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Measuring Effective Teaching Components of School-Based Agricultural Education Teaching Aspirants During the COVID-19 Pandemic

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Measuring Effective Teaching Components of School-Based Agricultural Education Teaching Aspirants During the COVID-19 Pandemic

Abstract

Defining, identifying, and evaluating teaching effectiveness is a difficult proposition; however, measuring the effectiveness of school-based agricultural education (SBAE) teachers is even more difficult considering the diversity of programs nationwide. Faculty in the agricultural education teacher preparation program at Oklahoma State University sought to measure the effective characteristics developed during the Spring 2020 semester, using the effective teaching model as a frame for this study in conjunction with the Effective Teaching Instrument for SBAE Teachers (ETI-SBAE). This approach allowed the research team an opportunity to further investigate the preparedness of SBAE teacher aspirants during the ongoing COVID-19 pandemic. A descriptive research design was implemented with SBAE teacher aspirants at Oklahoma State University with a junior- or senior-level classification (N = 72). The SBAE pre-service teachers at Oklahoma State University identified a high sense of effectiveness based on the ETI-SBAE instrument. In this group of pre-service teachers, all participants scored an overall teaching effectiveness score of strong to very strong, with the overwhelming majority (79.2%) planning to enter the teaching profession. Additionally, there was a relationship between intention to teach and teaching effectiveness scores, with those who intend to teach reporting higher teaching effectiveness scores. The ETI-SBAE holds utility for SBAE teacher preparation programs.

Introduction

Multiple perspectives exist regarding the design and implementation of school-based agricultural education (SBAE) teacher preparation programs (Darling-Hammond et al., 2002). Some have suggested teacher candidates must receive additional coursework or experiences focusing on the development of personal qualities (Roberts & Dyer, 2004), while others have

recommended the essential skills for teaching effectiveness revolve around instructional planning (Phipps et al., 2008).

> During their college years, students make the pivotal decision to focus their energy and attention on a major program that will shape their future. In turn, these programs provide direction and requirements intended to help students achieve their academic goals. (Kohn, 2018, p. 1)

Regardless, students come to "each new task or problem [with] a set of skills, performance standards, and values" (Krumboltz et al., 1976, p. 73); although, for this discourse to be effective, students must engage in the learning environment, "which incorporates behavioral, emotional, and cognitive aspects" (Marx et al., 2016, p. 213).

Although numerous scholars have attempted to define effective teaching throughout the decades, it has been referred to as "an elusive concept" (Hayes, 2006, p. 43). Rosenshine and Furst (1971) found that effective teachers are those who are clear, infuse a variety of teaching methods and media, are enthusiastic about teaching their subjects, remain on-task throughout the duration of the lesson, and provide students ample opportunities to apply their learning, to name a few. Steele (2010) identified effective teachers as those who exhibit servant leadership, a strong sense of personal self-efficacy, and nonverbal communication skills. Farrell (2015) suggested that effective teachers must be "multidimensional" in their ability to teach students. Despite the rich amount of scholarship and literature devoted to and written on effective teaching, various opinions exist regarding the competencies teachers need to possess to be deemed effective at their profession (Hayes, 2006).

When considering the uniqueness of SBAE teachers, the problem becomes even more difficult due to the added expectations of the complete program (i.e., Classroom and Laboratory Instruction, Supervised Agricultural Experiences, and the FFA) outlined by the National FFA

Organization (2015). SBAE teachers are expected to be effective in community relations, marketing, professionalism, program planning, and possess the personal qualities necessary to perform the job well (Roberts & Dyer, 2004). In addition, SBAE teachers should be effective in leading classroom instruction, maintain a proper work-life balance, and focus on diversity and inclusion of all students in their programs (Eck et al., 2019).

Defining SBAE teacher effectiveness is a challenging proposition, but evaluating the effectiveness of SBAE teachers is perhaps even more difficult due to the diversity of programs nationwide (Enns et al., 2016; Roberts & Dyer, 2004). In light of these variations and challenges, SBAE teacher preparation programs must continually consider how teacher aspirants are prepared for a successful career in agricultural education.

The semester in which this study was conducted was Spring 2020, which had its own set of challenges due to the onset of the COVID-19 pandemic. Educators across the country scrambled to quickly overhaul and restructure their course delivery to virtual learning platforms (Daniel, 2020), leading Hodges et al. (2020) to coin the term: *Emergency Remote Teaching*. At Oklahoma State University, educators were forced to overhaul their classes to a complete online delivery of instruction in one week. Although some teacher educators at Oklahoma State University had experience delivering instruction online, the circumstances were vastly different among the faculty. The change in instructional delivery certainly added a challenge to preparing SBAE teacher aspirants for their future careers. Considering the implications of the COVID-19 pandemic, along with the multitude of developmental needs of SBAE teacher aspirants, a need existed to determine the essential components of an SBAE teacher developed during the Spring 2020 semester at Oklahoma State University. Understanding the deficiencies in perceived competence of these teacher aspirants as a result of the COVID-19 pandemic is imperative for us to know if and what types of professional development may be needed for these teachers in the future.

