and 3) perceived competence. These items used a 4-point rating scale: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, and 4 = *Strongly Agree*. Scherer (2016) reported reliability for these subscales with the following Cronbach's alpha coefficients: interest/enjoyment (0.91), perceived competence (0.89), value/usefulness (0.86). For this study, post-hoc reliability coefficients for this study were: 0.80 = interest/enjoyment, 0.79 = perceived competence, 0.82 = value/usefulness.

3.8.4 Food System Activity Semantics Rating Scale

The Food System Activity Semantics Rating Scale questionnaire consisted of 4 items with a 10-point rating scale. The items on this questionnaire were adapted from the STEM semantics survey (Tyler-Wood, Knezek, & Christensen, 2010). The STEM semantics survey measures attitudes and perceptions of STEM with regards to students on a 7-point rating scale. The rating scale is situated between two descriptive adjective pairs that describe positive and negative perspectives on presented statements. For example, one statement is "To me, SCIENCE is:" and two examples of the descriptive adjectives are "fascinating" on one end and "mundane" on the other end. Students are prompted to choose a point on the scale that matches most close to their perception of the statement. For the Food System Activity Semantics questionnaire, one statement was asked, and it was measured by four adjective pairs on a 10-point rating scale. Tyler-Wood, Knezek, and Christensen (2010) shared that the reliability for this instrument was found with a Cronbach's alpha coefficient between 0.78 and 0.93.

3.8.5 Demographics

The instrument concluded with a section with items garnering demographic information on the participants within the study. The items gathered for this section included gender, grade level, ethnicity, and previous experiences. Participants chose between the options of male and female for gender demographics. For ethnicity demographics, the options included Black/African American, White, Hispanic/Latino/Mexican-American, Native Alaskan, Native Hawaiian or other Pacific Islander, Native American/American Indian, Asian American, and Other (with an option to type in the response. Demographic data options for grade level included a response option for every grade between 4th and 8th and also the option to choose "other." This study was originally aimed at students grade 4-8, however, the researcher worked with a 3rd grade classroom and some students that identified as other grade levels as well. Lastly, the demographic data for previous experiences included a range of 14 different options for participants to self-report their prior engagements. These previous activities included: gardening, cooking, raising animals for food, visited a farm, shopped at a farmers' market, donated food to those in need, recycling, camping, reading about food, reading about nature or the environment, fishing, hunting, playing outside, and spending time in nature. Each of these demographics were used to check relationships across demographic data with the other variables.

3.9 Validity

This study's content and face validity evaluated by student volunteers and a panel of experts. Face validity was evaluated through a pilot test by the student volunteers which included students who signed up for a test round of the virtual Agri+STEM Camp which included youth at home between fourth and eighth grade. These students were asked about the items on the pre and post questionnaire and whether or not they could comprehend what was being asked of them. Feedback from students confirmed that the instrument was comprehendible for the target grade levels. Content Validity was established through a panel of experts, which was made up of five individuals, including three faculty members and two master's degree students. These individuals were chosen because of their background in agricultural education and their knowledge of research methods and survey development. The individuals selected are all currently faculty members or graduate students in a college of agriculture. The areas of expertise represented by the panel of experts cover a wide range of topics related to this study including, experiential learning, learner-centered teaching, STEM through Agriculture and Food, diversity and equity in agriculture, community development interdisciplinary education, and STEM career development. While minor suggestions and edits were made to the instruments, there were no specific issues of validity that were identified as major.

3.10 Role of the Researcher

During the intervention of this study, the researcher served as the educator for the student participants. As the educator, the researcher prepared all of the lesson plans, facilitated all of the virtual sessions, and helped guide students through the virtual activities. As such, the researcher's role as an educator opened up the potential for bias. While the researcher aimed to attain honest results on the questionnaire from the students, the role of creating and determining the order of the questions might have influenced the way that students gave their responses (Qu & Dumway, 2011). This was addressed and monitored by having the study reviewed by a panel of experts and furthermore through weekly peer debriefing meetings with the research advisor.

While this potentially served as a cause for bias, the researcher's role also had some benefits. With a baccalaureate degree in food science and experience in engaging youth in agricultural topics, the researcher was able to stay organized and remain comfortable in the process of delivering the content. As a master's degree student, the Agri+STEM lessons were developed and initially pilot tested with elementary and middle school students in a graduate level course (ASEC 545: Teaching STEM through AFNR). Furthermore, it allowed the researcher to develop relationships with the students participating, which allowed for them to be more comfortable in the process of the virtual camp. This also allowed the researcher to have the opportunity to collect data in the same way throughout the data collection period.

3.11 Data Collection

With the limitations due to social distancing, the data collection process was primarily taken care of virtually. The researcher developed a Qualtrics link for parents and students to sign up for the Virtual Agri+STEM camp. This link was shared along with flyers through emails and other social media methods to reach more people. Once a parent/student registered, the researcher then sent a follow-up email with further details about the study and about the virtual camp. Included in these emails was a link to the pretest questionnaire and instructions for completion. The email specified for students to complete the pretest questionnaire before logging on the first day of camp. Furthermore, the researcher made sure to remind students throughout the first session to make sure that they completed the survey. The researcher set up the pretest questionnaire and posttest questionnaire in a manner that allowed for participants' information to remain confidential while also allowing for the researcher to match the questionnaires later for statistical analysis. At the completion of the virtual camp, the researcher reminded the participants that completion of a follow-up survey would be needed. The researcher shared the Qualtrics link with the students in the Zoom meeting on the final day and also through email to the parents. The researcher also sent out reminders through email to ensure that the participants completed the post-questionnaire. These questionnaires remained securely stored in the Purdue University Qualtrics system under the account of the researcher until all data were collected and the research was able to begin the analysis stage.

3.12 Data Analysis

The pretest and posttest questionnaire data collected for served as the quantitative data for this study. The Statistical Package of the Social Scientist (SPSS) was the program used by the researcher to analyze the responses of students across all of the items in this study. Descriptive statistics, which included means, standard deviations, and Pearson's correlation coefficient. Decimals were rounded to the $1/100^{th}$. All of the demographic data served as independent variables in this study, and they were measured at the nominal level. The dependent variables of food system concern, food system interest, activity engagement, and food system activity semantics all utilized descriptive statistics. Means and standard deviations were computed to describe students' respective food system concern, food system interest, activity engagement, and food system semantics. The relationships among the dependent and independent variables were analyzed using correlations. For interval and ratio variables, Pearson's product moment correlation coefficients were used. Spearman rank correlations were utilized for nominal variables with more than two options. For all nominal with two choices and interval variables, point-biserial correlations were utilized. The level of measurement, analysis, and breakdown of dependent and independent variables can be viewed in Table 3.4 below.

Table 3.7

Data Analysis by Research Question

Research Question	Independent Variables	Dependent Variable	Scale of Measurement	Analysis
RQ1: To what extent:				
1a) Did students report their level of concern regarding food system related issues before and after the food system lesson?	Previous Experiences	Food System Concern	Interval	**Mean, SD**
1b) Did students report their level of interest in food system related activities before and after the food system lesson?	Previous Experiences	Food System Interest	Interval	**Mean, SD**
1c) Did students report their level of activity engagement (interest/enjoyment, competence, value) after experiencing food system lessons?	Previous Experiences	Activity Engagement	Interval	**Mean, SD**
1d) Did students report their attitude towards the food system activities after the lesson?	Previous Experiences	Activity Semantics	Interval	**Mean, SD**
1e) Did students have previous food system related experiences?	Previous experiences		Nominal	**Frequency**

Table 3.4 continued

Research Question	**Independent Variables**	**Dependent Variable**	**Scale of Measurement**	**Analysis**
RQ2: What are the relationships among the following variables?				
2b) Food System Interest (pre and post)		Food System Interest	Interval	**Pearson's Correlation**
2c) Activity Engagement (Interest/Enjoyment, Competence, Value)		Activity Engagement	Interval	**Pearson's Correlation**
2d) Did students report their food system activity semantics after the food system lesson?		Activity Semantics	Interval	**Pearson's Correlation**
2e) Did students have previous food system related experiences?			Nominal	**Point-Biserial**

Note: This table gives an overview of the data analysis plan used for this study.

The statistical tests described in Table 3.4 were utilized to describe the relationships between the variables. Hopkin's (2000) conventions were used to explain the descriptions of the relationships (Table 3.5). Practical significance was determined using effect sizes. Items with a medium or large effect size were labeled as practically significant. Cohen's conventions were used to describe effect sizes for all relationships calculated with a Pearson's Correlation (Table 3.6). Cohen's d (1988) was used to calculate effect sizes for mean differences (Table 3.7).

Table 3.8

Conventions for Relationships (Hopkins, 2000)

Relationship Coefficient (r)	Convention
0.0 - 0.1	Trivial
0.1 - 0.3	Low
0.3 - 0.5	Moderate
0.5 - 0.7	High
0.7 - 0.9	Very Large
0.9 - 1.0	Nearly Perfect

Note: Relations were reported as positive or negative

Table 3.9

Conventions for Effect Sizes of Relationships (Cohen, 1988)

Effect Size Coefficient (r^2)	Convention
0.01 - 0.08	Small
0.09 - 0.24	Medium
> 0.25	Large

Table 3.10

Effect Sizes for Differences between Two Independent Means (Cohen, 1988)

Effect Size Coefficient (r^2)	Convention
0.0 - 0.2	Trivial
0.2 - 0.5	Small
0.5 - 0.8	Moderate
> 0.8	Strong

CHAPTER 4. RESULTS

4.1 Introduction

In this chapter, the results from this study are presented. The findings were organized first by presenting the reported demographics of the participants, followed by a section for each of the research questions that were addressed in this study.

4.2 Statement of the Purpose

The purpose of this study was to explore and describe elementary school students' interests and concerns about the food system, and their overall engagement in the learning experience after participating in an authentic learning based Virtual Agri+STEM Camp focused on food systems education, AFNR, and STEM activities.

4.3 Research Questions for the Study

1. To what extent:
    a. Did students report their level of concern regarding food system related issues before and after the food system education lesson?
    b. Did students report their level of interest in food system related activities before and after the food system education lesson?
    c. Did students report their level of activity engagement (i.e., interest/enjoyment, competence, value) after experiencing the food system education lessons?
2. What were the relationships among the following variables?
    a. Food System Concern (pretest and posttest)
    b. Food System Interest (pretest and posttest)
    c. Activity Engagement (i.e., Interest/Enjoyment, Competence, Value)
    d. Food System Activity (Semantics Scale)
    e. Previous Youth Experiences
    f. Demographics/Personal Characteristics (i.e., race/ethnicity)

4.4 Results for the Research Questions of the Study

This section will present the results found in this study for each research question. Results for each of the research questions along with the statistical analyses used for to answer each question will be described.

4.4.1 Results for Question 1a

Research Question 1a: *To what extent did students report their level of concern regarding food system related issues before and after the food system education lesson?*

Participants' Food System Concern

The Food System Concern questionnaire (Appendix B) contained 12 items and was the first component of the pretest and posttest questionnaire. This questionnaire measured students' concerns about the food system and food system related topics before (pretest) and after (posttest) the Virtual Agri+STEM Camp. Students' responses around their perceived level of concern were reported on a 4-point rating scale: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, and 4 = *Strongly Agree*. The average scores from the ratings reported by students, depicted in Table 4.2, showed that students "Agree" (M = 3.06, SD = .55) that they had a level of concern for the food system before the Virtual Agri+STEM Camp, and "Agree" (M = 3.10, SD = .50) to the same after the Virtual Agri+STEM Camp. The average scores of the participants indicated that they were concerned about the food system before the Virtual Agri+STEM Camp and after the camp. While the data showed a very small increase in concern from pretest to posttest, Cohen's effect size value was calculated (d = .08) and indicated that the practical significance was trivial for pre and post food system concern.

4.4.2 Results for Research Question 1b

Research Question 1b: To what extent did students report their level of interest in food system related activities before and after the food system education lesson?

Participants' Food System Interest

The Food System Interest questionnaire (Appendix B) contained 13 items and was the second component of the pretest and posttest questionnaire. This questionnaire measured students' interests in food system related activities and ideas before (pretest) and after (posttest) the Virtual Agri+STEM Camp. Students' responses around their perceived level of interest were reported on a 4-point rating scale: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, and 4 = *Strongly Agree*. The average scores from the ratings reported by students, depicted in Table 4.62 showed that students "Agree" (*M* = 3.25, *SD* = .55) that they had a level of interest for food system related activities and topics before the Virtual Agri+STEM Camp, and "Agree" (*M* = 3.23, *SD* = .52) to the same after the Virtual Agri+STEM Camp. The average scores of the participants indicated that they were interested in the food system related activities and topics before the Virtual Agri+STEM Camp and after the camp. The data showed a very small decrease in interest from pretest to posttest questionnaire. Cohen's effect size value was calculated (*d* = .03) and indicated that the significance was trivial between pre and post food system interest. This is displayed in Table 4.2.

Table 4.1

Descriptive Statistics and Effect Size for Pre and Post Concern & Interest

Variable	N	M	SD	D	Effect Size
Food System Concern PRE	99	3.06	.55	.08	Trivial
Food System Concern POST	99	3.10	.50		
Food System Interest PRE	99	3.25	.55	.03	Trivial
Food System Interest POST	99	3.23	.52		

Note: This table presents the descriptive statistic data for variables food system concern (pre/post) and food system interest (pre/post). *M = Means, SD= Standard Deviations, D = Cohen's d for effect size

4.4.3 Results for Research Question 1c

Research Question 1c: *To what extent did students report their level of activity engagement (interest/enjoyment, competence, value) after experiencing food system education lessons?*

Participants' Food System Activity Engagement

The students' Food System Activity Engagement portion of the posttest questionnaire (Appendix B) was used to measure student motivation and engagement within the activities after participating in the Virtual Agri+STEM Camp. There 12 items used for this measure, broken down into three subscales: 1) interest/enjoyment, 2) perceived competence, and 3) value/usefulness. Students' responses to the Food System Activity Engagement questions were reported on a 4-point rating scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree. Means and standard deviations were calculated for each of the subscales measured.

Students reported they "Strongly Agreed" that they were engaged and motivated regarding the interest/enjoyment (*M* = 3.64, *SD* = .47) of their experience in the Virtual Agri+STEM Camp (Table 4.3). Students reported that they "Agreed" they were engaged and motivated regarding their perceived competence (*M* = 3.41, *SD* = .59) after the Virtual Agri+STEM Camp. Lastly, with regards to the food system activity engagement measure, students reported that they "Agreed" that they saw value/usefulness (*M* = 3.48, *SD* = .57) in the food system activities for the Virtual Agri+STEM Camp.

Table 4.2

Descriptive Statistics for Food System Activity Engagement

Variable	N	M	SD
Interest/Enjoyment	99	3.64	.47
Perceived Competence	99	3.41	.59
Value/Usefulness	99	3.48	.57

Note: This table presents the descriptive statistic data for the Food System Activity Engagement Variables. *M = Means, SD= Standard Deviations.

4.4.4 Results for Research Question 1d

Research Question 1d: *To what extent did students report their attitudes towards the activities on the food system activity semantics rating scale?*

Food System Activity Semantics Rating

The students' Food System Activity Semantics Rating Scale portion of the posttest questionnaire (Appendix B) was used to measure student attitudes and emotions towards the activities and overall experience after participating in the Virtual Agri+STEM Camp. There were four adjective pairs that served as four items for this measure. One adjective represented a more positive experience and the other adjective represented a less positive experience. The adjective pairs were situated on a rating spectrum from 0 to 10, with one adjective at each end of the scale. Students were prompted to choose the adjectives that they identified with most by choosing a number on the scale closest to how they felt about the activities. There were two items that had more positive adjective pairs at the 10 on the spectrum with the negatively worded items at 0. The other two items reversed this order and had the more positive adjective pairs at the 0 on the spectrum and the negatively worded items at 10. The last two items were reverse coded to allow for accurate analysis so that means and standard deviations could be calculated. A grand mean was calculated after means and standard deviations were analyzed.

Students were prompted with the question "To me, the Virtual Agri+STEM Camp was:" to which they selected their respective number on the scale closest to the adjective/description that most aligns with them. These adjective pairs were rated on a scale of zero to 10 with 10 being the mre positive adjective. Semantics items three and four were reverse coded to match the scale of the other items, therefore a ranking of 10 would show a maximum level of positive attitudes towards the Virtual Agri+STEM Camp. Between adjective pairs "meant nothing" and "meant a lot" (Semantics item 1 – SEM1), most students reported a more positive attitude towards the camp activities meaning a lot to them (M = 8.52, SD = 2.21). Between adjective pairs "was boring" and "was interesting" (Semantics item 2 – SEM2), most students reported a more positive attitude towards the camp activities meaning a lot to them (M = 8.59, SD = 2.37). For the adjective pair "was exciting" and "was ordinary" (Semantics item 3 – SEM3), the researcher reverse coded the item and found that most students reported a more positive attitude towards the camp activities, specifically that it was exciting to them (M = 8.70, SD = 1.52). For the adjective pair "was fascinating" and "was unappealing" (Semantics item 4 – SEM4), the researcher reverse coded the item and found that most students reported a more positive attitude towards the camp activities, specifically that they were more fascinated with the activities (M = 8.70, SD = 1.47). Once all of the semantic scale were individually processed, a grand mean was analyzed to assess the overall attitude of students with regards to the Virtual Agri+STEM Camp. The overall mean for the semantics scale was $M = 8.56$ and the standard deviation was $SD = 1.47$. Table 4.4 displays the results from the food system activity semantics scale.