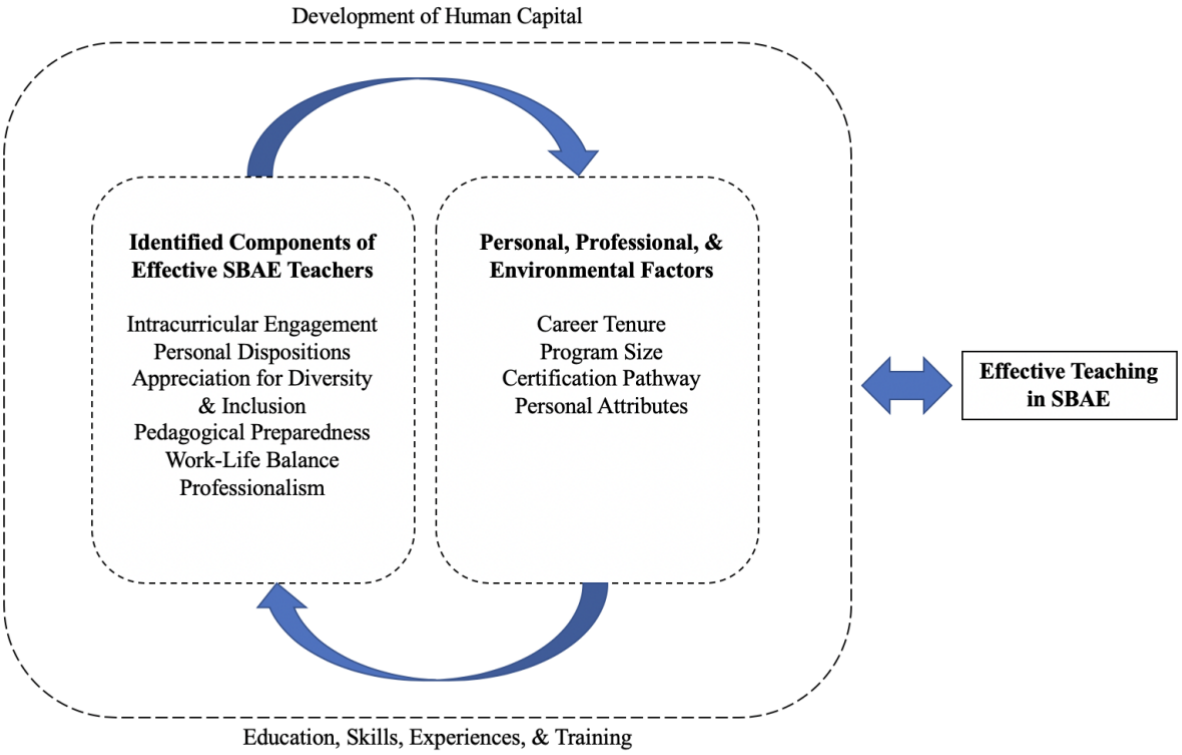
Theoretical/Conceptual Framework

The human capital theory was used to frame this study, as human capital evaluates education, training, and skills obtained related to future employment (Becker, 1964). In the case of this study, the education, training, and skill acquisition is related to SBAE teacher aspirants' enrollment in the agricultural education teacher preparation program at Oklahoma State University. The human capital development of SBAE teachers begins at Oklahoma State University with specific skills embedded in our teacher preparation program in the areas of teaching, supervising, and advising, and are continued and enhanced during the clinical teaching internship (NCATE, 2010). The human capital students acquire assists them in their future employment (Robinson & Baker, 2013). Human capital can also impact student success, as Pil and Leana (2009) connected teachers' application of their human capital to a positive impact on student outcomes.

Although similarities exist in preparation of SBAE teacher aspirants across the U.S., the demands placed on SBAE teachers once they enter the classroom vary greatly (Roberts & Dyer, 2004). Therefore, specific evaluation metrics appropriate for SBAE teachers and their human capital development are necessary. To that end, the effective teaching model for SBAE teachers (Blinded for Review) was implemented to help frame the development of effective teaching components in SBAE teacher aspirants (Figure 1).

Figure 1

The Effective Teaching Model for SBAE Teachers



As SBAE teachers represent such a diverse landscape (Roberts & Dyer, 2004), there is no one-size-fits-all formula for the preparation, support, and evaluation of effective teachers (Steele, 2010). Using the effective teaching model (Figure 1) as a frame for this study in conjunction with the Effective Teaching Instrument for SBAE Teachers (ETI-SBAE) developed by Eck et al. (2020) allows us the opportunity to further investigate the preparedness of SBAE teacher aspirants at Oklahoma State University during the ongoing COVID-19 pandemic.

Purpose of the Study

The purpose of the study was to measure the development of effective teaching principles in SBAE teacher aspirants at Oklahoma State University. Four research questions guided this study:

1. Identify the effective teaching principles developed by SBAE teacher aspirants at Oklahoma State University during the Spring 2020 semester,
2. Determine the teaching effectiveness score for SBAE teacher aspirants,
3. Determine SBAE teacher aspirants' intent to teach SBAE after graduation, and
4. Identify the impact of career intent on SBAE teacher aspirants teaching effectiveness.

Methods and Procedures

A descriptive research design was implemented for this non-experimental study, as there were no circumstances being manipulated within the population of interest (Gay et al., 2012). The population of interest was all SBAE teacher aspirants at Oklahoma State University with a junior- or senior-level classification (N = 72) during the Spring 2020 semester. Therefore, these students were either enrolled in AGED 3203 (n = 45) or were actively encountering their clinical teaching experience in a secondary agricultural education program (n = 27). Due to the COVID-19 pandemic, data collection occurred virtually using dedicated time during a scheduled Zoom meeting to allow participants to follow a weblink or scan a quick response (QR) code to complete the instrument via the Qualtrics data collection form. As the SBAE teacher aspirants were a captive audience during this meeting, this study resulted in a 100% response rate, as all 72 teacher aspirants participated.

The instrument used in this study was the (ETI-SBAE) developed by Eck et al. (2020). The 26-item instrument spans six components including intracurricular engagement, personal dispositions, appreciation for diversity and inclusion, pedagogical preparedness, work-life balance, and professionalism (Eck et al., 2020) as detailed in Table 1.

Table 1

Effective Teaching Components and Item Descriptions (26 items)

Component Title	Item	Corresponding Item Description
1. Intracurricular Engagement	IE_1	I instruct students through FFA.
	IE_2	I advise the FFA officers.
	IE_3	I advise the FFA chapter.
	IE_4	I facilitate record keeping for degrees and awards.
	IE_5	I am passionate about FFA.
	IE_6	I instruct students through SAEs.
	IE_7	I use the complete agricultural education 3-component model as a guide to programmatic decisions.
2. Personal Dispositions	PD_1	I am trustworthy.
	PD_2	I am responsible.
	PD_3	I am dependable.
	PD_4	I am honest.
	PD_5	I show integrity.
	PD_6	I am a hard worker.
3. Appreciation for Diversity and Inclusion	AD_1	I value students regardless of economic status.
	AD_2	I value students of all ethnic/racial groups.
	AD_3	I value students regardless of sex.
	AD_4	I care about all students.
	AD_5	I understand there is not an award for all students, but that does not mean they are not valuable.
4. Pedagogical Preparedness	PP_1	I demonstrate classroom management.
	PP_2	I demonstrate sound educational practices.
	PP_3	I am prepared for every class.
5. Work-Life Balance	B_1	I have the ability to say no.
	B_2	I lead a balanced life.
	B_3	I am never afraid to ask for help.
6. Professionalism	P_1	I have patience.
	P_2	I show empathy.

With any psychometric design, validity and reliability are important considerations (Privitera,

2017). To determine validity and reliability of the ETI-SBAE, a national census study was conducted using the instrument developed from the findings of a nationwide Delphi study which identified the key components of an effective SBAE teacher (Eck et al., 2019; 2020; 2021). The results deemed the instrument to be reliable (Blinded for Review) with an acceptable Cronbach's alpha of 0.87 (Nunnally, 1978). This instrument included a four-point Likert-type scale (i.e., 1 = very weak; 2 = somewhat weak; 3 = somewhat strong; 4 = very strong) for the SBAE teacher aspirants to self-assess their preparedness to be a SBAE teacher after graduation. In addition to the ETI-SBAE, aspirants were asked to identify their intent to enter the SBAE teaching profession, in which they were asked to select: Yes, No, or Undecided.

Data were analyzed using SPSS Version 26 for descriptive statistics for the first three research questions and the analysis of variance (ANOVA) included in the final research question. In addition to SPSS, Microsoft Excel was used to calculate the overall effectiveness scores of each of the 72 SBAE teacher aspirants at Oklahoma State University, as the 26-items were evaluated on a four-point Likert-type scale, providing a potential effectiveness score range from 26 (very weak) to 104 (very strong). The calculated effectiveness score was then used in the ANOVA to compare teacher aspirants' effectiveness based on their career intent (i.e., Yes, No, or Undecided).

Although the research team of this study served as instructors and university supervisors for SBAE teacher aspirants at Oklahoma State University, the completion of the ETI-SBAE was not connected to any course grade or evaluation score. Participants were asked to consider the instrument as a measure of growth as an agricultural education student at Oklahoma State University and their preparedness as a future SBAE teacher.

Findings

Research Question 1: Determine the effective teaching principles developed by SBAE teacher aspirants at Oklahoma State University during the Spring 2020 semester

The ETI-SBAE was distributed for self-evaluation to pre-service SBAE teachers at the end of the Spring 2020 semester during online instruction due to the COVID-19 pandemic. SBAE teacher aspirants identified themselves as least prepared to instruct students through the FFA, advise the FFA chapter, facilitate record keeping for degrees and awards, demonstrating classroom management, being prepared to teach every class, having the ability to say no, leading a balanced life, not being afraid to ask for help, and having patience based on the frequency of participants marking very weak or somewhat weak (Table 2). These nine items resulted in mean scores ranging from 3.03 to 3.39, with the lowest mean score (3.03) resulting from the item related to leading a balanced life as an SBAE teacher aspirant. Mean and standard deviation scores of all 26-items from the ETI-SBAE are displayed in Table 2.

Table 2

Effective Teaching Results for SBAE Teacher Aspirants at Oklahoma State University (N = 72)

Component	Item Description	μ	σ
Intracurricular Engagement	I instruct students through FFA.	3.38	.57
	I advise the FFA officers.	3.44	.58
	I advise the FFA chapter.	3.39	.57
	I facilitate record keeping for degrees and awards.	3.14	.68
	I am passionate about FFA.	3.89	.32
	I instruct students through SAEs.	3.57	.55
	I use the complete agricultural education 3-component model as a guide to programmatic decisions.	3.56	.50
Personal Dispositions	I am trustworthy.	3.96	.20
	I am responsible.	3.86	.35
	I am dependable.	3.89	.32
	I am honest.	3.93	.26
	I show integrity.	3.93	.26
	I am a hard worker.	3.97	.17
Appreciation for Diversity and Inclusion	I value students regardless of economic status.	3.96	.20
	I value students of all ethnic/racial groups.	3.96	.20
	I value students regardless of sex.	3.97	.17
	I care about all students.	4.00	.00
	I understand there is not an award for all students, but that does not mean they are not valuable.	3.96	.20

Component	Item Description	μ	σ
Pedagogical	I demonstrate classroom management.	3.38	.64
Preparedness	I demonstrate sound educational practices.	3.60	.52
	I am prepared for every class.	3.39	.72
Work-Life	I have the ability to say no.	3.17	.80
Balance	I lead a balanced life.	3.03	.75
	I am never afraid to ask for help.	3.14	.89
Professionalism	I have patience.	3.38	.64
	I show empathy.	3.57	.58

Note. 1 = very weak; 2 = somewhat weak; 3 = somewhat strong; 4 = very strong

Research Question 2: Determine a teaching effectiveness score for SBAE teacher aspirants

The 26-items associated with the ETI-SBAE (Eck et al., 2020) were evaluated on a four-point Likert-type scale, with a perfect effectiveness score of 104 (very strong) and a minimum effectiveness score of 26 (very weak). Effectiveness scores for SBAE teacher aspirants at Oklahoma State University ranged from 79 to 104 with a mean of 94.28 (*SD* = 5.98). Therefore, participants considered themselves to be strong to very strong in terms of their preparedness to be an effective SBAE teacher. SBAE teacher aspirants deemed themselves most effective in their appreciation for diversity and inclusion, followed by their personal dispositions. Work-life balance, on the other hand, received the lowest average effectiveness score from the SBAE teacher aspirants.