Table 4.3

Descriptive Statistics for Food System Activity Semantics Rating

Variable	N	M	SD		Overall Mean	Overall SD
SEM1	99	8.52	2.21	SEM	8.56	1.47
SEM2	99	8.59	2.37			
SEM3	99	8.70	1.52			
SEM4	99	8.70	1.47			

Note: This table presents the descriptive statistic data for the Food System Activity Semantics Rating Variables. The scale for these items were from zero to 10 with representing positive attitudes towards the activities. *M = Means, SD= Standard Deviations.

4.4.5 Results for Research Question 1e

Research Question 1e: *To what extent did students report their previous experiences? (Playing outside, Cooking, Spending time in Nature, Fishing, Shopping at a farmer's market, Visited a Farm, Gardening, Reading about Nature or the Environment, Hunting, Recycling, Reading about Food, Donating food to those in need Camping, Raising Animals for Food)*

Previous Experiences

The participants' Previous Experiences was part of the demographic portion of the questionnaire and this information was used to measure the number of food system related activities that the students had previously engaged in before the Virtual Agri+STEM Camp. This specific research question aimed to take record of what previous experiences students had participated for the main purpose of informing research question 2 where the researcher is looking for any correlations between previous experiences and students overall experience with the camp. Participants were asked to report previous experiences that they might have engaged in related to food systems and agriculture related topics. Students were able to self-report from a listing of 14 different activities. To see the rate at which students reported specific numbers of previous experience, activities were computed into a single variable and frequencies and percentages were taken to showcase the rate at which students reported their previous experiences. This is shown in Table 4.4.

Furthermore, percentages of students who participated in each respective previous activity were also taken, as noted in Table 4.5. Out of the 99 total participants the following activities were reported by the students: 83% reported that they played outside, 69% reported that they participated in cooking, 49% reported that they spent time in nature, 46% reported that they participated in a fishing experience, 37% reported that they had shopped at a farmer’s market, 35% reported that they had visited a farm, 33% reported that they participated in gardening, 33% reported reading about the environment, 33% reported that they had been hunting, 31% reported that they participated in recycling, 29% reported reading about food, 24% reported that they had donated food to those in need, 23% reported that they had been camping, and 22% reported that they had raised animals for food.

Table 4.5

Number of Previous Activities Reported by Participants (n = 99)

Number of Activities	Students that Participated
	% of students
1	15.2
2	9.1
3	10.1
4	7.1
5	10.1
6	13.1
7	8.1
8	7.1
9	3.0
10	11.1
12	3.0
13	1.0
14	2.0
Total	100

Note: This table displays the percentage of students reporting previous activities specific numbers of previous activities.

Table 4.6

Percentage of Participants Reporting Previous Activities (n = 99)

Previous Activity	Number of Students
Playing outside	83%
Cooking	69%
Spending time in Nature	49%
Fishing	46%
Shopping at a farmer's market	37%
Visited a Farm	35%
Gardening	33%
Reading about Nature or the Environment	33%
Hunting	33%
Recycling	31%
Reading about Food	29%
Donating food to those in need	24%
Camping	23%
Raising Animals for Food	22%
Total	100%

Note: This table presents the percentage of participants who reported experiencing specific previous activities

4.4.6 Results for Research Question 2

Research Question 2: *To what are the relationships among participants' Food System Concern, Food System Interest, Food System Activity Engagement, Food System Activity Semantics Rating, and their Previous Experience?*

Correlations among Variables

For research question 2, Pearson's correlation coefficients were used to describe the relationships between participants' food system concern, food system interest, food system activity engagement, food system activity semantics rating, and their previous experiences. To measure the strength of relationships among the variables, Hopkins (1997) conventions were used and Cohen's (1988) conventions were used to measure effect size. An effect size (r^2) that is <.08 is considered to have a small effect, the effect sizes between 0.09 - 0.24 are considered to have medium effect, and effect sizes >.25 are noted to have large effect sizes. A medium effect size (.09 - .24) or larger is needed to be considered practically significant. With regards to relationship strength (r), a scale is used to assess the level of strength between the variables. A trivial relationship ranges from 0.00 - 0.10, low relationships range from 0.11 - 0.30, moderate relationships range from 0.31 - 0.50, high relationships range from 0.51 - 0.70, very large relationships range from 0.71 - 0.90, and nearly perfect relationships range from 0.91 - 1.00 (Hopkins, 1997).

Based on results collected in this study there were several significant correlations among the variables, as illustrated in Table 4.10. These correlations will be explained by the first by the variables with the most correlations. Participants' post food system interests were significantly correlated with their post food system concerns (r = .77, very large, positive). Therefore, as participants' interests in the food system and food system related activities increases, their concerns for the food system and food system related issues increases. Post food system interest was also significantly correlated with participants' food system activity engagement – interest/enjoyment (r = .39, moderate, positive), food system activity engagement – perceived competence (r = .50, high, positive), food system activity engagement – value/usefulness (r = .49, moderate, positive). Therefore, as participants' interest/enjoyment, perceived value, and perceived competence increased (self-determination) their interest in food systems and food systems related activities also increases by seeing the value/usefulness, feeling competent in the activities, and being interested/enjoying the learning experience. Participants' post food system concerns were significantly correlated with food system activity engagement – interest/enjoyment (r = .35, moderate, positive), food system activity engagement – perceived competence (r = .50, high, positive), and food system activity engagement – value/usefulness (r = .46, moderate, positive). Therefore, as participants' see the value/usefulness, feel competent, and are interested/enjoy the learning experience, their concerns for the food system and food system related topics increases. Post food system concern was not significantly correlated with the food system activity semantics rating (r = .19, low, positive) or with previous experiences (r=.12, low, positive). Food system activity engagement – interest/enjoyment was significantly correlated with food system activity engagement – perceived competence (r = .77, very large, positive), food system activity engagement – value/usefulness (r = .78, very large, positive), and with the food system activity semantics rating (r = .45, moderate, positive). Therefore, as participants' interest/enjoyment increases, they will see more of the value/usefulness, feel more competent in the learning experience, and have more positive attitudes towards the learning experience. Food system activity engagement - perceived competence was significantly correlated with food system activity engagement – value/usefulness (r = .76, very large, positive), and with the food system activity semantics rating (r = .38, moderate, positive). Therefore, as participants' increase in feeling competent, they will more likely feel see the value in the learning experience and more likely have more positive attitudes towards the learning experience. Participants' food system activity engagement – value/usefulness was significantly correlated with their food system activity semantics rating (r = .44, moderate, positive). Therefore, as participants' see the value in the learning experience, they will have more positive attitudes towards the learning experience. These correlations can be seen in a more direct model with figure 4.1. Participants' pre food system concern was only correlated with pre food system interest (r = .73, moderate, positive), post food system concern (r= .49, small, positive), post food system interest (r = .51, moderate, positive), food system activity engagement – perceived competence (r = .28, small, positive), and food system activity engagement – perceived value (r= .34, small, positive). Participants' pre food system interest was only otherwise correlated with post food system concern (r = .41, small, positive), post food system interest (r = .48, small, positive), and food system activity engagement – perceived value (r = .21, small, positive). Community type relationships with two variables. Participants community type was significantly correlated with their Post Food System Concern (r = .2, medium, positive), and with Race/Ethnicity (r = .24 medium, positive). Therefore, depending on the participant's community their level of post food system concern varied and their race/ethnicity varied among their community type also. Both Gender and Grade level had no significant relationships with any of the other variables.

Furthermore, in relation to the activity engagement variables: (1) competence explained 25% of the variance for students interests and 25% of variance for students' concerns for the food system after completing the camp experience; (2) value explained 21% of variance in student post concerns and 24% in students post interests; and (3) interest/enjoyment explained 12% of variance in student post concerns and 15% of post interest.

Table 4.7 *Pearson Correlations among Variables*

Variables	Pre_FS_CON	Pre_FS_INT	Post_FS_CON	Post_FS_INT	ACE_Int	ACE_Comp	ACE_Val	SEM	Prev_Exp	Race/ Ethnicity	Gender	Grade Level	Comm. Type
Pre_FS_CON	--												
Pre_FS_INT	.73**	--											
Post_FS_CON	.49**	.41**	--										
Post_FS_INT	.51**	.48**	.77**	--									
ACE_Int	.12	-.02	.35**	.39**	--								
ACE_Comp	.28**	.12	.50**	.50**	.77**	--							
ACE_Val	.34**	.21*	.46**	.48**	.78**	.76**	--						
SEM	.17	.05	.19*	.19*	.45**	.38**	.44**	--					
Prev_Exp	.06	.03	.12	.15	.20*	.23*	.25*	.06	--				
Race/ Ethnicity	-.01	.03	-0.21	-0.25*	0.04	-0.07	-0.02	0.05	.34**	--			
Gender	-.08	-.05	.02	-.01	-.04	.05	-.9	.03	.09	.19	--		
Grade Level	.19	.05	.01	.14	.04	.04	.10	-.18	.06	-.08	-.03	---.	
Comm. Type	.17	.08	.21*	.19	.07	.19	.16	-.04	.14	.24*	.12	.08	--

Note. This table displays all of the relationships between the variables of this study. * Indicates level of significance, Pre_FS_CON = Food System Concerns, Pre_FS_INT = Food System Interest, Post_FS_CON = Food System Concerns, Post_FS_INT = Food System Interest, ACE_Int = Food System Activity Engagement (Interest/Enjoyment), ACE_Comp = Food System Activity Engagement (Perceived Competence), ACE_Val = Food System Activity Engagement (Value/Usefulness), SEM = Food System Activity Semantics Rating Scale, Prev_Exp = Previous Experiences, and Comm. Type = Community Type

These findings revealed that participants' food system interests and food system concerns had very large relationships between each other and moderate to high relationships between the variables under food system activity engagement but there was little to no relationship with how they rated their attitudes on the food system activity semantics. Findings also revealed that variables under food system activity engagement had strong relationships among each other and more moderate relationships with the food system activity semantics rating while having a weaker relationship with previous experiences. Participants' previous experiences had no relationship to their food system concerns or food system interest.

Further analysis explored the relationships between the demographic data and all of the other variables. There was no significant relationship between gender or grade level with any of the other variables. However, the analysis showed that race/ethnicity had a significant relationship with both pre/post interest and concern variables, and also with previous activities. This prompted the researcher to disaggregate the data and look further at the specific previous activities. Races/ethnicities that had fewer than 10 participants were excluded from the analysis (i.e., Hispanic/Latino, Native American/American Indian, Native Alaskan, and Other). As such African American and Caucasian American students were compared. Race/ethnicity cases were sorted, and a split file was run to determine the specific differences in previous activities based on race. This analysis showed that African American participants had significantly less previous AFNR experiences/activities in comparison to those reported by Caucasian American participants, especially around natural resource related (Table 4.7)

Table 4.4

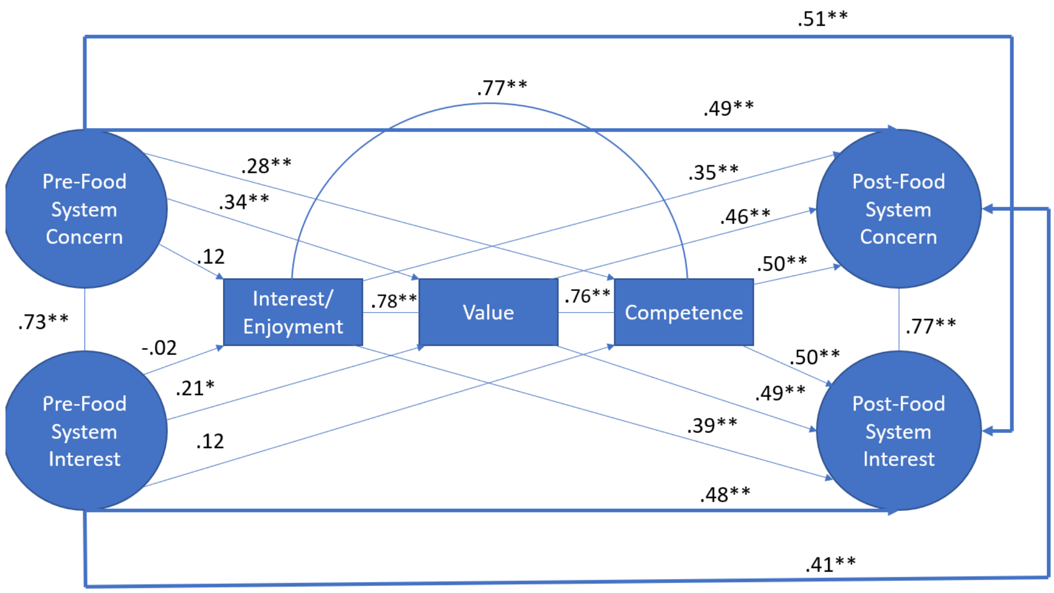
Previous Experiences by Race (n = 99)

Categories	Previous Activities	% of Students that Participated	
		African American Participants	Caucasian American Participants
Agriculture	Visited a Farm	31%	50%
	Gardening	29%	50%
	Raising Animals for Food	23%	33%
Food	Cooking	68%	78%
	Shopping at a farmer's market	31%	61%
	Reading about Food	25%	33%
	Donating food to those in need	16%	33%
Natural Resources	Reading about Nature or the Environment	23%	61%
	Hunting	31%	39%
	Recycling	29%	44%
	Playing outside	84%	83%
	Spending time in Nature	43%	67%
	Camping	16%	61%
	Fishing	45%	72%

Note: This table presents a breakdown of the reported previous experiences by African American and Caucasian American Students. Activities are grouped by their AFNR type and percentages are reported by ethnic group.

While African American Students reported having less previous AFNR experiences than Caucasian American students, they also reported having higher interests and concerns about the food system before and after the Virtual Agri+STEM Camp than Caucasian students. There were significant differences in the reported interest and concerns between African American and Caucasian American students. Effect sizes were calculated between the groups and showed that before the Agri+STEM experience, there was: 1) a strong effect size for Food System Concern (d = .81); and 2) a small effect size for Food System Interest (d = .21). For after the Agri+STEM experience, effect sizes showed: 1) a moderate effect size for Food System Concern (d = .52); and 2) a moderate effect size for Food System Interest (d = .63). These findings further support the notion that participants' previous experiences had no relationship to their food system concerns or food system interest, as students with less reported experiences also reported being more interested and concerned in the food system.

Overall, these finding revealed that previous experiences had little to no correlation to students' level of engagement and attitudes from the Virtual Agri+STEM Camp and overall, it had no bearing on their general food system concerns or food system interests (Table 4.10). Students who reported less AFNR related previous activities were more interested and concerned than those that reported more of them. However, students who reported feeling more interest/enjoyment, saw the value, and felt competent (IMI variables) in the experience were more likely to report higher levels of interest and concerns regarding the food system as represented in Figure 4.1. While previous experiences were not reported with higher levels of interest and concerns, IMI variables were reported with higher levels of interests and concerns and these relationships should be further explored. Each of the variables within this study and as shown on the conceptual framework highlighted to show their relationships in Figure 4.1, below. As students reported higher levels of activity engagement variables (interest/enjoyment, competence, and value) they also reported higher levels of Post Food System Interest and Post Food System Concern, as displayed in figure 4.1.



Note. This figure displays the relationships among the pre/post food system interest and concern variables along with the activity engagement IMI variables of interest/enjoyment, value, and competence.

Figure 4.1

Correlations across the Conceptual Framework

CHAPTER 5. CONCLUSIONS AND DISCUSSION

5.1 Introduction

The conclusions for this study are presented in this chapter. Overall, four conclusions will be shared to include a discussion with regards to how this study contributes to the knowledge base are presented. Implications for practice are also presented within each conclusion. Implications for policy and recommendations for future research are then shared to conclude this chapter.

5.2 Statement of Purpose

The purpose of this study was to explore and describe elementary school students' interests and concerns about the food system, and their overall engagement in the learning experience after participating in an authentic learning based Virtual Agri+STEM Camp focused on food systems education, AFNR, and STEM activities.

5.3 Research Questions for the Study

1. To what extent:
    a. Did students report their level of concern regarding food system related issues before and after the food system education lesson?
    b. Did students report their level of interest in food system related activities before and after the food system education lesson?
    c. Did students report their level of activity engagement (i.e., interest/enjoyment, competence, value) after experiencing the food system education lessons?
2. What were the relationships among the following variables?
    a. Food System Concern (pretest and posttest)
    b. Food System Interest (pretest and posttest)
    c. Activity Engagement (i.e., Interest/Enjoyment, Competence, Value)
    d. Food System Activity (Semantics Scale)
    e. Previous Youth Experiences
    f. Demographics/Personal Characteristics (i.e., race/ethnicity)

5.4 Conclusion 1

Students that participated in the Virtual Agri+STEM Camp were motivated and engaged in the learning process while doing the Agri+STEM Camp activities.