Research Question 3: Determine SBAE teacher aspirants' intent to teach SBAE after graduation

The majority (79.2%) of SBAE teacher aspirants at Oklahoma State University selected "Yes" regarding their intent to become a SBAE teacher after graduation. Table 3 outlines the aspirants' intentions related to becoming an SBAE teacher after graduation (i.e., Yes, No, or Undecided).

Table 3

Oklahoma State University SBAE Teacher Aspirants' Intention to Enter the SBAE Profession (N = 72)

Intention	*f*	%
Yes	57	79.2
No	3	4.2
Undecided	12	16.6

Research Question 4: Determine the impact of career intent on SBAE teacher aspirants' teaching effectiveness

To consider the impact of career intent on teaching effectiveness, participants' response to the question: "Do you intend to become a SBAE teacher after graduation?" was used as the independent variable with answer choices of Yes, No, or Undecided. The dependent variable was the composite effectiveness score (ranging from 79 to 104) of SBAE teacher aspirants. Normality and homogeneity of variance were assessed with all responses being normally distributed and a non-statistically significant ($p > .05$) Levene's test statistic. Therefore, a one-way ANOVA was conducted in SPSS, which resulted in a statistically significant difference based on composite effectiveness scores F (2, 65) = 4.66, $p < .05$. To further understand the statistical significance of the ANOVA output, a post-hoc analysis was conducted. Based on the ability to control for Type I error, a Bonferroni post-hoc analysis (Field, 2009) was used. A 95% confidence interval for the post-hoc analysis resulted in a statistically significant difference based on the SBAE teacher aspirants' intent to enter the SBAE teaching profession (Table 4).

Table 4

Multiple Comparisons Mean Differences of SBAE Teacher Aspirant Effectiveness Based on Intent to Become an SBAE Teacher (N = 72)

Career Intent	Yes	No	Undecided
Yes	-		
No	-8.61*	-	
Undecided	-4.04	4.58	-

Note. * = $p < .05$. Values identify the mean difference between groups.

Conclusions

The SBAE teacher aspirants at Oklahoma State University identified a high sense of effectiveness based on the ETI-SBAE instrument. The mean score for each item ranged between the somewhat strong (3) to very strong (4) scale. Each participant rated the item, *I care about all students*, as very strong in their capacity to be an effective teacher. The components of, *Appreciation for Diversity and Inclusion*, as well as, *Personal Dispositions*, received the highest scores of perceived effectiveness in this group of teacher aspirants. These findings resonate with today's generation of college students who are among the most diverse populations in history and express greater appreciations of diversity and inclusion than previous generations (Sanchez et al., 2018). Personal dispositions such as work ethic and trustworthiness are largely developed in childhood and adolescence (Syed et al., 2020). Therefore, the teacher aspirants in this study likely possessed these characteristics prior to their enrollment in the SBAE teacher preparation program at Oklahoma State University. Regardless, Darling-Hammond and Bransford (2005) stated that diversity and inclusion and personal dispositions should be highlighted by teacher preparation programs. Fortunately, the SBAE teacher preparation program at Oklahoma State University emphasizes diversity and inclusion through its international agriculture, special education, and adolescent psychology course requirements. Such opportunities for students to experience, learn, and practice such characteristics should continue.

SBAE teacher aspirants rated record keeping, exhibiting patience, pedagogical preparedness, and work-life balance with a greater frequency of very weak (1) and somewhat weak (2). This conclusion aligns with work by Toombs and Ramsey (2020) and Toombs et al. (2020) that also found a lack of confidence in keeping financial records for Supervised Agricultural Experience (SAE) projects in SBAE pre-service teachers. Some of the teacher aspirants in this study identified a lack of patience in their professionalism component. This may be contributed to Generation Z's scarcity of patience in their digital native world (National Retail Federation, 2017). It is possible a shortage of clinical and preclinical experiences may have contributed to the reported lack of confidence in pedagogical preparedness, specifically as it relates to classroom management and class preparation, as 62.5% (n = 45) of the teacher aspirants were still one or more semesters away from their clinical teaching experience. Additionally, the teacher aspirants encountering their student teaching experience (n = 27) were removed from their internship sites early due to the COVID-19 pandemic. These experiences are vital to developing mastery and vicarious experiences to build teacher self-efficacy in managing student behavior and preparing instruction (Bandura, 1997; Smalley & Retallick, 2012). Some of the study's participants questioned their ability to maintain a work-life balance before they had entered the teaching profession. All three items in this component, *ability to say no, leading a balanced life,* and *willingness to ask for help* were rated as very weak (1) or somewhat weak (2) by a significant portion of individuals. This may be problematic regarding the retention of these future SBAE teachers (Crutchfield et al., 2013). Though the mean scores were high for each item, frequency of low effectiveness responses should not be ignored.

The teaching effectiveness score was calculated by adding together the participants' effectiveness score for each of the 26 items, with a maximum possible effectiveness score of 104. In this group of teacher aspirants, all participants scored an overall teaching effectiveness score of

strong to very strong (i.e., ranging from 79 to 104) indicating these future SBAE teachers are confident in their ability as they near entrance into the teaching profession. The aforementioned responses of very weak and somewhat weak were not sufficient to reflect a low teaching effectiveness score for any participant. A person's positive view of his or her own ability is important in career choice and early career self-efficacy (Bandura, 1997). These neophyte teachers may be more resilient with a greater likelihood of being retained in the teaching profession than their less confident peers (Redman, 2015).

The extreme score of 104 on the ETI-SBAE is worth mentioning. Two possible explanations exist for this data point. It is possible this individual is very confident in their ability to be an effective SBAE instructor. It is also possible this individual could have reported a very strong (4) sense of effectiveness to each item with little to no regard to the item in question. Still, Liu et al. (2017) found extreme cases to have little impact to their overall findings.

Of the 72 SBAE teacher aspirants who participated in this study, only three (4.2%) reported they did not intend to teach SBAE. Even with another 12 (16.6%) being undecided, the overwhelming majority (79.2%) plan to enter the SBAE teaching profession, which surpasses national data from 2018 that found 77% of agricultural education graduates entered the teaching profession (National Association of Agricultural Educators, 2019) and from 2001 that found only 59% of graduates were entering the teaching ranks (Camp et al., 2002). It also surpasses research conducted by Eck and Edwards (2019) who found that six out of ten SBAE teacher aspirants who encountered a teacher preparation program actually entered the teaching profession. Even in the midst of a global pandemic, mandated distance learning, and a shortened student teaching internship, most SBAE teacher aspirants envisioned a future as a SBAE teacher. Considering a SBAE teacher shortage across the nation, SBAE graduates who are interested in teaching jobs are likely to be hired as an SBAE instructor (Camp et al., 2002).

In comparing teaching effectiveness scores across intention to teach groups, a statistically significant difference was found in the one-way ANOVA. Post-hoc analysis revealed statistically significant differences between those who intend to teach and those who do not. Uneven group sizes (Yes = 57, No = 3) were mitigated by homogeneity of variance within the groups. No statistically significant differences were found relating to the undecided group. Therefore, a relationship exists between intention to teach and teaching effectiveness scores, with those who intend to teach reporting higher teaching effectiveness scores than those who do not. This finding corroborates with Bandura's (1997) theory of self-efficacy and the connection of higher self-reverent beliefs and motivation.

Recommendations

The ETI-SBAE holds utility for SBAE teacher preparation programs. Peer institutions are encouraged to conduct similar survey research studies of their own teacher aspirants to compare populations across institutions. The same instrument could be used to assess the efficacy beliefs on entrance to the teacher preparation program, at the completion of pre-clinical experiences, and again after the conclusion of the student teaching internship to track human capital development throughout the SBAE teacher preparation program. Participants also could be followed into the novice years of their SBAE teaching careers. Additional qualitative data would add context to explain participants' rankings of their efficacy beliefs and ability. The findings of such research could impact course content, delivery, and pacing within SBAE teacher preparation programs.

Specific to the agricultural education teacher preparation program at Oklahoma State University, teacher educators should analyze existing instruction relating to the area's participants marked as somewhat weak and very weak. Specifically, topics of record keeping, maintaining patience, pedagogical preparedness, and work-life balance need to be emphasized and reinforced in the curriculum. Perhaps current in-service SBAE teachers could be recruited as guest speakers to

speak on record keeping systems and work-life balance. Further, teacher aspirants should have the opportunity to prepare and present lessons from various agricultural pathways before student teaching but specifically in regard to record keeping (i.e., data management). This mastery experience could be designed to build pre-service teachers' confidence in teaching in a variety of agricultural classes (Bandura, 1997) and build human capital in all areas of the SBAE curriculum.

To better interpret extreme responses in future studies, one or more items on the instrument could be reverse coded (Liu et al., 2017). This would eliminate the confusion on the true state of self-reverent beliefs in relation to teaching effectiveness. Although these teacher aspirants held a high sense of their ability to be effective SBAE teachers, they had yet to test their true abilities as a practicing SBAE teacher. Still, this belief in their ability to be successful should be fostered by teacher educators (Clark & Newberry, 2018). A positive self-perception of a person's ability to be successful is a necessary ingredient to sustained motivation (Bandura, 1997).

Discussion

Despite the Spring 2020 semester rapidly changing due to the onset of the COVID-19 pandemic, SBAE teacher aspirants at Oklahoma State University developed the necessary human capital based on the results of the ETI-SBAE. Oklahoma State University faculty worked diligently to provide effective and timely instruction throughout the pandemic, even as they were forced to quickly restructure their course delivery to virtual learning platforms (Daniel, 2020), which may have led to this positive development of necessary human capital skills. Considering the implications of the COVID-19 pandemic, along with the multitude of developmental needs of SBAE teacher aspirants, the data tend to be favorable despite the circumstances.

The clinical teaching experience has been referred to as one of the greatest benefits of a traditional teacher preparation program (National Council for Accreditation of Teacher Education,

2010). Fortunately for some of the teacher aspirants, they were able to continue delivering content through online modules, live class meetings using synchronous learning platforms, or sending homework packets to their students each week. All of these opportunities allowed for essential human capital development as it relates to preparedness for establishing teaching effectiveness. Some teacher aspirants had the opportunity to hold synchronous meetings with FFA officers, prepare career development teams, and host chapter meetings and banquets using online platforms. Unfortunately, for others, the clinical teaching experience ended as school districts failed to have the necessary resources to provide virtual instruction or offer other distant delivery methods. Although the SBAE teacher aspirants deemed themselves effective based on the ETI-SBAE, how should professional development opportunities for these first-year teachers be developed to offset the potential gap that was left at the beginning of the pandemic? As the COVID-19 pandemic continues, how should SBAE teacher preparation programs change to best prepare future teachers? Perhaps it is time to consider preparing teacher aspirants to become familiar with and use various online learning management systems, such as Google Classroom, Canvas, Moodle, and Docebo, to teach and deliver content, advise student learning, and supervise student projects, as other studies have identified (Eck, 2021). Maybe teacher preparation programs need to include training on teaching curriculum using a hybridized and flexible delivery system (i.e., synchronous and asynchronous teaching strategies). Although this study identified the SBAE teacher aspirants' self-perceived effectiveness as being strong to very strong, agricultural education teacher preparation faculty need to consider the future effectiveness of this group and others as they enter an everchanging education system.