5.4.1 Discussion

Students in the Virtual Agri+STEM Camp were motivated because they felt competent, saw the value and usefulness, and enjoyed doing the activities. When assessing the level at which participants saw the value/usefulness of the Agri+STEM Camp, nine out of 10 participants reported that they agreed that: (1) the Virtual Agri+STEM Camp was beneficial to them; (2) they would do the camp again because they saw the importance/value; and, (3) they believed that doing activities like the Virtual Agri+STEM Camp can help them understand where food comes from. When it came to perceived competence, nine out of 10 participants reported that they agreed that: (1) they felt like they were good at doing the Agri+STEM Camp Activities; and (2) they felt satisfied with their performance in the Agri+STEM Camp. Lastly, participants in this study also reported that they that they were interested and enjoyed the Virtual Agri+STEM Camp activities. When assessing interest and enjoyment, 19 out of 20 participants reported they agreed that: (1) they enjoyed doing the Virtual Agri+STEM Camp very much; and (2) the camp was fun to do. These findings suggest that students enjoyed and found interest in the Virtual Agri+STEM Camp activities, they saw value and usefulness in participating in the activities, and they felt confident and comfortable in their abilities while navigating the Virtual Agri+STEM Camp. These findings support the notion that students positively reported levels of intrinsic motivation from the activities in the Virtual Agri+STEM Camp.

In connecting the Agri+STEM lessons to the IMI subscale of interest/enjoyment, the researcher focused on how to make the learning experience more engaging to spark the interests of students. Incorporating experiments, sensory analyses (i.e., taste testing), and simple hands-on activities with everyday household items was one of the key factors the researcher observed that sparked an interest in student engagement in the learning experience. When it came to value/usefulness, the researcher was strategic in shaping the Agri+STEM camp lessons in a way that would be relevant to students by connecting science, food systems, and AFNR back to the community. With regards to competence, the researcher recognized the importance of developing age-appropriate authentic activities that would help build students' competence.

This conclusion supported the body of literature regarding the theory of self-determination (SDT) and, more directly, supported previous studies which indicate that the use of more engaging and experiential instructional strategies/contexts can be a positive influenxe student motivation in the learning experience and potentially lead to more self-determined individuals (Liu, Horton, Olmanson, & Toprac, 2011; Hidi & Harackiewicz, 2000). SDT identifies that individuals are naturally motivated and inclined to try to want to satisfy the needs of competence, autonomy, and relatedness.

When it comes to competence, Liu et.al. (2011) points out that competence is acquired at the intersection of self-efficacy and feeling challenged and that it is further developed when individuals gain new and better skills and abilities and receive positive feedback. While students self-reported their perceived level of competence in this study, the researcher imbedded relevant hands-on learning experiences into the lesson while also ensuring that the content was at a level to that students could adequately comprehend.

Autonomy is said to be promoted when a person finds personal value or interest in a specific task (Ryan et.al., 2006). Autonomy was imbedded into the learning experiences through the use of activities, particularly the product development activity where students were tasked with creating their own pickle flavors/recipes and then with then tasked with making their own marketing plan (i.e. commercial, skit, jingle, etc.) to then present and sell to their classmates.

Lastly, the need for relatedness is said to be met when students feel connected to others in the learning experience and secure in themselves (Liu et.al. 2011). Although the concept of relatedness was not explicitly explored in this study, the researcher posits that relatedness was a component of the learning experience as students were prompted to build connections with their classmates as they were: (1) asked to discuss their personal food story; and (2) encouraged to work in groups to develop and present their own food products (e.g., pickles). As pointed to in this study, experiential and authentic learning strategies embedded in the learning experience has the capacity to further engage and motivate students and help them in the process of becoming more self-determined individuals.

Furthermore, and even more specific to the context of this study, this conclusion also supported previous studies that used SDT as a framework point to food systems and other AFNR related activities as a contextualized experiential strategy. For example, gardening can be a means for educating students and as a way to develop more motivated and self-determined students (Shaw, 2020; Martin, 2017). Shaw (2020) compiled a listing of critical building blocks (i.e., recognizing where food comes from, personal/cultural connections, community building, science exploration) in elementary garden education that help lead to a better understanding of the food system and pointed out how these building blocks connect back to SDT because of their ability to provide a more developed and advanced learning experience. Martin (2017) used SDT as a theoretical framework in looking at how contextual teaching and learning through garden activities can be used to explore the relationships among "food and garden experiences, school engagement, future educational aspirations, activity engagement, and activity motivation of middle school students" (p.15). This study and it's conclusions showed that food and garden-based activities were not only engaging to students, but also motivating and that food-based and garden-based activity participation was a variable associated with higher levels of reported school engagement by participants (Martin, 2017). Both of these studies showed that AFNR can be used as a building blocks to help students become more self-determined and as a context help them become more intrinsically motivated and engaged.

This conclusion also speaks to the credibility and utility of using the IMI, as supported by SDT, as an assessment tool in studying student experiences when engaged in authentic and experiential AFNR and STEM activities. The correlations between the interest/enjoyment, perceived competence, and value/usefulness variables were among the highest of all the variables measured in this study (see Conclusion 4). While the IMI has already been noted as tool of high reliability and and validity (McAuley, Duncan, & Tammen, 1987), the strength of the relationships between these subscales from this study help to support the validity of this instrument and shows the relevance between these specific variables.

5.4.2 Implications for Practice

When considering Conclusion 1 of this study, there are two main implications for practice related to student motivation to engage in Agri+STEM learning experiences and activities: (1) afterschool and other youth-based programs need to think about how they can use SDT as a means to better engage and motivate youth; and, (2) virtual methods of engaging youth in learning experiences need to be further explored. Focusing on assessing these activity engagement variables in efforts to help students become more self-determined allowed for the researcher to better develop the Agri+STEM lessons in a way that would speak to each of these components. If afterschool and other youth-based programs are truly trying to build the next generation of leaders, scientists, and activists, then SDT should be looked at as a framework to better develop and deliver programming to youth in efforts of intrinsically motivating the leaders of tomorrow and empowering them to become more self-determined. Furthermore, AFNR should be viewed as a vehicle to make these learning experiences more engaging because of the experiential and authentic nature of the field.

Educators and practitioners need to leverage authentic and contextualized learning experiences as it relates to relevant social issues like the food system to better engage students in the learning experience. As youth educators are trying to engage more underrepresented students in their programming, they should look into trying to center learning around a problem, a social issue, or grand challenge that connects to the learner. SDT should then be used as a framework to try to find ways to better engage these students in learning activities and tasks that are relevant to their everyday life and that build upon things that students already know or are familiar with. In this study, students were tasked with making their own pickle products, and as consumers of snack foods like pickles, students already came to the learning experience with their own knowledge and thoughts on what they would like their pickles to taste like and lastly, what would be "popular." This was something that sparked excitement to participate and that was relevant enough to students that they could understand the task. As educators and others do programming for youth, they need to consider making the learning experience more relevant by thinking through what their audience finds interesting/enjoyable, what their audience sees value/usefulness in, and, furthermore, what activities could they have them do that would help build their competence and confidence. When these points are taken into consideration, educators make the learning experience more relevant to their audiences and they increase their potential to intrinsically motivate and empower youth to be more engaged in these topics and have the capacity to lead them to action. These are all practices that should be kept in mind when developing youth education programming, and SDT serves as a primary fit to better motivate students and make learning authentic.

Secondly, in the process of developing this study, the researcher was able to note the value of engaging students in virtual learning experiences. While in-person hands-on experiences were originally planned, the COVID-19 pandemic presented challenges to this more traditional approach to youth engagement, prompting the researcher to pivot in this study into a virtual learning venue. Based on this conclusion, the virtual learning space did not take away from the learning experience or keep students from becoming intrinsically motivated. Rather, the virtual venue allowed for the researcher to broaden access to the learning experience while incorporating technology and visuals that might not have been as seamlessly used in person. As educators and youth program leaders continue to search for ways to reach more students, they should consider using virtual methods to better engage students, such as Zoom. Virtual platforms offer the opportunity to reach more students at once with less expenses that would have normally been used on travel. Using this method of delivery in an engaging way should be considered for educators, afterschool, and other youth programs who are limited due to effects of the COVID-19 pandemic, but also for future reference post-pandemic.

5.5 Conclusion 2

Students who participated in the Virtual Agri+STEM Camp were interested and concerned about the food system-related topics and activities before and after participating in the Virtual Agri+STEM Camp.

5.5.1 Discussion

When assessing the level at which students reported their food system concern, six out of seven participants reported that they agreed that they were concerned about the way that their food was handled before it got to them (i.e., food safety). Three out of four participants reported that they agreed that they were concerned about the decisions law makers make regarding food. Eight out of 10 participants reported that they: (1) agreed that they were concerned about food waste; (2) that they were concerned about the impacts on the environment; and (3) that they were concerned about the health of the soil in which their food grows. Finally, nine out of 10 participants reported that they agreed that they were concerned about the people going hungry in their communities.

When assessing the level at which students reported their food system interest, five out six participants reported that they agreed they are interested in learning about the life stages of food from seeds to plate. Eight out of 10 participants reported that they agreed they are interested in learning about what makes up a healthy diet. Finally, and nine out of 10 participants reported that they agreed they are interested in learning the differences between processed food and fresh food; and nine out of 10 they also reported that they agreed they are interested in learning about the health problems that come with (are associated with) limited access to food.

Participants had a similar levels of concern and interest in the food system topics addressed before and after the Virtual Agri+STEM Camp. There may be three plausible reasons for this finding. First, this could be due to the novelty of the Agri+STEM Camp such as the authentic learning approach and hands-on learning experiences. This could have sparked students to already have a level of interest and concerns for the food system before taking the pre-questionnaire. Second, this could also be attributed to the appeal of this hands-on experience during a time of social-distancing and home confinement. The Virtual Agri+STEM Camp, especially in contrast to the limited engagement during virtual learning experiences that they were subject to during the COVID-19 pandemic, offered students an opportunity to not just learn about STEM and AFNR but to engage in hands on experiences and experiments. This contrast may have contributed to the appeal and high levels of interest/concern. Lastly, and probably most notable, students may have just come into the camp experience with their own strong levels of interest and concern for the food system based on their personal experiences. This could be due to the language on the items in the instrument being accessible and relevant to students' lived experiences through food. For example, the majority of students who participated in this study are from a socioeconomically depressed area that has experienced some of the food systems challenges posed in this study. This would explain the level of agreement between pretest and posttest questionnaire regarding food system interests and concerns, and, furthermore, the types of activities shared may be the very types of opportunities students are looking for in the learning experience.

This conclusion supports the knowledge base that points to the value of incorporating authentic learning strategies into the learning experience. Authentic learning is noted as an educational strategy that encourages student exploration, discussion & dialogue, and meaningful construction of concepts centered around real-world and community based issues that are relevant in efforts to bring about a deeper connection and understanding to the learning process (Donovan, Bransford, & Pellegrino, 1999). With regards to science education, authentic tasks are noted to enhance the development and overall culture of science in the classroom and, furthermore, authentic activities represent what students face in their everyday lives (Casely, 2004; Knobloch, 2003). Each of the components in the food system interest and food system concern questionnaires were based on real world issues in the environment, around health, food production/processing, and food access/security all of which were concepts that were addressed in the Virtual Agri+STEM Camp. The value of authentic learning and the relevant nature of the Agri+STEM topics was further justified when students reported high levels of interest and concerns regarding the food system before and after the camp. Meaning that these topics were relevant to students to students' personal lives before the experience and these topics remained important to students after the experience.

This conclusion also supports multiple other studies that have pointed to the use of authentic learning strategies, especially those incorporating AFNR concepts, to help better engage students (Van Tine, 2005; Knobloch, 2008; Knobloch, Ball, & Allen, 2007). What most researchers define as experiential learning experiences aligns directly with standards for authentic learning which has the potential provide a sound psychological framework for learning (Knobloch, 2003). This is evident in Van Tine's (2005) study where she looked at using AFNR to engage elementary students in experiential learning experiences in the classroom. She found that the experiential learning activities motivated students to learn about agriculture and the environment and pointed out that the nature of the activities engaged students to learn about the agroecosystems in an authentic way (Van Tine, 2005). Other researchers have found that elementary teachers find value in teaching AFNR as it provides an authentic learning context for the classroom (Knobloch, 2008; Knobloch, Ball, & Allen, 2007). Specifically, teachers integrated AFNR topics into their instruction if they saw the value and authentic connection to fit their content areas (Knobloch, 2008).

Lastly, this conclusion also supports studies that utilize agricultural literacy and food systems education to engage students to learn in new ways. For example, as this conclusion is focused on the high levels of student interests and concerns regarding the food system, it further supports the use of food systems education to reach students in new ways like Prescott et.al. (2019) who used food systems education with 6th grade students and found that food systems education can be used to improve fruit and vegetable consumption of students and limit their food waste during school meals. It also supports Charoenmuang's (2020) findings who used food systems education as a way to assess suburban high school students' level of systems thinking after going through an online sustainable food systems program and found that students recognized the benefits of thinking in a systems way. Noting the previous work that has been done in these areas, this conclusion supports the notion that food systems can be used as a context to authentically engage students within the classroom because of the level of interests and concerns displayed around food systems.

5.5.2 Implications for Practice

When considering Conclusion 2 of this study, there are two implications for practice regarding students' level interest and concern about the food system: (1) food systems education offers a context that provides an opportunity for educators to better engage their students through authentic learning activities based on real-world experience; and (2) food systems and authentic learning strategies helps educators and students to make connections beyond the classroom. As educators, especially science teachers, look to find ways to connect learning in the classrooms with students interests and potentially their concerns and values, food systems should be viewed as a way to make the learning experience more authentic. As authentic learning strategies are based on real world experiences, it provides educators an opportunity to make learning relevant for students. This conclusion clearly identifies that students were interested and concerned about the food system and food system related activities, which should encourage educators to utilize it as a context to better connect with students.

Furthermore, taking a step outside of food systems, educators should take the extra step to identify societal issues and grand challenges of interest/concern to students that can connect back to their classrooms. These topics could include be centered around community-based issues that may be seen locally, including, but not limited to topics such as social justice, health, economic development, climate change, and even the effects of poverty. Not only will this help make the learning experience better, but it could potentially lead to students being engaged in enhancing their communities. When youth are able to participate in authentic and meaningful sustainability-related issues like food systems, it not only benefits the food system and society, but it helps contribute to community and youth development in a positive way (Linds, Goulet, & Sammel, 2010; Schusler & Krasny, 2010).

Noting that authentic learning and food systems can be beneficial to both youth and communities, it is also important to note that they also provide a context for making connections beyond the classroom. Because authentic learning is based on real-world experiences, it provides an opportunity for educators to incorporate students home knowledge and lived experiences in into the learning experience. Within this study, students were able to connect to science, agriculture and food systems, culture/history, and even their community. It would be useful for teachers to incorporate this type of strategy into their classroom, a wholistic and interdisciplinary approach to learning. By making the learning experience more authentic and making connections to students' knowledge outside of the classroom, educators are able to give students the opportunity to feel ownership over their learning experience and become more engaged.

5.6 Conclusion 3

African American student participants reported less previous AFNR experiences, yet they reported more interests and concerns in the food system than Caucasian American participants before and after completing the Virtual Agri+STEM Camp.

5.6.1 Discussion

When looking at the correlation between participants reported previous AFNR experiences and their ethnicity, on average, African American students reported having participated in about five previous AFNR-related experiences in comparison to their Caucasian American counterparts who averaged having eight prior experiences out of 14 different previous experiences listed in the questionnaire. More specifically, when looking at each individual experience, less than 50% of African American students reported participating in 12 of the AFNR activities, while there were only 4 AFNR activities that less than half of the Caucasian American students reported they experienced. When comparing African American to Caucasian American students, there were eight different experiences that showed a significant difference in the two groups: (1) Gardening; (2) Shopping at a Farmer's Market; (3) Visiting a Farm; (4) Camping; (5) Fishing; (6) Reading about Nature; and, (7) Spending Time in Nature. However, while African American students reported having fewer previous AFNR experiences than Caucasian American students, they also reported having higher interests and concerns about the food system before and after the Virtual Agri+STEM Camp than Caucasian students. There were significant differences in the reported interest and concerns between African American and Caucasian American students.

Recognizing these differences, it is important to note which of the three AFNR-based activities African American students reported being most experienced with and which ones they had little to no previous experiences with, in comparison to Caucasian American students. Of the AFNR previous activities assessed, African American reported having higher levels of experiences with the food-related components of ANFR. Overall, African American students reported having a lot less experience with natural resource-related activities in comparison to their Caucasian counterparts. Yet, comparably, African American students reported higher levels of interest and concerns regarding the food system. Because the activities of the Agri+STEM camp were more directly connected to food-based AFNR activities, perhaps African American students found higher interest in the camp because they were more familiar with the activities. This could very well encourage the notion that food is a prime topic area to use to authentically engage students in the learning experience while making it relevant. Ultimately, this conclusion shows that regardless of students having fewer experiences, they can still be interested in and motivated to learn about topics that they might not be as familiar with.