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GPS and Geocaching Integration in Agriscience: The Impact on Critical Thinking

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GPS and Geocaching Integration in Agriscience: The Impact on Critical Thinking

Abstract

Global Positioning System (GPS) technology has an important role in both agriculture and in everyday life. However, the effects of GPS integration into agricultural classrooms has never been fully explored. This study evaluated the potential for critical thinking skill development as a result of student participation in a GPS lesson and the GPS-based treasure hunting game of Geocaching. The GPS lesson for both groups combined, the treatment (integrated Geocaching) and control (no geocaching integration), yielded statistically significant improvements on student engagement, cognitive maturity, innovation, and total critical thinking disposition. However, there were no statistically significant improvements resulting from the Geocaching integration. The authors recommend additional research on the influence of Geocaching on other variables of student achievement (i.e., knowledge gained, mathematical processing skills, science processing). Geocaching can be designed to be educational and the authors contend it is a novel way to promote student engagement and reinforce academic content into the Agriscience classroom.

Introduction

Treasure hunting is often imagined to be the sport of pirates and adventurers looking to strike it rich. Now, thanks to the concept of Geocaching, anyone with a Global Positioning System (GPS) receiver and Internet access can explore for hidden objects. Geocaching can serve as an enjoyable hobby, but can also be beneficial within various learning environments (Christie, 2007; Hendrix et al., 2011). This study introduced GPS technology and a modern-day treasure hunting activity, Geocaching, into the agriscience classroom.

GPS technology is a "navigation and precise-positioning tool" that was developed by the U.S. Department of Defense in 1973 (Glasscoe, 1998, para. 1; "What is GPS?," 2011). Global Positioning System technology allows users to create accurate maps of their surroundings by

receiving geographic information beamed down from satellites orbiting the Earth (Shaunessy & Page, 2006). One way to introduce GPS technology to students is through the game of Geocaching (Groundspeak, 2011). Geocaching is a high-tech treasure hunt experience in which participants use GPS units to discover hidden objects known as Geocaches. Any member of the Geocaching community can hide a Geocache, although they must follow certain rules pertaining to safety and legal issues (Groundspeak, 2011).

The impact of technology integration in education has been studied widely, and results indicate that access to technology in education improved student motivation, self-esteem, technical knowledge, and interpersonal skills compared to students without access (U.S. Department of Education, 1998). Teachers who frequently use technology can aid in developing their students' understanding of essential 21st Century Skills – skills regarding knowledge of technology, the developing world, communication, creativity, teamwork, and self-discipline (Grunwald & Associates, 2010).

Teaching with GPS "is an ideal context in which to develop critical thinking" (Schwartz, 2016, p. 13). "Students use critical thinking skills [when learning through GPS] to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources" (Schwartz, 2016, p. 13). According to Siegel (1988), critical thinking skills are an important component of life, and should be included in educational systems because young people deserve the chance to learn to think critically. Additionally, critical thinking has been included in frameworks to illustrate the skills students need to succeed in work and life (Crawford & Fink, 2020). A student's mastery of critical thinking also helps them to improve control over their own lives and increase the quality of their life experiences (Paul, 1995). In a 1991 report, the U.S. Department of Labor identified critical thinking skills as one of the foundational skills in which students should gain competency (Secretary's Commission on Achieving Necessary Skills).

In addition to critical thinking, GPS requires a working knowledge of geography, math, and physical science. Therefore, GPS systems and tools are often utilized in classrooms in these subject areas. Geocaching adds to the teacher toolbox, allowing them to cover almost any topic in a fun and engaging manner (Dixon, 2011; Thorpe, 2006;). Related technology experiences have had significant impacts on the development of critical thinking in students (Duran & Sendag, 2012). Therefore, we tested the impact of integrating a GPS and geocaching lesson and activity in an agriscience course to determine if similar, positive critical thinking outcomes would be realized.

Conceptual Framework

Critical thinking has been defined as "a reasoned, purposive, and introspective approach to solving problems or addressing questions with incomplete evidence and information and for which an incontrovertible solution is unlikely" (Rudd et al., 2000, p. 5). Angelo (1995) notes critical thinking involves "the intentional application of rational, higher order thinking skills" including "analysis, synthesis, problem recognition and problem solving, inference, and evaluation" (p. 6). Although these definitions are complex, when simplified, they reveal that critical thinking is the ability of a person to make a difficult decision after considering all people, situations, and options – a trait agricultural education students ought to reflect (Facione et al., 1997).

Effective critical thinking has positive effects across the aspects of one's life. Murawski (2014) says that critical thinkers produce more ideas of higher quality than non-critical thinkers, and are more likely to set goals and overcome obstacles such as failure, distraction, and limitations. Ruggiero (2012) notes critical thinkers are better at demonstrating effective listening skills, identifying extreme views, avoiding emotionalism and stereotyping, seeing multiple perspectives, acknowledging limitations, and thinking before acting. Butler (2012) and Butler et al. (2015) found that critical thinking was more effective than intelligence at predicting life decisions. In their study, individuals possessing higher critical thinking scores reported experiencing fewer negative life

events than those with lower critical thinking scores.

Critical thinking has benefits in the workplace (Ennis, 1987; Murawski, 2014; Willsen, 1995). Casner-Lotto et al. (2006) found that 92.1% of surveyed employers identified critical thinking and problem solving skills as "very important" to successful job performance for four-year college graduates (p. 20). Research shows that people who score well on critical thinking assessments are rated by their supervisors as possessing "good analysis and problem-solving skills," "good judgment and decision making" skills, "good overall job performance," "the ability to evaluate the quality of information," "creativity," "job knowledge," and "the potential to move up" in the workplace (Harris, 2015, para. 9).

Leaders who exercise quality critical thinking on the job are better able to evaluate and mitigate risk, weigh options, and recognize the effect that consequences have on not only themselves, but on coworkers and stakeholders (Anderson, 2013; Murawaski, 2014). Unfit or hasty decisions result in real issues for businesses, which illustrates the need for employees who can gather information, consider outcomes, and make informed decisions. Thus, critical thinking - alongside related behavioral skills such as leadership, communication, collaboration, and innovation – are highly sought by employers when making hiring decisions (AACU, 2010; Casner-Lotto et al., 2006; Hendrix & Morrison, 2018; Landrum & Harrold, 2003).

While effective critical thinking is beneficial to students, it is a difficult skill to teach (Angelo, 1995). It does not often arise "simply as a result of maturation," but rather through guided learning experiences that overtly highlight "active engagement" and "personal investment" in the learning activity, "comprehensible and timely feedback," and cooperative work "with peers and teachers" (Angelo, 1995, p. 6). Yet students cannot simply be passive receivers of knowledge. Critical thinking is purposeful, and it requires the active use of information to make effective decisions – a process that includes application of knowledge in real-world circumstances,

experimentation through trial and error, and reflection upon successess and failures (Murawski, 2014; Paul, 1995).

When measuring the critical thinking abilities of agricultural education students, Cano (1995) stated they were able to "think critically at various levels," and that they tend to "score at higher percentages at the higher levels of cognition" (p. 29). These findings supported the earlier work of Rollins et al. (1988), who found agricultural education students able to successfully employ critical thinking skills when addressing problem-based situations. Akins et al. (2019) noted the use of case studies in agricultural communications courses increased students' critical thinking, information-seeking, and interpersonal engagement behaviors.

Ricketts and Rudd (2004) found the National FFA Organization – a co-curricular organization for agricultural education students – to be fertile ground for critical thinking development. Student leaders in the National FFA Organization showed "high" levels of critical thinking, with scores in the "upper end of the range" for the sub-skills of analysis, inference, and evaluation (Ricketts & Rudd, 2004, p. 15). In contrast, Latham et al. (2014) found that critical thinking was occuring at a lower level among senior Texas FFA members than their counterparts. Latham et al. called for an improvement for critical thinking instruction within agricultural education throughout the curriculum.

The conceptual framework for this study is supported by a National Delphi study conducted by Facione (1990), who defined critical thinking as "purposeful, self-regulatory judgment, which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (p. 2). The Delphi study revealed a set of critical thinking dispositions that are inherent in critical thinking. Facione (2011) referred to the dispositions as approaches to life that characterize critical thinking. He developed an assessment of the following critical thinking

dispositions: Truth-Seeking, Open-mindedness, Analyticity, Systematicity, Self-confidence, Inquisitiveness, and Maturity.

This study utlized a model of critical thinking developed by agricultural educators at the University of Florida (UF). Researchers at UF developed an instrument that measured dispositions as Facione (2011) did, but in a more effective and efficient way (Irani et al., 2007). Because of the length and amount of time Facione's assessment took to complete and the suspect reliability of the scales on Facione's California Critical Thinking Disposition Inventory (CCTDI) (Moore et al., 2002), researchers developed the UF-EMI (Irani et al., 2007). For this study, changes in these dispositions were assessed utilzing a retrospective/post version of the UF-EMI (University of Florida – Engagement, Maturity, and Innovativeness) assessment (Ricketts et al., 2007) described in the methods section below.

The UF-EMI model of critical thinking assessment used to reach this study's objectives contains three scales (Engagement, Cognitive Maturity, and Innovativeness). The Engagement construct measures a person's ability to anticipate and seek out situations requiring logical reasoning, use existing critical thinking skills to confidently solve problems, and to be an effective group leader. The Maturity construct assesses a person's awareness of their own biases, their environment, their opinions, and their influences on both their own lives and the lives of others. The Innovation construct assess a person's desire to learn new information and to explore the world around them while continually seeking truth through research and questioning (Irani et al., 2007; Ricketts, 2003).

Purpose and Objectives

Despite existing literature illuminating how effective Geocaching can be as an educational activity (Christie, 2007; Dixon, 2011; Schwartz, 2016), its use has rarely been documented as a method of teaching agriculture. While this does not exclude the possibility that agriculture teachers

have used Geocaching before, it does show a lack of knowledge about either the educational possibilities or the existence of the game in general.

Therefore, it is important that if GPS technology and Geocaching are to be used as an educational tool in agriculture classes, the possibilities are fully explored. Geocaching makes learning an active experience that requires the evaluation of ideas alongside problem-solving, decision-making. Therefore it is possible that students' critical thinking will be impacted by the introduction of GPS in the agriscience education curriculum.

The purpose of this study was to determine the effects of Geocaching integration in an agriscience lesson plan. The primary objectives of this study were to:

1. Describe the change in critical thinking dispositions as a result of the GPS lesson for both the treatment (Geocaching integration) and control (no Geocaching integration) groups in the agriscience courses.
2. Compare the critical thinking dispositions of students of the treatment group who participated in the GPS lesson with integrated Geocaching activity against those the control group who participated in a GPS lesson void of Geocaching integration.