This conclusion supported the knowledge base around the previous experiences of students, especially African American students, regarding AFNR activities and some of the limitations and disparities that some students experience in these spaces (Brown, 2018; Pettigrew, 2018; Sprague et.al., 2020; Van Tine 2005). In this study, Caucasian American students reported higher levels of camping like the students in Van Tine's (2005) study where 73% of students in a suburban mid-west community reported having camping experiences. This conclusion also aligns with what Sprague, Berrigan, and Ekenga (2020) pointed out in their study highlighting the role of nature experiences and contact as an influencer of health disparities between populations. That, in comparison to black children, white children have significantly more nature-based experiences and contact with nature, which can be pointed to the educational inequalities that black and Hispanic children face in comparison to white and higher income children (Sprague, Berrigan, Ekenga, 2020). This is very relative to the natural resource category of reported previous activities from this study in that African American youth reported less natural resource and environmental experiences than Caucasian American students. This conclusion also supported Pettigrew's (2018) study that explored how the motivation of urban African American middle school parents plays a role on the interest their child has in agriculture and STEM activities. Pettigrew (2018) found that, on average, urban parents in her study reported participating in four different types of activities with their children, similar to the five on average reported in this study. Pettigrew (2018) also found that of the four activities reported, AFNR-related activities were least popular and least reported with participants reporting activities like visiting a greenhouse at 3%, visiting a farm at 4%, and camping at 6%. It was also noted in Pettigrew's (2018) study, that potentially parents do not have AFNR-related opportunities presented to them to engage their children in even though these same parents wanted to engage their children in agriculture and STEM activities. This aligns directly with the overarching theme of this conclusion in that African Americans reported less previous experiences and activities, yet there is a large interest to engage in these types of activities.

Lastly, this conclusion also added to the knowledge base because it offers findings related to youth interests and concerns with a large participant population of African American students. African American youth interests, concerns, and engagement with the food system is an area in the literature in need of growth and this conclusion and study as a whole provides more insights to this area.

5.6.2 Implications for Practice

When considering Conclusion 3 of this study, there are a number of implications that come to mind. However, most of these implications for practice can be placed under the umbrella of one major theme and that is access for underserved communities. These implications around access for underserved communities can be highlighted through three key points: (1) misconceptions and myths about African Americans in AFNR; (2) role models and relationship building; and (3) relevant connections: culture and community vs. careers.

Access for Underserved Communities

To fully understand the necessary implications for practice around this access for these communities, it is important to first note some of the gaps and barriers that exist around engaging students, especially those from underserved communities like African Americans in agriculture. As noted in this conclusion, African American students were interested in activities and further learning around the food system and food system topics. Unfortunately, their access to opportunities for these experiences continues to be limited, leaving a gap around food literacy and how they can explore food in a scientific or liberating way. The literature speaks to some of the struggles and limitations that traditional and even policy-initiated programs (i.e., Extension, 4-H) based in AFNR have with engaging and serving African American audiences (Brown, 2018; McCray 1994).Specifically Brown (2018) outlined some of these barriers in her study that provided a number of insights into the agricultural experiences, or lack thereof, with regards to African American students. Brown (2018) pointed out three main issues that contribute to the scarcity of African Americans in agriculture and STEM: (1) lack of mentorship, role models, and representation, (2) negative perceptions, and (3) limited access to educational experiences in agriculture. Focusing specifically on the third factor shared, Brown (2018) highlighted that student achievement is influenced by their access or possession to capital and that African Americans students are in need of programming that not only helps engage them in agriculture and STEM, but that also helps them gain social and cultural capital also.

As educators continue advance in the era of technology and industrialized food systems where food producers and manufacturers are finding more efficient ways of doing business, there is a gap around consumer's knowledge that continues to grow as this advancement takes place. Fewer people are connected to the food system today than there were 100 years ago, leaving many youth without an understanding of where their food comes from. Food has become normalized as an abstraction to youth to a point that they no longer look at food as something from nature that has nutritional and ecological significance (Barton, 2005). It has been noted that basic knowledge of the environment and the interconnected systems has been on the decline leaving many citizens with limited knowledge about their food (Kimura, 2011; Hubert, Frank, & Igo 2000).

Furthermore, programs that would typically provide more of a sense of food education like family and consumer sciences (FCS) are experiencing significant declines in availability of programs and ultimately enrollment. Wehran (2013) found that between 2002 and 2012 FCS student enrollment had decreased by over 38%. These were some of the only opportunities for youth to engage in getting a better literacy around food, food safety practices, and hands-on food learning. When it comes to underserved communities in agriculture like African Americans, this issue is further exacerbated as disparities in access and experiences exist. Brown (2018) pointed out that even though traditional programs like 4-H and FFA are doing a great job of influencing students to engage in AFNR and STEM through hands-on experiential (authentic) learning, leadership development, and other avenues they are struggling to reach African American youth. The limited opportunities and inequities in access for African Americans around AFNR have also caused this involuntary absence to be misconstrued as lack of interest or concern for AFNR related topics. Practitioners, educators, and program developers need to (1) address misconceptions and myths about African Americans in AFNR; (2) incorporate role models and relationship building in their programming; and (3) make relevant connections in the learning experience, using culture and community as a draw in vs. careers. These implications are explained further below.

Myths and Misconceptions of African Americans in AFNR

In efforts to address these issues of access, AFNR educators, administrators and researchers need to actively work to call out and negate misconceptions regarding African Americans within AFNR contexts, and work towards better engaging these populations (Larson et.al. 2010; Jones, 2002; Nxumalo & Ross, 2019; McCray, 1994; Brown, 2018). A number of studies have been done over the last 30 years that have not only identified disparities around race and environmental engagement opportunities, but they have also outlined and negated a number of myths and misconceptions about African Americans' interests, concerns, and education regarding the environment (Taylor, 1989; Jones, 1994, Jones, 2002; Larson, 2010; Nxumalo & Ross, 2019). Just as this study found that there were significant differences in the amount of AFNR activities, especially natural resource related, Larson et.al. (2010) found in their study that African American youth were passionate about nature; however, they were less aware of ecological issues and facts about nature. Societal disparities around how different ethnic and socioeconomic groups are able to access and be exposed to nature were pointed to as the potential main cause (Larson et.al. 2010). To combat these issues, educators need to draw upon current research to meet the needs and interests of these underserved communities and work against societal disparities that may limit opportunities. This may look like going into classrooms or places in the community with youth to assess what interests they have in AFNR topics and then using that information to create programming to engage them. Not only this, but these programs should look to expose students to new concepts by first meeting their initial interests as a Segway. For example, if a student is interested in cooking or product development, and AFNR educator could Segway these topics and activities into something more STEM specific by highlighting the plat science behind certain foods, the science behind food safety practices, or even the science of cooking.

Furthermore, program staff and educators need to be knowledgeable of and be able to recognize how these disparities can fester into myths and misconceptions in efforts to be more competent in their engagement. Jones (2002) shared that a number of social analysts have suggested that the way environmental concern and environmentalism have been investigated and developed has led to inaccurate and unfair notions of how black people and other people of color view and value the environment. One of the persisting myths is that black people are not concerned about the environment, yet there is limited empirical research to give this claim credence or support (Jones, 2002). Jones (2002) pointed out that because most of the research on public concern for the environment has been done on white citizens, which in turn, has ultimately framed this concept through the lens of the white majority. There is little known regarding the opinions and views of people of color regarding the environment. This has resulted in the little information that is known about the views of people of color being based more around myths and assumptions rather than reality, like another myth that black people are "shallow in their support for environmental protection" (Jones, 2002, p. 479). Jones (2002) also noted that there has been slow and often times no movement to negate or challenge these claims made by academia, media, governmental agencies, mainstream environmental organizations, and business and industry. Furthermore, he highlights that some of these very entities have used these very same misconceptions to further their own interests and overall agendas even at the expense of marginalized communities – especially people of color - and ultimately the environment (Jones, 2002).

Programs should also try to do better about understanding these issues and meeting students where they are, helping them to see opportunity in their community instead of through a deficit mindset. They should also be mindful of the cultural and social implications that come along with their community and historically with agriculture as a whole. As McCray (1994) pointed out, Extension programs frequently label African Americans as a "hard to reach" audience, which lends itself to be a blanket statement that could potentially try to excuse low engagement with these populations. McCray (1994) provides brief context and knowledge to a frequent question "Are African Americans uninterested in the educational opportunities offered by Extension organizations?" McCray (1994) gives a resounding "NO!" to this question in her explanation, noting that African Americans are "hard to reach" because the Extension system is often viewed as something for "other" people in many ways. That on a local level, regardless of any equal opportunity statement, most African Americans, and any other person for that matter, would be hesitant to attend any activity or program meeting held at the local church, country club, or other place in the local community that otherwise would not receive or be as welcoming to them on any other day of the week (McCray, 1994). This continues to be a reality for many African Americans in communities, particularly rural ones, where Extension services are being provided.

Perhaps Extension and other agriculture-based programs may need to try to address this issue from a different lens by tackling structural issues. While many programs like Extension have an overarching goal to diversify and better serve underrepresented audiences, this may be an opportunity for these entities to take closer more informed look at what is happening on a local level in the communities they serve. Understanding that social and cultural norms that one might see in a more urban area like Indianapolis, Indiana are going to be different than what one might see in a small town/community in the rural south. These entities should be mindful and intentional about building trust within their respective communities and recognize that no parent or individual will jump at the opportunity for engagement if a level of trust and familiarity is not established. By being more intentional in using these understandings and competencies through the rollout of programming can help those working in these spaces to better engage underserved, and oftentimes misunderstood, communities.

Role Models & Relationship Building

One of the main barriers to access for underserved communities is the limited community of professionals and role models that they can relate to and identify with. Perhaps these programs should try to better recruit and hire role models and representatives that can identify with underrepresented communities could be a way to better recruit and serve these communities of interest and help provide more access. Brown (2018) and Alston and Crutchfield (2009) both point to the need for agriculture-based youth programs to utilize role models and mentors attract, retain, and enhance the experience for African American youth. Program leaders and developers need to keep this in mind as they continue to try to increase diversity efforts in their programs. Role models are known to serve as key influencers for young people (Denise, 2015). In this study, the researcher took on an informal position as a role-model for students engaged in the Virtual Agri+STEM Camp. While this role was not formally explored as a part of this study, one can draw that this role had somewhat of a positive impact on the overall student experience based on informal feedback from parents, teachers, and students. Practitioners, Program Administrators, and educators need to look into incorporating role models into the learning experiences when engaging with students. This could include hiring educators, program developers, and or volunteers from communities that are underrepresented. This would aid in providing relevant role models and potential mentors for students as they go through the learning experience.

In situations where this strategy has not yet been successful, as recruitment and hiring efforts are tedious, perhaps these programs could go a step deeper and reach out to community entities (e.g., churches, clubs/lodges, civic organizations) that serve these underrepresented groups and find ways to build true partnerships and relationships so that youth and their families can have better access to these programs. This leads into another point that highlights the importance of knowing who you serve – or want to serve. Knowing the target audience and making learning relevant to them is key to building youth interest in AFNR and STEM related topics. As African American students noted high levels of interest and concern before even beginning the Virtual Agri+STEM Camp, one can note that the topics centered around food were something that they could relate to and were interested in. While student perception of relevance was not a variable that was explored, it is a hallmark of authentic learning strategies like the ones used to develop this lesson. The lessons were specifically tailored to engage students to share their own personal food story (including family connections), to have discussions around what food access looked like in their community, and of course engage in sensory related activities as they did experiments and built community connections, cultural connections, and sensory connections to the lesson.

This afforded students the opportunity to bring their own prior funds of knowledge to the learning experience and already feel like they had some buy-in to what was being presented. This strategy should be used to help bridge the connections between what students see in their everyday life to the science and other STEM related concepts that educators are trying to teach them. This has the potential to make for a more engaging and interesting learning experience for students. This conclusion highlighted that students who had less AFNR related experiences are already interested in engaging in more opportunities and activities around the food system (under the AFNR umbrella). The problem is that these students are limited with regards to their access and opportunities around these programs, the very programs that could lead students to be exposed to further opportunities down the road like career and entrepreneurial options. It is very important for youth AFNR program leaders to find ways to better understand their audiences and make the learning experience relevant to that they can receive the experiences and exposure that could lead them to identify and think about opportunities not just for a career but to make their communities better. When this happens then these educational experiences have the potential to open up opportunities for students both academically and socially as their eyes are opened to how they can use this newfound knowledge to enhance their own communities and the world at large.

Relevant Connections: Culture & Community vs. Careers

This leads to the last implication for this conclusion. Creating relevant connections between AFNR youth learning experiences and cultural/social and community-based connections. This method to engaging students has the potential to give students agency to engage in efforts to enhance their community instead of just focusing on careers. Jones (2002), in pointing out that African Americans do have environmental concerns, shared that while African Americans may not be a present in the mainstream environmental movement, they are heavily involved in the more grassroots movement around environmental justice activism, which can be rooted back to the civil right movement. Jones (2002) describes the environmental justice movement as one of the fastest growing segments of the environmental movement and noted that sociocultural factors contribute to the overall understanding over environmental injustice issues. It is important to note that these environmental concerns can lead to environmental justice and activism as environmental concerns is used as a basis to describe food system concerns in this study. This study found that African Americans reported high levels of concern for the food system, which shows that there is potential to engage these students in activities that could spark agency to satisfy these concerns. Perhaps educators and AFNR program developers should take on the approach of engaging students around social, cultural, and community issues by using AFNR and/or STEM as a context. Because of the ability for AFNR topics to address many of the grand challenges of the food system, it poses the opportunity to engage students in citizen science which is broadly defined as research that non-scientist play a role in through project development, discovery, and collection of information (Ryan et al. 2018). Citizen science has specifically been used focus on activism and social justice in agriculture through approach that engage the community (Ryan, 2018).

If more AFNR youth education programs can use this approach or similar ones to tailor the educational experience, perhaps more people of color will see the ability for these programs to engage them in a way that gives them agency to enhance the world around them. Brown (2018) saw the importance and success of this practice when highlighting how the African American community-based organizations with an emphasis on youth agriculture and STEM education are able to meet the social and cultural capital needs of youth through their programming, which has sustained their interest and retained their program engagement. Brown (2018) also specifically pointed out how these program leaders do not take the approach of trying to explicitly lead their students into agricultural careers, instead they focus on how they can use AFNR to meet the social and cultural needs of the community. The residual effect of this engagement is students becoming interested enough in agriculture from this type of engagement to explore and possibly pursue further agricultural opportunities, like careers or education. Perhaps creating access to AFNR learning should lead first with making connections to culture, second with community, and lastly with careers using the Three Cs model (N. Knobloch, personal communication, May 3, 2021). Too often, AFNR programs lead with careers and career development as the focus when trying to engage students and they miss making the more relevant connections to culture and community that students already bring to the table. By doing this, not only can we potentially lead youth to careers, but in a larger way it opens the opportunity to engage more students in becoming collective agents of change for their community by making learning relevant and accessible. Perhaps this will open up the doors for more programming opportunities and experiences for African American youth.

5.7 Conclusion 4

Students that felt more competent, saw the value, and were interested/enjoyed the Agri+STEM experience were more likely to be interested and concerned about the food system.

5.7.1 Discussion

This conclusion supported the conceptual framework in highlighting that as students see the value, feel competence, and find enjoyment in activities they in turn can develop interest and concerns for food system topics. As noted by the conceptual framework of this study, a student's food system activity engagement (i.e., interest/enjoyment, value, competence) can be an indicator of a student's level of food system interest and food system concern. In examining the relationships between participants' food system activity engagement (i.e., interest/enjoyment, value, competence), food system interest, and food system concern, it was evident that a number of significant relationships existed. Food system activity engagement variables (adapted from the IMI) of interest/enjoyment, value, and competence were highly related among each other and to the food system interest and food system concern variables. This conclusion supported the efforts of authentic learning in that it shows that if the activities and context of educational experiences are to have an authentic focus, then educators should look try to focus on developing student values and student interest and enjoyment while also making them feel competent in the learning experience. When these three variables are met, then the educational experience has the ability to spark student interest and concerns for those topics, in this case the food system. This further supports Martin's (2017) study that found that similar IMI variables (e.g., competence, intrinsic motivation, autonomy) had a strong relationship to the development of school engagement, food and garden activity engagement, and future educational aspirations.

This conclusion supported the knowledge base that points out that creating classroom and situational interest in a topic can lead to further interest outside of the classroom that may involve actions. Because of the length of time and concept of the Virtual Agri+STEM Camp, the type of interest that students may have experienced is situational interest. Situational interest (SI) is defined as a psychological state predominantly influenced by environmental stimuli that is situation specific that may occur only once or be repeated over a short frame of time (Knogler, Harackiewicz, Gegenfurtner, & Lewalter, 2015). The Virtual Agri+STEM Camp was a 5-day experience that engaged students in authentic hands-on activities and experiments that students verbally noted as exciting. Renninger and Hidi (2014) shared that situational interest and specific curiosity are states of motivations, in some ways, that encourages an individual to acquire new information and interact with the environment.

Furthermore, Hidi and Harackiewicz (2000) noted that while situational interest is normally triggered by external factors like the environment, it leads to self-initiated persistent activity which, as time goes on, starts being internally imposed which can be defined as individual interest (Hidi & Renninger, 2006). This leads students to become more intrinsically motivated and self-determined by the activities and find as they find them more enjoyable (Hidi &Harackiewicz, 2000). Guthrie et.al. (2006) studied and shared those hands-on activities, like those used in this study, can be a mechanism for change from situational interest to individual interest. This conclusion directly supports this notion as students were consistently engaged in hands-on activities related to the food system for a 5-day period after which they reported high levels of interest and enjoyment. Hidi and Harackiewicz (2000) also noted that effective learning experiences and classrooms promote intrinsic motivation as situational interest has the ability to enhance individual interest in some students. The conceptual model in this study and this finding also further supported what Bergin (2016) shared in his model of interest development, which shows how exposure to new concepts through hands-on experiences leads to situational interest which then leads to the development of individual interests. This describes what was accomplished through the Virtual Agri+STEM camp, students were exposed to concepts of the food system and related science topics which had the potential to trigger their situational interest. Bergin (2016) also shared that individuals develop interest around items they deem relevant to their cultural background. This aligns directly with the use of culture as way to better engage students.

Lastly, this study addresses the gap in research highlighted by Hidi and Harackiewicz (2000) in noting their concerns around the paucity of research that looks at using educational interventions to promote situational interest. While this study was not framed directly using situational interest specifically, the basis was centered around exploring student interests as a whole and when noting the limitations and time constraints with a 5-day camp, situational interest defines the learning experience better than other types of interests defined in the literature. Hidi and Harackiewicz (2000) pointed out that more research is needed with regards to situational interest in order to develop effective interventions.

5.7.2 Implications for Practice

Considerations for Conclusion 4 of this study, brought out two specific implications for practice: (1) AFNR related activities play a role in building student interests and concerns; and (2) youth program developers should use value, competence, and interest and enjoyment as a basis for developing student interest and concerns. Further studies are needed that use authentic learning in curriculum development and student engagement especially when engaging them in AFNR activities. There is a need to better understand how authentic, experiential, and other hands-on AFNR experiences can get students interested and concerned about AFNR topics like food systems. It is often assumed that underrepresented students are not interested in agriculture, but this study and others with a similar focus have shown that they actually are interested in AFNR (Scherer, 2016; Ortega, 2011; Pettigrew, 2018). Further studies are needed that assess both interest and concern as variables to explore this relationship deeper. AFNR is a very broad area, yet the breadth of this area is not what is always portrayed to students from non-agriculture backgrounds. Youth from more underrepresented and underserved communities in agriculture often initially think of fieldwork, animal husbandry, or the use of a tractor as the ultimate measure of the field of agriculture. Other practices and opportunities in agriculture like product development, agricultural technology, cooking, nutrition, and community/economic development are not often associated with the field, keeping students from seeing the relevance and value in AFNR fields.

Programs developers should aim to find ways to engage youth in AFNR through means that relate to their everyday lives and personal knowledge. This could include teaching youth about product development by building on any prior experience with cooking, or teaching youth about nature and the environment by taking them to a local nature-oriented space. Educators could even teach youth about gardening by highlighting the importance of food access and fresh fruit/vegetable consumption. These are just a few ways that prior knowledge and understanding of AFNR can help enhance the learning experience. This could also mean making the learning experience more interdisciplinary by not only focusing on the science but also on the social impacts by highlighting historical and sociocultural connections, and even the language arts/communications side of AFNR by employing writing activities to community leaders or journaling. Curriculum developers, program directors, and educators looking to enhance the learning experience could benefit well from employing some of these practices into their work. The use of photography and allowing youth to use technology in the AFNR learning experience could also help to further highlight their personal values and interests through the use of photo-voice. Wang and Pies (2004) define photovoice as "a process in which people (1) photograph their everyday health and work realities, (2) participate in group discussions about their photographs, thereby highlighting personal and community issues of greatest concern, and (3) reach policy makers, health planners, community leaders, and other people who can be mobilized to make change" (p. 96). Efforts like these will provide an opportunity to help students see the bigger picture regarding AFNR and potentially get them more interested and concerned about its connections to their community and the world.

As youth program developers and educators try to better engage youth, they should look into making sure that as they build curricula and other experiences, that students will be able to see the value, that they feel competent while doing the activities, and ultimately that they find interest/enjoyment in the experience. Making the learning experience authentic and triggering the situational interest of students can eventually lead to students becoming intrinsically motivated to engage in these activities. This study supports the notion that if the focus of the learning experience is on student values, competence, and interest/enjoyment then it can ultimately trigger further interests and concerns. When a task is of personal value or interest, autonomy is supported (Ryan

& Deci, 2006). This is something that should be kept in mind in developing educational programing for youth with an authentic focus.

Schraw, Flowerday, and Lehman (2001) offered a few suggestions to also better increaser the learning experience though value and autonomy: (1) offer meaningful choices to students to give a better sense of self determination; (2) use texts that are vivid and that provide a sense of imagery; (3) use texts that students know about to that can build off of their prior knowledge; (4) encourage students to be more active learners; and, (5) provide relevance cues for students to make the learning experience relevant. These are practices that all youth program educators and leaders should use in the development of programming that is trying to enhance student interests and concerns. By focusing on these variables, the overall experience becomes more learner-centered, which helps to give students buy-in to participate in the learning experience. As efforts continue to better engage youth in AFNR and STEM subjects, focusing on triggering their values, interest/enjoyment, and competence will help spark further interest and concern. As noted above, this could lead to students developing individual interest, which ultimately could motivate students to take action on those interests based on their respective values.

5.8 Implications for Policy

Taking in an overall consideration for each of the findings within this study, three implications for policy come to mind related to food systems, AFNR, and STEM education of youth: (1) promoting and incentivizing the use of authentic learning; (2) providing more support and incentives for the use of youth Agri+STEM education to solve grand challenges and community issues; and, (3) equity and access: providing more support and resources to make AFNR learning opportunities more accessible to underserved communities.

Promoting Authentic Learning Use

This studies and previous ones in the literature have pointed to the effectiveness of utilizing authentic (experiential) learning strategies nonformally and within the classroom (Van Tine, 2005; Knobloch, 2008; Knobloch, Ball, Allen, 2007). Policymakers should fund, incentivize, and help school districts and administrators support training opportunities and other resources for educators to help find ways to incorporate more authentic learning-based strategies into the classroom. While nonformal education programs usually have more of an engaging approach than traditional classroom settings, policymakers also aim to further support for training and implementation efforts regarding authentic learning strategies in these programs. As noted in this study, authentic learning strategies help make the learning experience more engaging by bringing a real-world context to students. Learning through authentic hands-on experiences helps to better engage students and make learning valuable and enjoyable. It also has the ability to make students feel competent in the learning experience. This learner-centered strategy for education should be used more broadly in both classroom settings and in youth education programs. Furthermore, school districts, program administrators, and policy minded audiences like agricultural educators should also explore the effects of implementing these authentic approaches to learning. This could look like collecting data or monitoring test scores and reporting back to entities of support. If found useful to their organizations, they should find ways to incentivize educators going the extra step to make learning more relevant for the students they serve. Authentic learning strategies can also help policymakers and other relevant governmental leaders begin to work towards preparing the next generation of Agri+STEM prepared youth ready to solve the challenges facing communities both locally and globally.

Youth Agri+STEM Education & Grand Challenges

Legislators, policymakers, and other relevant leaders should work towards providing more support and incentives for schools, youth programs, and communities to use AFNR and STEM as a way to educate students about the problem-solving process of grand challenges such as food systems and food insecurity. This study connected to grand challenges regarding the food system (e.g., food (in)security, food safety, health) to educate youth about agriculture and STEM concepts. This approach not only made the learning experience more authentic, but it also was a worked as a strategy to bring further context to STEM learning. Students reported high levels of engagement in the Virtual Agri+STEM Camp experience and they also reported high levels of food system interest and food system concerns after participating in the camp. This helps to note the potential for approaches like this to be effective in introducing and engaging students in learning centered around grand challenges. If AFNR and STEM educators develop the next generation of scientists and problem solvers for the challenges faced across the world, then it would behoove educators and administrators to tailor the learning experience to 1) introduce students to grand challenges in these areas, and 2) empower students to use the knowledge that they acquire to find solutions.

Policymakers should look into providing more support and incentives for schools, youth programs, and even communities to use AFNR and STEM as a way to educate students about finding solutions to grand challenges like food systems and food insecurity. Perhaps this could look like increased funding towards salaries for educators implementing these types of practices and funding for communities to develop and implement more community-based programs engaging youth through authentic learning experiences. These types of incentives and supports would prove to be very useful in limited resource and poverty-stricken communities that are currently limited to opportunities because of limitations around infrastructure, especially finances. This will help further the cause of providing more access to AFNR youth experiences for all communities and it will also help promote the use of authentic learning as these grand challenges are situated around issues face by people every day.

Federally funded grant and loan programs like those led by the USDA agencies (e.g., National Institute of Food and Agriculture (NIFA), Rural Development, and Farm Service Agency) should look into putting more emphasis on highlighting youth engagement and education around grand challenges as a priority in their requests for applications and proposals. Perhaps this can be achieved through the development of more program priorities that focus not only on educating youth about agriculture, but specifically how authentic learning approaches to agricultural education can help solve the very societal grand challenges the USDA aims to address on a daily basis. Increasing program funding and support for educational programs and projects that utilize authentic, experiential, and problem-based learning approaches can help achieve this goal. Program priorities can also promote the use of relevant interdisciplinary learning experiences for youth in efforts to build competencies in efforts to not just make learning relevant, but to develop skills in multiple areas. This has the potential to foster more competitive approaches among applicants to educating youth about AFNR and the STEM concepts imbedded in these fields. Furthermore, agencies like these and others funded by federal dollars with programs that fund youth engagement and education should also prioritize the incorporation of more community, and in some cases, cultural connections to student learning in proposed projects. These approaches will aid in not only helping students have more AFNR and

STEM experiences, but it will help them develop competencies today for solving challenges tomorrow.

Equity & Access

Lastly, policymakers, governmental agencies, and political leaders should work towards providing more support and resources to make AFNR based programs and related opportunities more equitable and accessible to underserved communities. This study found that African American students were interested and concerned about the food system. However, they had limited previous AFNR experiences compared to Caucasian American students. This supported current literature that speaks to some of the disparities around access and opportunities that underrepresented youth in agriculture, like those in this study, face with regards to AFNR programming. State Departments of Education, Extension/4-H programs, and National Programs such as FFA, Agriculture Futures of America, and MANRRS should put policies in place that provide more opportunities for training around cultural and social competence to help ensure that staff can assist in making sure that all students feel welcome to their programming efforts. Furthermore, funds should be made available to incentivize programs to recruit and retain relevant volunteers and potential educators that can connect with students in social and cultural levels. More specifically, perhaps a focus on how to better assess and approach how programs these programs engage and support underrepresented audiences on a local level rather than just nationally or state-wide. This can be done through listening sessions and surveys with underrepresented groups in the community to understand how they can be better supported and how to make programming efforts more relevant to them.

Ultimately, the overall function of how these programs operate locally determines what their reach looks like nationally and state-wide. On a federal level, issues of equity and access have already been a focal point of discussion and initiatives set around engaging more underserved communities around agricultural programs. A number of leaders in federal agencies continue to speak toward how these issues of equity and access will be addressed. Secretary Tom Vilsack, in his confirmation hearing before congress, made a point to specifically note racial justice and equity among his top priorities during his tenure (Iowa Soybean Association, 2021). He shared that the agency needs to "take a much deeper dive, deeper than has ever been taken before, in terms of USDA programs, to identify what barriers in fact exist in each of these programs" (Vuong, 2021, p.1). This can be accomplished through enhancing current department programs, like those sponsored by the USDA-NIFA on funding and investing in agricultural research, including youth education initiatives, makes it a prime candidate for enhancing outreach and engagement efforts to underserved communities. NIFA has a unique opportunity and responsibility in that it can foster more equitable practices through the development of more programs and priorities with a focus on engaging more communities and also by working towards ensuring a more diverse and equitable review process for their federal programs; a note highlighted by Dr. Carrie Castille, Director of NIFA.

If the new generation and workforce is to truly be diversified, equitable, and inclusive of all people that make up this country, then policymakers must take action now toward making programs more accessible to underrepresented groups and invest in ensuring equity and access to all communities. Dr. Chavonda Jacobs-Young, USDA ARS administrator and acting Undersecretary for the USDA REE mission area made this point even more clear in her statement to congress that "Investing in inclusion, diversity, and inspiring future generations through formal and informal learning is critical for the future. Talent must be inspired, nurtured, and advanced across the country if the United States is to maintain its global leadership in science and technology" (Statement of Dr. Chavonda Jacobs-Young, 2021, p. 4). The creation of more program priorities and federal initiatives with a strategic focus on engaging underserved and underrepresented communities has the potential to help push these initiatives forward and ultimately provide better access to resources and programs for African American and other underserved communities. This could also look like including more measures to support and increase cultural competency training for programs such as Extension and even for programs applying for funding to implement youth-based initiatives. However, it is incumbent upon programs like these who aim to engage more underrepresented audiences to first understand what is going on at the local level so these groups are not lost in the peripheral of national and state-wide initiatives.

5.9 Recommendations for Future Research

This research study explored student interest and concerns regarding the food system and there was valuable information found in this process. There were, however, a few limitations of this study that informed thoughts and recommendations for future research. First, with regards to participants, this was a convenience sample and a majority of students that made up this study were from rural communities, which limits generalizability to students from other communities. Moreover, the researcher experienced a number of obstacles regarding recruitment, which led to a smaller sample of participants. Due to the effects of the COVID-19 pandemic, the researcher was limited to only virtual engagements with students, which was a pivot from the original plan of working with teachers in classrooms. This ties directly into the second limitation which was the virtual context of the learning experience. This limited the opportunities for hands-on engagement through authentic activities, leaving the research to pivot the lessons developed for implementation. Furthermore, this presented challenges for some teachers and at-home students when connectivity issues arose. Lastly, the pivots made to accommodate this virtual format presented a number of issues with collecting data. Because the researcher was not allowed to go into the classroom, data collection was limited to a virtual format through Qualtrics surveys, including consent from parents. While using a web link to collect data seemed to provide more flexibility, the researcher found that utilizing the Qualtrics link to engage parents was problematic in more rural communities as teachers shared technology access problems. Furthermore, the researcher was not able to be present to distribute and collect the questionnaire from students which left the only option to be for teachers and parents to initiate this process on their own time. Because of these limitations and other observations during this study, the researcher has three recommendations for future research: (1) programmatic considerations; (2) participant engagement considerations; and (3) research design considerations.

5.9.1 Programmatic Considerations

First, there should be some programmatic changes to the way that programs and learning experiences like the virtual Agri+STEM camp are implemented. Future studies should incorporate and measure variables that speak to cultural connections into the learning experience. Specifically, studies should make connections to AFNR (especially food) education through culture. This will require knowing the audiences that will be served in efforts to connect to their cultural backgrounds. While this can be done through the use of culturally relevant activities, researchers also suggests using role models that can identify with students (Brown, 2018; Alston & Crutchfield, 2009; Cano & Bankston, 1992). While this study did not officially incorporate or measure the effect of role models, the researcher served as an informal role model to students throughout the Virtual Agri+STEM Camp experience. Therefore, future studies should conscientiously make room to ensure that role models are not only part of their learning experience, but that data are collected from youth to show the effects of role models.

Future studies should also dive further into exploring how student interest and concerns can lead to action after participating in programs focused on 21st century grand challenges like food systems and food (in)security. While this study was limited due to the virtual nature of it, future studies should look into how to take learning outside of the classroom legitimately through immersive experiences in the community like visiting a farm, farmer's markets, food processing/distribution centers, or any other relevant practical location where students can make connections beyond the classroom to their learning experience. In efforts to adequately incorporate solving 21st century grand challenges through youth, concepts like systems thinking should also be incorporated into the learning experiences measured. Furthermore, science interest and science knowledge should also be measured to bring further validity to how learning experiences like these enhance science education. While this study incorporated a number of science experiments and science content into the learning experience, this was not measured. Lastly, future studies should modify the duration and frequency of their educational experience. In efforts to reach more participants and not take away too much class time from teachers, this study modified the learning experience to five days. This may have limited the ability of this study to trigger further interest from the participants. Future studies should look into making the educational component at least two weeks (or 10 school days), or they could extend the program to be once a week over the course of a semester. This will allow for students to be engaged for a longer period of time and it also allows for the research to measure their engagement and interest over that time period.

5.9.2 Participant Considerations

Secondly, the researcher recommends that future research modifies the participants that data is collected from. In the study, youth were the primary participants of focus for the data collection process. Collecting data from parents and teachers who help students engage in AFNR and STEM based programs like the virtual Agri+STEM camp may also provide relevant observations and other data to speak to the effectiveness and perceptions of this kind of program. Anecdotally, the teachers and parents who participated with their young people in the Virtual Agri+STEM were very engaged as helpers with experiments and taste testing for students. Their perspectives would be valuable to not only enhance learning experiences, but to also understand how programs like this have an effect on students even outside of the time of engagement. Future research should also look into modifying participant criteria to speak further to the knowledge base around African American, especially rural, student experiences in AFNR. Researchers should look into exploring specifically how African American and other underserved communities experience AFNR and STEM engagement. This can be accomplished through more qualitative approached to data collection. This would help the advance the body of knowledge around experiences that African Americans have with AFNR programs and how to further engage them.

5.9.3 Research Design Considerations

Lastly, the third recommendation for research is to advance the research methods and overall design of future studies to allow for further insights. The instrument created for this study showed that there were significant relationships between variables measured. Therefore, it would be useful for more studies to be done using this instrument. Future studies using this instrument should be done on a larger sample size to help further validate its psychometrics (e.g., reliability, construct validity). Exploratory factor analysis should be utilized to help the psychometric properties of the instrument. Next, future studies should also go a step beyond this study and establish a quasi-experimental design to study causality of relationships explored. This study was not able to make causal claims due to the descriptive nature of the research design. Finally, these studies should also go further and employ qualitative data to go beyond the limitations presented with the survey design in this study. Qualitative data would help to better explain the experiences, interests, and concerns reported by students in the survey. Incorporating a more interpretivist type of study would help to highlight the voices of youth who may not have access to AFNR experiences like those who reported such in this study. These suggested recommendations for research design can help future studies speak further to engaging students in AFNR and STEM activities around grand challenges and potentially also speak to the experiences of underserved communities in a more qualitative way.

Summary

As the food system will continue to be a topic of relevance in generations to come due to increases in populations, it is incumbent upon researchers, educators, and communities to further explore students' interest, concerns, and perceptions about food system concepts and how this can be used to engage them around these issues. To accomplish this, AFNR and STEM education should remain to be a vehicle to engage youth in authentic, relevant, and experiential learning experiences. Only when these groups can better understand the perceptions that youth have about the food system will they be able to initiate further efforts to empower students to become agents of change in their communities and the world around these relevant grand challenges.

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APPENDIX A

ITEM 1: IRB APPROVAL

PURDUE
UNIVERSITY

This Memo is Generated From the Purdue University Human Research Protection Program System, Cayuse IRB.

*****THIS LETTER IS BEING ISSUED DURING THE FACE TO FACE RESTRICTION ON HUMAN SUBJECTS RESEARCH STUDIES RELATED TO COVID-19. NO FACE TO FACE RESEARCH IS ALLOWABLE UNTIL FURTHER NOTICE.**
THIS DOCUMENT SERVES AS PROTOCOL APPROVAL FROM THE HRPP/IRB, BUT DOES NOT PERMIT FACE TO FACE RESEARCH UNTIL THE COVID-19 RESTRICTION IS LIFTED***

Date: June 3, 2020
PI: NEIL KNOBLOCH
Department: PWL Ag Sciences Edu & Comm
Re: Initial - IRB-2019-768
Exploring Middle School Students' Interests and Concerns Regarding the Food System

The Purdue University Institutional Review Board has approved your study "*Exploring Middle School Students' Interests and Concerns Regarding the Food System.*" The study expiration date is June 1, 2023. No human subjects research may be conducted after this date without renewed IRB approval. The IRB must be notified when this study is closed. If a study closure request has not been initiated by this date, the Purdue HRPP/IRB will request study status update for the record.

Specific notes related to your study are found below.
Decision: Approved
Category:
7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Findings:
Research Notes:

Any modifications to the approved study must be submitted for review through Cayuse IRB. All approval letters and study documents are located within the Study Details in Cayuse IRB.

What are your responsibilities now, as you move forward with your research?

Document Retention: The PI is responsible for keeping all regulated documents, including IRB correspondence such as this letter, approved study documents, and signed consent forms for at least three (3) years following protocol closure for audit purposes. Documents regulated by HIPAA, such as Release Authorizations, must be maintained for six (6) years.

Site Permission: If your research is conducted at locations outside of Purdue University (such as schools, hospitals, or businesses), you must obtain written permission from all sites to recruit, consent, study, or observe participants. Generally, such permission comes in the form of a letter from the school superintendent, director, or manager. You must maintain a copy of this permission with study records.

Training: All researchers collecting or analyzing data from this study must renew training in human subjects research via the CITI Program (www.citiprogram.org) every 4 years. New personnel must complete training and be added to the protocol before beginning research with human participants or their data.

Modifications: Change to any aspect of this protocol or research personnel must be approved by the IRB before implementation, except when necessary to eliminate apparent immediate hazards to subjects or others. In such situations, the IRB should still be notified immediately.

Unanticipated Problems/Adverse Events: Unanticipated problems involving risks to subjects or others, serious adverse events, and
noncompliance with the approved protocol must be reported to the IRB immediately through an incident report. When in doubt, consult with the HRPP/IRB.

Monitoring: The HRPP reminds researchers that this study is subject to monitoring at any time by Purdue's HRPP staff, Institutional Review Board, Research Quality Assurance unit, or authorized external entities. Timely cooperation with monitoring procedures is an expectation of IRB approval.

Change of Institutions: If the PI leaves Purdue, the study must be closed or the PI must be replaced on the study or transferred to a new IRB. Studies without a Purdue University PI will be closed.

Other Approvals: This Purdue IRB approval covers only regulations related to human subjects research protections (e.g. 45 CFR 46). This determination does not constitute approval from any other Purdue campus departments, research sites, or outside agencies. The Principal Investigator and all researchers are required to affirm that the research meets all applicable local/state/ federal laws and university policies that may apply.

If you have questions about this determination or your responsibilities when conducting human subjects research on this project or any other, please do not hesitate to contact Purdue's HRPP at irb@purdue.edu or 765-494-5942. We are here to help!

Sincerely,

Purdue University Human Research Protection Program/ Institutional Review Board
Login to Cayuse IRB

IMPORTANT UPDATE (March 16, 2020): Effective at 5:00 pm on Monday, March 16, 2020, all face-to-face human subjects research activities are to cease until further notice. This includes activities involving Purdue University researchers (faculty, student, staff) at any site. Principal Investigators are expected to pass this notification on to all human subjects research personnel immediately.

See Purdue HRPP/IRB Measures in Response to COVID-19
https://www.irb.purdue.edu/docs/IRB%20Covid-19%20Recommendations.pdf

ITEM 2: RECRUITMENT LETTER/EMAIL

PURDUE
UNIVERSITY

Greetings ___________,

I hope that this message finds you well. I am Ryan Kornegay, a master's degree students at Purdue University. I am reaching out to you today to encourage you to sign your youth up for a virtual STEM/Science camp learning experience. This camp is a part of a study entitled *"Exploring Middle School Students' Interests and Concerns Regarding the Food System"* (Principal Investigator: Neil Knobloch, Ph.D., IRB-2019-768). This will be a FREE 5-day virtual learning camp that will teach students about concepts of science, technology, engineering, and math (STEM) in a way that is relatable and relevant to them, through food and agriculture. There will be one session for each day that will last for approximately 45 minutes. This camp is a part of a research study that aims to explore how to get youth more interested in STEM and their food system. Students will learn about the science behind the food preservation, food processing, and the food system. Ultimately, students will learn about the science and process of making pickles and we will take them through that process step by step in this virtual experience, ending off with a virtual taste testing.

This camp is aimed at 4th– 8th grade students. So if you are a student that would like to sign up or if you are a parent that would like to sign their student up, please respond back to this email or feel free to email me at rkornega@purdue.edu. Sign up for this virtual STEM camp session will end on (inserts date). Further instructions will be provided upon registration. Please feel free to contact me if you have any further questions. I look forward to hearing from you!

Best regards,

Ryan Kornegay

Virtual Agri+STEM Camp Coordinator

Lilly Hall of Life Sciences. Room 3-230 ■ 915 W. State St. ■ West Lafayette, IN 47906

(765) 494-8423 Office Number ■ Fax: (765) 496-1152

ITEM 3: PARENT FOLLOW-UP EMAIL

Greetings Parent(s),

Thank you so much for your interest in the Virtual STEM through Agriculture Camp! I hope that this message finds you well. I am Ryan Kornegay, a master's degree student at Purdue University. This camp is a part of a study entitled *"Exploring Middle School Students' Interests and Concerns Regarding the Food System"* (Principal Investigator: Neil Knobloch, Ph.D., IRB-2019-768). This will be a FREE 5-day virtual learning camp that will teach students about concepts of science, technology, engineering, and math (STEM) in a way that is relatable and relevant to them, through food. There will be one session for each day that will last for approximately 45 minutes. I am only asking students to complete a brief questionnaire before and after going through the camp. This camp is a part of a research study that aims to explore how to get youth more interested in STEM and their food system. Students will learn about the science behind food preservation, food processing, and the food system. Ultimately, students will learn how to make their own pickles and we will take them through that process step by step in this virtual experience, ending off with a virtual taste testing.

Thank you for already registering for the camp! Here is the link to the Pre-Questionnaire for the camp. Here is the link to the Pre-Questionnaire: https://purdue.ca1.qualtrics.com/jfe/form/SV_e4JVsqnL0TVnl33 . This survey is estimated to take about 10-15 minutes. Please take a moment to go through this with your child as your approval will be needed. While assisting your child with this pre-questionnaire, please allow them to answer the questions on their own, but please feel free to provide any explanations if necessary. If possible, please have this pre-questionnaire completed before we start the Virtual STEM camp.

We will be utilizing zoom to stream this virtual camp. In efforts to maintain a secure virtual space, please do not share this link with anyone. Students will be prompted to register through zoom before being allowed into the meeting space. Only students on my roster will be allowed to enter. We would like to engage with the students as much as possible, but please feel free to not utilize the camera feature if you are not comfortable with being seen. Please use the link below to access the zoom room.

https://us02web.zoom.us/meeting/register/tZ0vdequqzIpGN3YEZtP8Zv8hHeBD-BjXCAd

Day 1 of camp will be more introductory. Below you will find a list of materials in the "Camp Checklist" so that your child can do the activities along with me. If you ever have any questions throughout the process of this Virtual Camp, please do not hesitate to contact me at ryan1.korneeav@email.com or rkornega@purdue.edu. Thank you so much again for wanting to be a part!

Best regards,

Ryan Kornegay

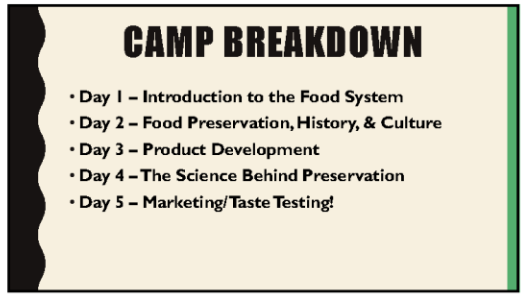
Virtual Agri+STEM Camp Coordinator

ITEM 4: RECRUITMENT FLYER

ITEM 5: CAMP CHECKLIST

ITEM 6: VIRTUAL AGRI+STEM CAMP LESSONS

1



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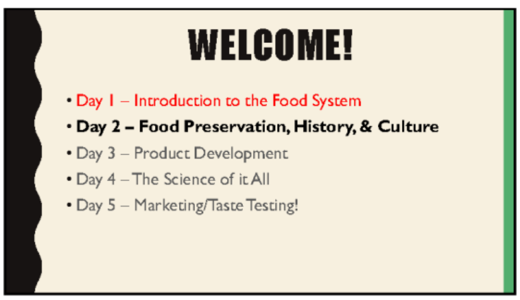

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4

5

6

1

FOOD SYSTEMS

- What is it?
- Why is it important?
- Environmental implications
- Community sustainability/Community solutions
- Food Systems & Hunger
- Food Waste

7

FOOD SYSTEMS

- **What is a system?**
  - A group of things that are related & depend on each other that function as a whole (e.g. your body)
  - A change in one part of the system affects every other component
- **What is a food system?**
  - It's how we get our food.
  - Includes all processes involved in feeding people: growing, harvesting, processing, packaging, transporting, marketing, consuming and disposing of food and food packages.
  - It also includes the inputs needed and outputs generated at each step

8

9

FROM SEED TO PLATE

https://www.youtube.com/watch?v=UVL8NXigTkI

10

FOOD MILES

- What is it?
- Why is it important?
- Food Miles and the Environment
- Community sustainability/Community solutions
- Food Systems & Hunger
- Food Waste

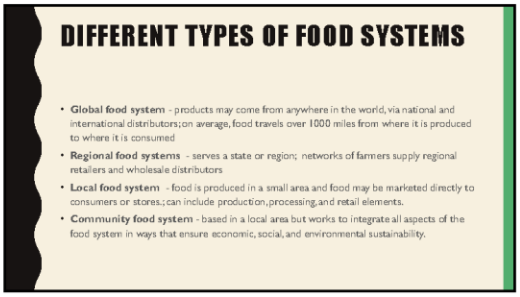
11

ACTIVITY 2!

CHECK YOUR FOOD MILEAGE

MAP OUT THE JOURNEY OF YOUR FAVORITE FOOD(S)

12



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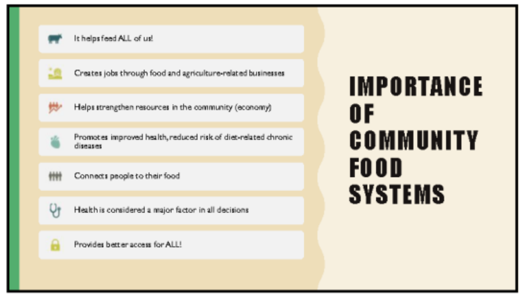

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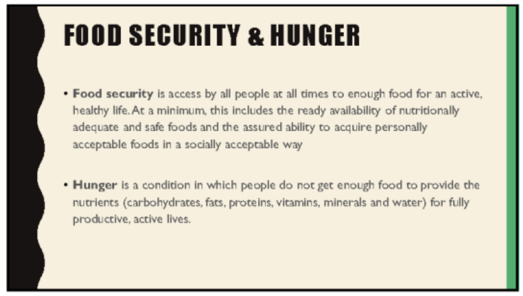

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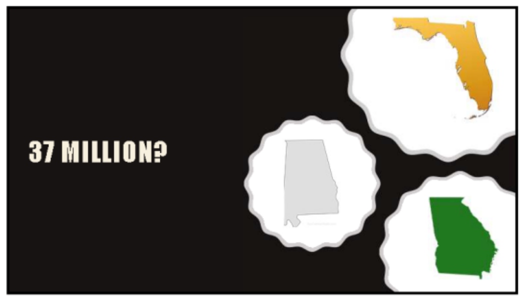

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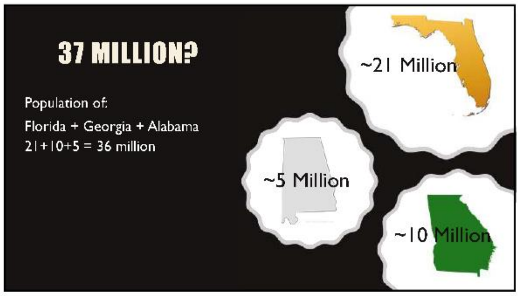

37 MILLION?
Population of:
Florida + Georgia + Alabama
21+10+5 = 36 million
~21 Million
~5 Million
~10 Million

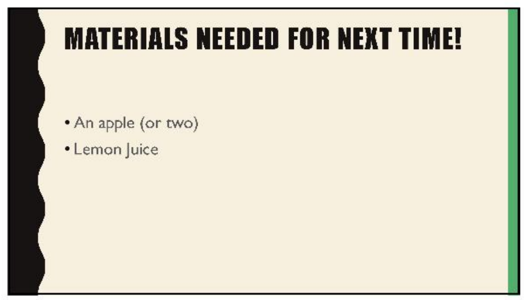
19


FOOD WASTE
Such a waste!
FOOD WASTE
40%
OF ALL FOOD
$2,200/YEAR
133 BILLION
POUNDS OF FOOD

20


DAILY WRAP UP!
Where does your food come from?
Share the picture of the journey that your favorite food/meal had to take
https://www.youtube.com/watch?v=PqgU3co4vcI

21


MATERIALS NEEDED FOR NEXT TIME!
• An apple (or two)
• Lemon Juice

22

VIRTUAL AGRI+STEM CAMP: FOOD & THE FOOD SYSTEM

RYAN KORNEGAY

1

WELCOME!

- Welcome to Day 2 of Virtual Agri+STEM Camp!
- 5 days of engaging/fun activities
- Learn more about science in and its connections food
- Engage in conversations about the food around you
- Expand your knowledge of the science behind food

2

CAMP BREAKDOWN

- **Day 1 – Introduction to the Food System**
- **Day 2 – Food Preservation, History, & Culture**
- **Day 3 – Product Development**
- **Day 4 – The Science of it All**
- **Day 5 – Marketing/Taste Testing!**

3

WELCOME!

- Day 1 – Introduction to the Food System
- **Day 2 – Food Preservation, History, & Culture**
- Day 3 – Product Development
- Day 4 – The Science of it All
- Day 5 – Marketing/Taste Testing!

4

DAY 2

FOOD PRESERVATION, HISTORY, & CULTURE

5

RECAP...

WHAT DO YOU REMEMBER FROM YESTERDAY?

6

RECAP

- Food Systems
- Food Miles
- Community Food Systems
- Food Security & Hunger
- Food Waste

7

FOOD, HISTORY, CULTURE

- Our Food Story
- How do people preserve food?
- Why is preserving food important?
- Why do people eat certain foods?
- Grandparents/Ancestors & Preservation
- How preservation ties into history & culture
- Feeding the next generation of people

8

MY FOOD STORY...

- Grew up in a rural farming area
- My Great Grandmother
- First Ag. Teacher/Culinary Arts Instructor
- Jars/Cans on the back porch
- The Great Depression; Her Family; Her Way of Life
- Feeding the Community
- Feeding the next generation of people

9

WHAT IS YOUR FOOD STORY?

FOOD PRESERVATION, HISTORY, & CULTURE

10

HUNGER+ FOOD WASTE=???

WHAT ARE SOME SOLUTIONS TO THIS PROBLEM?

11

PRESERVATION?

- Process that "preserves" food longer
- Extends the "shelf life" of food
- Changed/Advanced throughout history
- Vital to limit food waste

12

WHY PRESERVATION?

- There are over 7 billion people on this planet, of which 925 million are starving. Yet we annually lose and waste 1.3 billion tons of food – or enough to feed 3 billion people.
- Roughly 1/3 of the food produced in the world for human consumption every year – approximately 1.3 billion tons – gets lost or wasted (enough to feed 3 billion people).
- Just one quarter of all wasted food could feed the 795 million undernourished people around the world who suffer from hunger

13

EXPERIMENT OF THE DAY!

GRAB YOUR APPLE(S) AND YOUR LEMON JUICE!

14

EXPERIMENT OF THE DAY!

- What's the difference in these two items?

15

EXPERIMENT OF THE DAY!

- Cut your apple in half
- Pour Lemon juice all over the cut parts of the apple
- Put it to the side
- Let it sit for the rest of today's session
- Think about preservation..What do you think will happen?

16

FOOD PRESERVATION METHODS

17

PRESERVATION METHODS

- Think about the types of preservation methods used by your family and the types of food you preserve at home, if any.
- Which preservation method do you think could be best used on fruits/vegetables to avoid food waste?

18

3

DRYING METHOD

19

DRYING METHOD

- Water is good for many things, including the growth of bacteria that can cause food to spoil.
- Early on people realized that if you remove water from a food, that food will stay good longer
- The process of removing water from a food is known as dehydrating
- There are many different ways to dehydrate foods; sometimes salt is even used to help pull the water out of the food

20

FREEZING & REFRIGERATION

21

FREEZING

- Before refrigerators, people would use other methods to freeze food for later use
- In cold climates, people dug down into the frozen ground and buried the food
- Warmer climates, people would use cooler areas, such as streams or caves
- Icehouses were later used which led to refrigerators

22

CANNING

23

CANNING

- Foods naturally high in acid (fruits, tomatoes, etc.)
- Utilizes glass jars
- Jars are heated to kill bacteria
- Jars cool and create a vacuum seal
- Prevents any new bacteria from spoiling the food
- Highly used practice in the great depression and before further industrialization (Summer food for the Winter)

24

PICKLING

25

PICKLING

- Foods naturally high in acid (fruits, tomatoes, etc.)
- Utilizes glass jars
- Jars are heated to kill bacteria
- Jars cool and create a vacuum seal
- Prevents any new bacteria from spoiling the food
- Highly used practice in the great depression and before further industrialization (Summer food for the Winter)

26

FERMENTATION

27

FERMENTATION

- "Good Bacteria"/"Good Germs" are added to food
- They feed off of the sugars in foods (e.g. Milk)
- They create certain chemical compounds that stops/kills of the bad germs
- During this time the "acidity" of the food increases
- Milk, for example…
  - Good germs feed on the lactose (sugar) present in the milk. This creates lactic acid, which increases the acidity , creating a tangy taste and ultimately giving us yogurt

28

PRESERVATION METHODS

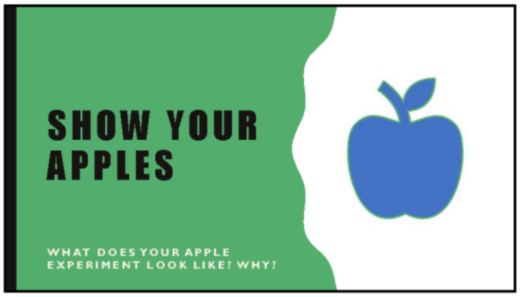
- What are some of the differences/similarities in the types of preservation that you observed?

29

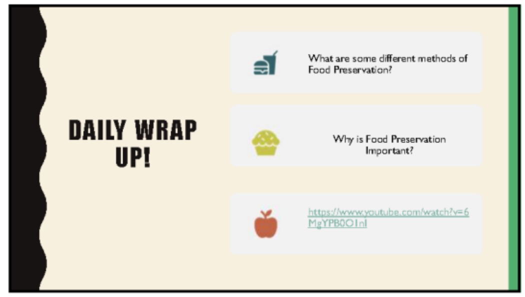
THE PICKLE JOURNEY

- https://www.youtube.com/watch?v=6MgYPB0O1nI

30


SHOW YOUR APPLES
WHAT DOES YOUR APPLE EXPERIMENT LOOK LIKE? WHY?

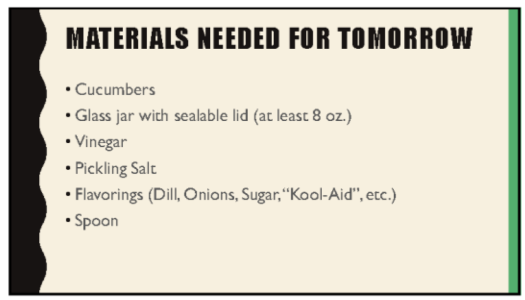
31


DAILY WRAP UP!
What are some different methods of Food Preservation?
Why is Food Preservation Important?
https://www.youtube.com/watch?v=6MgYPB0O1nI

32


CAMP CHECKLIST
DAY 1
PAPER
DRAWING UTENSIL
DAY 2
APPLES
LEMON JUICE
DAY 3
CUCUMBERS
GLASS JAR WITH A LID
PICKLING SALT
VINEGAR
FAVORITE FLAVORS (E.G. DILL, SUGAR, GARLIC, ETC.)
DAY 4
EGGS
DON'T FORGET!
• Tomorrow you will be creating your own pickle product!
• Ingredients and other Materials will be provided
• Start thinking about how you want to market/sell your pickles
– Commercial, Skit, Jingle… Whatever!
• Be prepared to put your pickles to the test!
– Taste Testing on Day 5!

33


MATERIALS NEEDED FOR TOMORROW
• Cucumbers
• Glass jar with sealable lid (at least 8 oz.)
• Vinegar
• Pickling Salt
• Flavorings (Dill, Onions, Sugar, "Kool-Aid", etc.)
• Spoon

34

VIRTUAL STEM CAMP: FOOD & THE FOOD SYSTEM

RYAN KORNEGAY

1

WELCOME!

- Welcome to Day 3 of Virtual Agri+STEM Camp!
- 5 days of engaging/fun activities
- Learn more about science in and its connections food
- Engage in conversations about the food around you
- Expand your knowledge of the science behind food

2

WELCOME!

- Day 1 – Introduction to the Food System
- Day 2 – Food Preservation, History, & Culture
- **Day 3 – Product Development**
- Day 4 – The Science of it All
- Day 5 – Marketing/Taste Testing!

3

DAY 3

PRODUCT DEVELOPMENT

PROCESSING YOUR PICKLES

4

RECAP...

WHAT DO YOU REMEMBER FROM YESTERDAY?

5

RECAP

- Definition of Preservation
- Different types of Food Preservation
- How did people preserve foods in History
- Acids & Food Preservation (Apple Experiment)

REMEMBER

- **Community Food Systems**
- **Food Waste & Hunger**

6

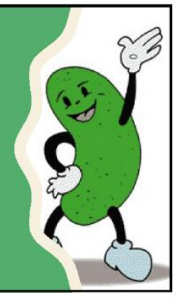
WHAT'S SO SPECIAL ABOUT PICKLING?

- Preservation of food/extended shelf life
- Changes in quality, texture, & taste
- Can be manipulated to take on desired flavors
- Helps eliminate waste and feed people

7

EXPERIMENT OF THE DAY!

LET'S MAKE PICKLES!!

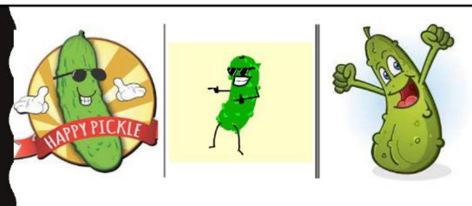


8

U. PICKLE INC.

- Imagine you have your own small business
- You are looking to test, develop, and produce THE BEST Pickle
- Choose your favorite flavors to create your pickles
- Let your pickles sit in the fridge
- During our Final Day of Camp present your pickles to everyone
  - Do a quick commercial, jingle, poem, etc.
- Taste your own pickles!!
  - Grab your family to taste with you!

9



IT'S PICKLE TIME!!

10

PICKLE RECIPE

- Materials Needed
  - 1 cup of water,
  - ½ a cup of vinegar
  - 2 Tsp of salt
  - Your choice of seasoning/flavors (i.e. dill, garlic, kool-aid)
  - 1 Canning Jar
  - Knife
  - Cucumbers
  - Spoon

11

DIRECTIONS PART 1

- Take 1 cup of water, ½ a cup of vinegar, and 2tsp of salt to mix as the base for your brine
- ** PLEASE Taste your brine! If the mixture is too salty for your taste please add a little water.
- Add your special seasoning/flavors to your brine.. Season to your liking (don't use too much!)
- Stir your mixture well

12

DIRECTIONS PART 2

- Take a Cucumber (Wash well)
- Cut off the ends of the cucumber and then cut into your desired slices
- Place Cucumber slices in jar
- Cover to the top with your brine mixture
- Seal the jar well
- Refrigerate for at least 2 days
- ENJOY!

13

MAKE YOUR PICKLES!

14

AND NOW WE WAIT...

15

DAILY WRAP UP!

How did you like making pickles?!

Who will have the best pickles?

Who will have the best sales pitch?

16

DAILY WRAP UP!

How did you like making pickles?!

Who will have the best pickles?

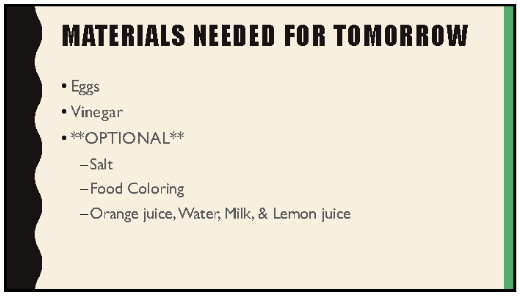
Who will have the best sales pitch?

17

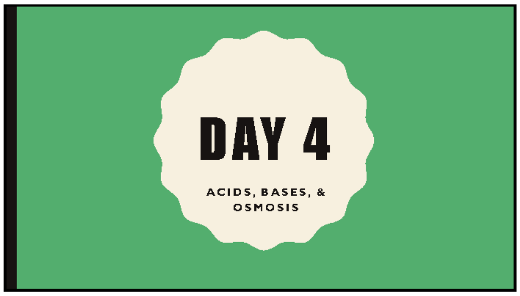
TIPS FOR DAY 5!

- Jingle/Commercial/Skit
  - –Make it personal!
  - –Show your Passion
  - –Highlight why you have the best product (flavor/shape)
- Grab your Family
  - –Have someone come taste your pickles with you
- Have Fun!!

18


MATERIALS NEEDED FOR TOMORROW
• Eggs
• Vinegar
• **OPTIONAL**
– Salt
– Food Coloring
– Orange juice, Water, Milk, & Lemon juice

19


DAY 4
ACIDS, BASES, &
OSMOSIS

1


WELCOME!
• Welcome to Day 4 of Virtual Agri+STEM Camp!
• 5 days of engaging/fun activities
• Learn more about science in and its connections food
• Engage in conversations about the food around you
• Expand your knowledge of the science behind food

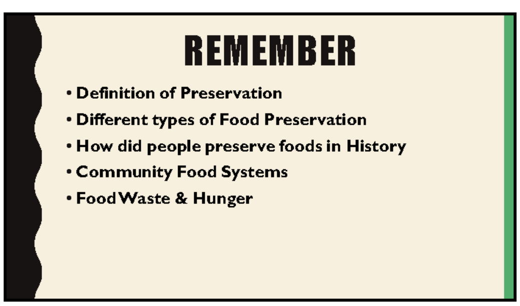
2


WELCOME!
• Day 1 – Introduction to the Food System
• Day 2 – Food Preservation, History, & Culture
• Day 3 – Product Development
• Day 4 – The Science behind Pickling
• Day 5 – Marketing/Taste Testing!

3


RECAP…
WHAT DO YOU REMEMBER FROM YESTERDAY?

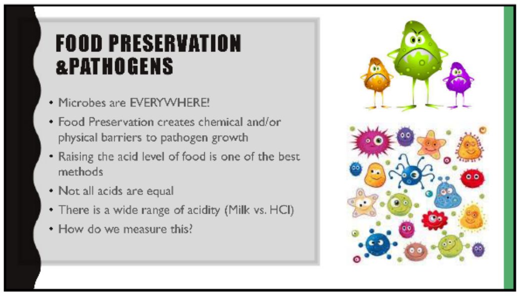
4


REMEMBER
• Definition of Preservation
• Different types of Food Preservation
• How did people preserve foods in History
• Community Food Systems
• Food Waste & Hunger

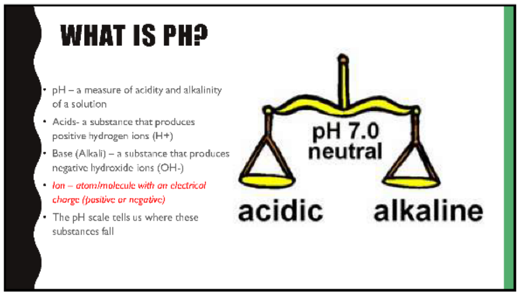
5


WHY?
WHY DID WE MAKE THE PICKLES WITH VINEGAR?

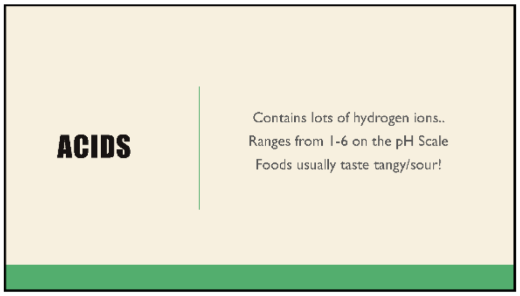
6


FOOD PRESERVATION &PATHOGENS
• Microbes are EVERYWHERE!
• Food Preservation creates chemical and/or physical barriers to pathogen growth
• Raising the acid level of food is one of the best methods
• Not all acids are equal
• There is a wide range of acidity (Milk vs. HCl)
• How do we measure this?

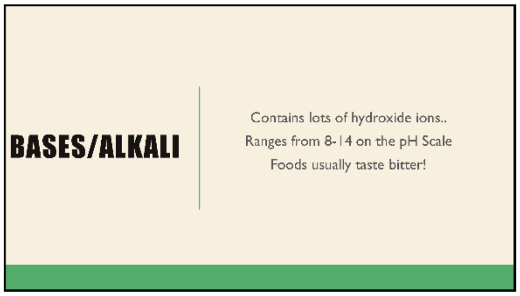
7


WHAT IS PH?
• pH – a measure of acidity and alkalinity of a solution
• Acids- a substance that produces positive hydrogen ions (H+)
• Base (Alkali) – a substance that produces negative hydroxide ions (OH-)
• Ion – atom/molecule with an electrical charge (positive or negative)
• The pH scale tells us where these substances fall
pH 7.0
neutral
acidic
alkaline

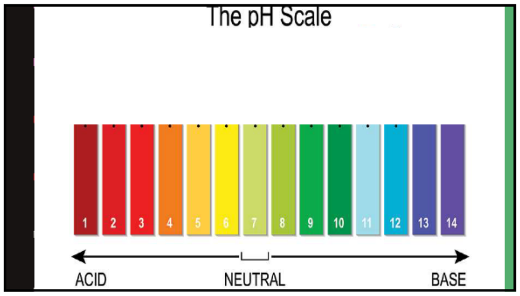
8


ACIDS
Contains lots of hydrogen ions..
Ranges from 1-6 on the pH Scale
Foods usually taste tangy/sour!

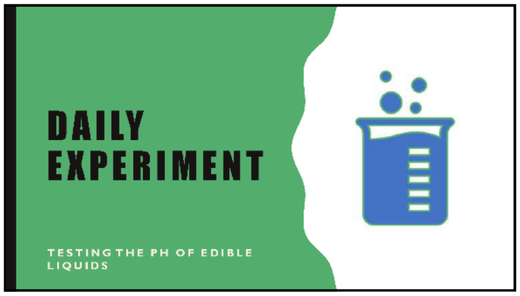
9


BASES/ALKALI
Contains lots of hydroxide ions..
Ranges from 8-14 on the pH Scale
Foods usually taste bitter!

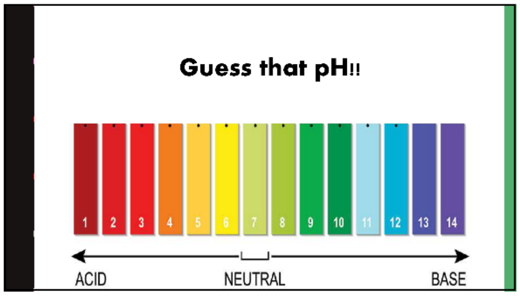
10


The pH Scale
1 2 3 4 5 6 7 8 9 10 11 12 13 14
ACID
NEUTRAL
BASE

11


DAILY EXPERIMENT
TESTING THE PH OF EDIBLE LIQUIDS

12



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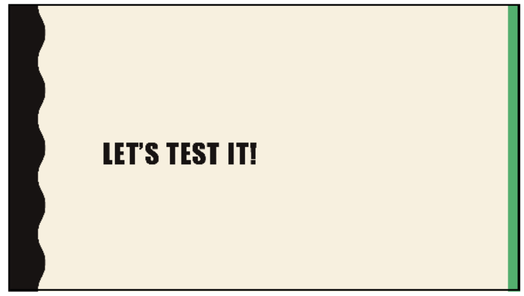

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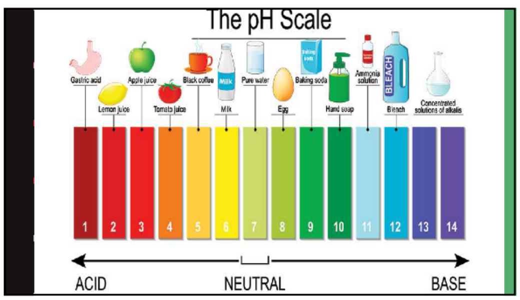

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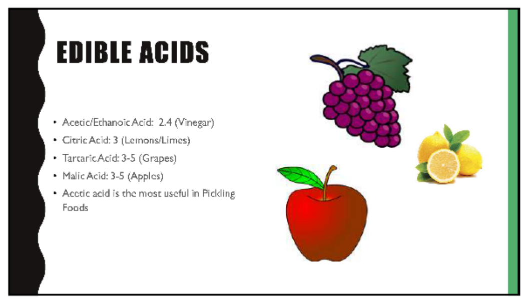

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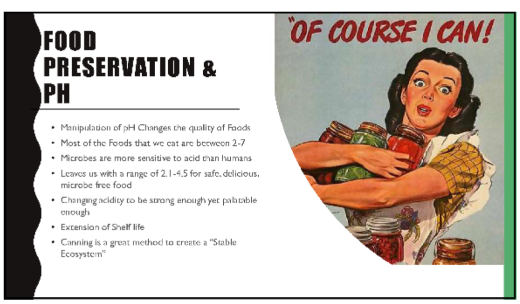

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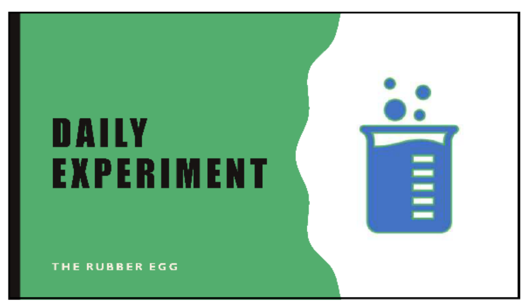


18

RUBBER EGG EXPERIMENT

- *Acids can be used to break things down too!*
  - *Calcium Carbonate Egg Shells*

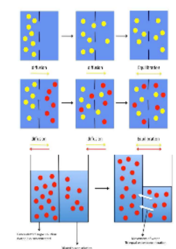
The Experiment

- Place your raw egg into a cup/jar/bowl
- Pour vinegar over the egg until it is completely covered
- Wait a day or two and watch your egg transform

19

OSMOSIS

- Osmosis- the movement of liquid molecules through a semi-permeable membrane
- Passive Transport (Diffusion) – movement of particles across a membrane without the use of energy
- Semi-Permeable- material/membrane allowing certain substances to pass through it but not others



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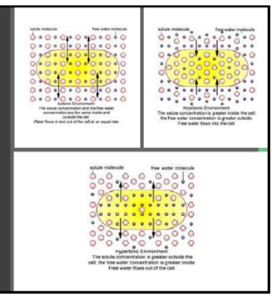
EQUILIBRIUM

A state of balance or stability where substances are equal on both sides. The goal of osmosis is to reach equilibrium

21

OSMOSIS

- Hypertonic- where the concentration of dissolved substances outside the cell is higher than the concentration inside the cell.
- Hypotonic-when the concentration of dissolved substances is lower in the solution outside the cell than the concentration inside the cell
- Isotonic- when the concentration of dissolved substances in the solution is the same as the concentration of dissolved substances inside of the cell



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HYPERTONIC

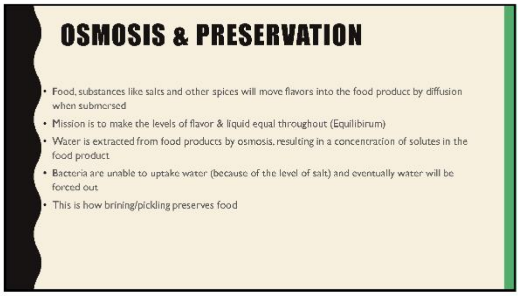
- Imagine placing the egg into a liquid/solution with a lot of particles (Sugar/Salt)… Something SALTY
  - The Egg in the Corn Syrup

23

HYPOTONIC

- Imagine placing an egg into a liquid/solution with a lot of particles (Sugar/Salt)… Something SALTY
  - The Egg in the Corn Syrup

24



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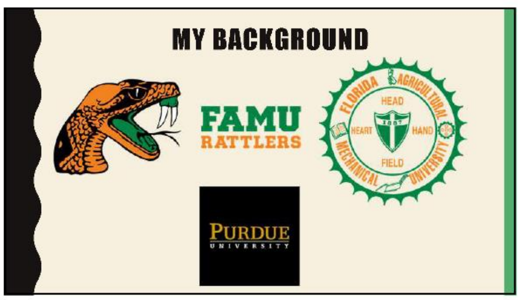

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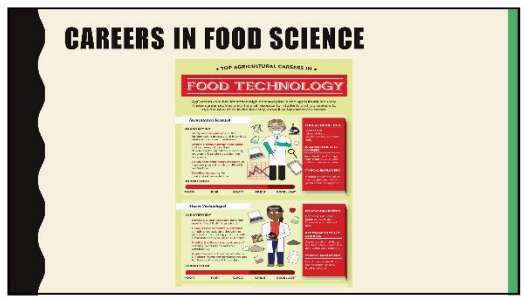

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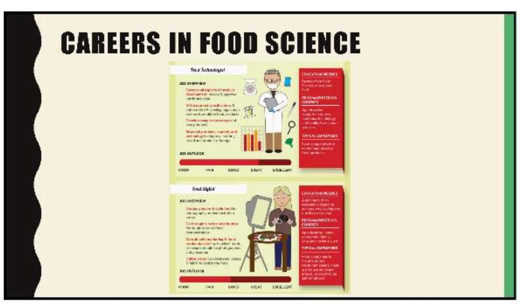

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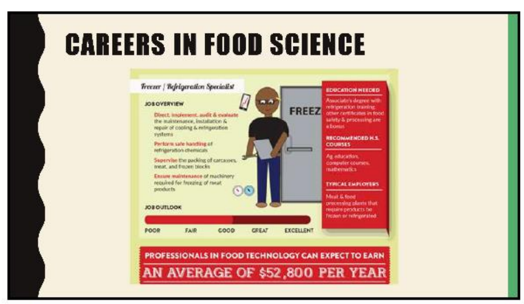

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LET'S LEARN A LITTLE MORE…

31

DAILY WRAP UP!

- Tell me one thing you learned today!
- Are you interested in a Food Related Career?
- Remember, preservation is ONE way that science can help solve hunger & food waste
- Who will have the best sales pitch?

32

TIPS FOR DAY 5!

- Jingle/Commercial/Skit
  - Make it personal!
  - Show your Passion
  - Highlight why you have the best product (flavor/shape)
- Grab your Family
  - Have someone come taste your pickles with you
- Have Fun!!

33

MATERIALS NEEDED FOR TOMORROW

- YOUR PICKLES!!
- Your Sales Pitch!
  - Commercial, Jingle, Skit, etc.
- Final Questionnaire Completion

34

VIRTUAL AGRI+STEM CAMP:
FOOD & THE FOOD SYSTEM

RYAN KORNEGAY

1

DAY 5

TASTE TESTING & WRAP-UP

2

WELCOME!

- Welcome to Last Day of The Virtual Agri+STEM Camp!
- 5 days of engaging/fun activities
- Learned about science and its connections food
- Engaged in conversations about the food around you
- Gained knowledge about the science behind food

3

WELCOME!

- Day 1 – Introduction to the Food System
- Day 2 – Food Preservation, History, & Culture
- Day 3 – Product Development
- Day 4 – The Science behind Pickling
- **Day 5 – Final Day Wrap up: Marketing/Taste Testing!**

4

RECAP...

WHAT DO YOU REMEMBER FROM YESTERDAY & EARLIER!

5

REMEMBER

- **Definition of Preservation**
- **Different types of Food Preservation**
- **How did people preserve foods in History**
- **Community Food Systems**
- **Food Waste & Hunger**

6

RECAP

- Food Preservation creates chemical and/or physical barriers to pathogen growth
- Most of the Foods that we eat are between 2-7 on the pH scale
- Increasing the acidity of a food can extend its shelf life
- Vinegar (Acetic acid) is used most in pickling
- Osmosis- the movement of liquid molecules through a semi-permeable membrane
- Osmosis not only helps pickles receive their flavor, but it also helps limit bacteria

7

LET'S SEE YOUR EGGS!

PULL OUT YOUR EXPERIMENT FROM YESTERDAY

8

ACTIVITY OF THE DAY!

LET'S SHOW THOSE PICKLES!

9

INSTRUCTIONS

- **Market your pickles!**
- **After everyone is done, we will all taste together!**
- **Who has the best?!?**

10

SHOWTIME!!

11

GREAT JOB EVERYONE!!

GIVE YOURSELVES A ROUND OF APPLAUSE!

12


CONGRATS GRADUATES!!
• You have…
– Completed 5 days of Agri+STEM Learning!
– Learned about concepts of the Food System!
– Learned about the Science of Food Preservation!
– Developed your own products and tested them!
– Learned about the concepts of Acids & Bases!
– Learned about the concept of Osmosis!
– Marketed your own food products!

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CERTIFICATE OF ACHIEVEMENT
To Certify your Completion & Honor Your Participation & Engagement in the
VIRTUAL STEM THROUGH AGRICULTURE CAMP
PRESENTED TO
The Most OUTSTANDING Students
August 8, 2020
Ryan D. Kornegay
Purdue University Masters Student

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CAMP WRAP UP
Congrats!!
Did you have fun?
Takeaways?
Certificates & Exit Questionnaire
Thank you!!!

15


HOUSEKEEPING ITEMS!
Post-Questionnaire!

16

APPENDIX B

INSTRUMENT

Food System Concern (Pre/Post)

For this section, you will be asked to share your ideas about Food and how it is connected to the community around you. Please indicate the extent to which you agree or disagree with the following statements. Your choices will always be one of the following four options:

1 = Strongly Disagree, 2= Disagree, 3 = Agree, 4 = Strongly Agree

FS Concern 1	1. I am concerned about the way that my food is handled before I eat it.	1	2	3	4
FS Concern 2	2. I am concerned that there are not enough grocery stores in my community.	1	2	3	4
FS Concern 3	3. I am concerned that people in my community do not understand the difference between processed foods and fresh foods.	1	2	3	4
FS Concern 4	4. I am concerned that my community does not know where to get local foods from.	1	2	3	4
FS Concern 5	5. I am concerned that people in my community do not eat healthy.	1	2	3	4
FS Concern 6	6. I am concerned about the decisions that lawmakers make about food.	1	2	3	4
FS Concern 7	7. I am concerned about people who do not have access to food.	1	2	3	4
FS Concern 8	8. I am concerned that there is not enough locally grown food in my community.	1	2	3	4
FS Concern 9	9. I am concerned about people going hungry in my community.	1	2	3	4
FS Concern 10	10. I am concerned about people wasting food.	1	2	3	4

FS Concern 11	11. I am concerned about the impacts of food production on the environment.	1	2	3	4
FS Concern 12	12. I am concerned about the health of the soil that my food is grown in.	1	2	3	4

Food System Interest (Pre/Post)

For this section, you will be asked to share your ideas about Food and how it is connected to the community around you. Please indicate the extent to which you agree or disagree with the following statements. Your choices will always be one of the following four options:

1 = Strongly Disagree, 2= Disagree, 3 = Agree, 4 = Strongly Agree

FS Interest 1	1. I am interested in learning about the life stages of food from seed to plate.	1	2	3	4
FS Interest 2	2. I am interested in learning about the types of foods that grow best during different seasons in my community.	1	2	3	4
FS Interest 3	3. I am interested in meeting the farmer that grows the food I eat.	1	2	3	4
FS Interest 4	4. I am interested in learning about the differences between processed foods and fresh foods.	1	2	3	4
FS Interest 5	5. I am interested in learning about what makes up a healthy diet.	1	2	3	4
FS Interest 6	6. I am interested in learning about the health problems that come with limited access to healthy food.	1	2	3	4
FS Interest 7	7. I am interested in learning how lawmakers make decisions about food in my community.	1	2	3	4
FS Interest 8	8. I am interested in learning about how food can make people healthier in my community.	1	2	3	4

FS Interest 9	9. I am interested in understanding how my family traditions connect to the foods that I eat.	1	2	3	4
FS Interest 10	10. I am interested in making sure that everyone has equal access to food in my community.	1	2	3	4
FS Interest 11	11. I am interested in learning ways I can help eliminate food waste.	1	2	3	4
FS Interest 12	12. I am interested in learning how to make the soil my food grows in healthier.	1	2	3	4
FS Interest 13	13. I am interested in learning how to limit the effects of food production on the environment.	1	2	3	4

Activity Interest (IMI)

For this section, please select the corresponding number that aligns with your thoughts on the STEM Activity (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree)
(Interest/Enjoyment (IM), Competence (COMP), Value (VAL))

IM 1	1. I enjoyed doing this Food Systems activity very much.	1	2	3	4
IM 2	2. The Food Systems activity was fun to do.	1	2	3	4
IM 3	3. I would describe the Food Systems activity as very interesting.	1	2	3	4
IM 4	4. I thought this Food Systems activity was quite enjoyable.	1	2	3	4
COMP 1	5. I think I was pretty good at doing the Food Systems activity.	1	2	3	4
COMP 2	6. After working at this activity for a while, I felt competent.	1	2	3	4
COMP 3	7. I am satisfied with my performance at during the Food Systems activity.	1	2	3	4
COMP 4	8. I was skilled at doing the Food Systems activity.	1	2	3	4
VAL 1	9. I would be willing to do this activity again because it has some value to me.	1	2	3	4
VAL 2	10. I believe doing this Food Systems activity could be beneficial to me.	1	2	3	4
VAL 3	11. I think this was an important activity.	1	2	3	4

VAL 4	12. I believe that doing this activity and others like it can help me to further understand where food comes from.	1	2	3	4

Food System Semantics

Instructions: Choose once circle between the word pairs to indicate how you felt about the food systems activity and bubble it in.

To me, the food systems activity:

1.	meant nothing	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	meant a lot
2.	was boring	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	was interesting
3.	was exciting	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	was ordinary
4.	was fascinating	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	was unappealing

Demographic Information

Please check the appropriate answers to the questions below

1. Gender
   - ❑ Male
   - ❑ Female

2. Please choose your ethnicity (check all that apply)
   - ❑ Black/African American
   - ❑ White
   - ❑ Hispanic, Latino, MexicanAmerican
   - ❑ Native Alaskan
   - ❑ Native Hawaiian or other Pacific Islander
   - ❑ Native American/ American Indian
   - ❑ Asian American
   - ❑ Other : _______________

3. What is your grade level?
   - ❑ 4th Grade
   - ❑ 5th Grade
   - ❑ 6th Grade
   - ❑ 7th Grade
   - ❑ 8th Grade

- ❑ Other: ______

4. What previous experiences have you participated in? (Check all that apply)
    - ❑ Playing outside
    - ❑ Cooking
    - ❑ Spending time in Nature
    - ❑ Fishing
    - ❑ Shopping at a farmer's market
    - ❑ Visited a Farm
    - ❑ Gardening
    - ❑ Reading about Nature or the Environment
    - ❑ Hunting
    - ❑ Recycling
    - ❑ Reading about Food
    - ❑ Donating food to those in need
    - ❑ Camping
    - ❑ Raising Animals for Food