Procedures

The first step undertaken in this study was the development of an introductory level GPS lesson which fit into a 50-minute class period. This lesson opened with a 20-minute lecture discussing GPS history, reading coordinates, usage in agriculture, and the game of Geocaching.Materials including an accompanying PowerPoint a coordinate worksheet, and a Geocaching worksheet were created as well.

Eight Garmin eTrex 10 GPS receivers and carrying cases were purchased for use in the study. These specific receivers were chosen due to their low cost, durability, and ease of use. Other purchased materials included Geocache container materials such as a plastic hide-a-key containter

and a PVC pipe with one cap attached to the bottom. All materials were clearly labeled as Geocaches using official stickers purchased from Groundspeak (2021).

Five schools were contacted through email about participating in the study. On the day of each visit, the researcher arrived at the selected school approximately forty-five minutes early and proceeded to hide the Geocaches. When the selected classes began, the researcher allowed the teacher to perform any necessary duties before beginning the GPS lesson.

After the end of the introductory lecture, the students were introduced to their first activity. This activity was developed to introduce basic GPS ability and to reinforce the concepts of latitude and longitude. In this activity, students were placed into groups of two to five students, with each group given a GPS unit, a GPS Instructions page, and a Coordinate Worksheet. Each group was then led outside and asked to turn on their GPS unit. The teacher visited each group to ensure that everyone understood the directions and to minimize potential problems. After each unit had a successful lock on three or more satellites, the teacher asked students to write their current coordinates down on the Coordinate Worksheet. The students then moved to a new location not far away, and wrote down a new pair of coordinates. Again, the teacher visited each group, this time to discuss the results with the students. Discussion topics included uncovering which coordinate numbers changed, why certain numbers changed the way they did, and how the numbers indicated the students' direction of travel. Then each group would compare their results with other groups before the Coordinate Worksheets were collected.

The next part of the GPS unit varied between classes. For those classes randomly chosen to be the control group, the GPS units were collected, the class returned to their classroom, and the paper-and-pencil based GPS Review Worksheet provided.

The treatment groups were instead allowed to keep their GPS units for a second activity in which they would experience the game of Geocaching. The Geocaching activity began by dividing

up students into three groups. Each group was given a different set of coordinates that were designed to lead them a Geocache. Although both their teacher and the researcher monitored the groups, the students were allowed to follow their GPS and search for the Geocaches on their own. If problems arose, students were given clues or hints to help them discover the final location of the cache. When the caches were discovered, students were instructed to sign the contained log sheet, take a few stickers as a prize, and then re-hide the cache back in its original location before returning to the classroom.

When either the Review Worksheet or Geocaching activity was complete, the students were given the GPS Test and survey instrument. The test was written with the specific intent of testing what knowledge was gained during both the lecture and activity portions of the lesson. It consisted of seventeen multiple choice questions that covered basic concepts regarding the history of GPS, the usage of GPS in agriculture, the workings of GPS technology, and also latitude and longitude. Students were not allowed to use notes during the test, and would be given as much time as needed to answer the questions and survey instruments.

Following the end of the lesson, GPS units, tests and surveys were collected, and the remaining five to ten minutes left in each class period would be spent debriefing students about what they had learned and experienced. This was to help the students further retain what they had learned, and to give them a chance to offer their thoughts on the GPS unit as a whole.

Methods

This study utilized survey research and took place at [university] and in five different high schools in three counties in the [state]. These schools were chosen to participate in the study due to their proximity to [university], because they all had successful agricultural education programs, and because they offered agriculture courses that fit study criterion. In order to be selected, a school had to offer two of the same agriculture classes that were taught by the same teacher. This

was done to minimize error and decrease the number of potential variables. Due to budgetary and time restraints, the selected classes were not the same in every school. A total of four different types of agricultural classes were visited overall – two agriscience classes, two agricultural mechanics classes, two floral design classes, and four small animal care classes.

Each class had a different number of students ranging between 13 and 21 students, with an average of 16.8 students per class. One hundred and fifty-five usable responses were collected, for a response rate of 92%. Of these usable responses, 79 were from female students and 76 were from males. Students ages ranged from 14 to 19 with an average age of 16.1 years. One of the two classes at each school was randomly selected by a coin toss to serve as the test group that would receive the treatment Geocaching activity. The other class served as the control group and received a paper assignment in place of the Geocaching activity. Seventy-eight students who provided usable responses were members of the treatment group/classes, while seventy-seven were members of the control group/classes.

The survey instrument used to collect data was the EMI Critical Thinking Disposition Retrospective Post Instrument (Ricketts et al., 2007) as adapted from the original UF-EMI (Irani et al., 2007; Ricketts, 2003). This version was used for convienience since it has been found to be just as reliable as the original instrument. Reliability of the original UF-EMI ranges from ($\alpha = 0.79$ to 0.94) (Irani et al.), and reliability of the retrospective post version, as used in this study, ranges from ($\alpha = 0.79$ to 0.93) (Ricketts et al., 2007).

This instrument asks students to state on a six-point scale their agreement or disagreement with 26 statements in order to evaluate their level of critical thinking disposition. Because it was a retrospective post instrument, it asks students to first rate how they thought their critical thinking disposition was before participating in the study, and then to rate their disposition following the lesson. Retrospective post research designs are frequently used in Agricultural Education and

Extension research and evaluation, specifically in regards to the effectiveness of educational programs (Klatt & Taylor-Powell, 2005). A retrospective post design was chosen for use in this study for two reasons.

First, it was selected to minimize the effects of response shift bias. Response shift bias occurs when a participant's understanding of the construct being measured changes in response to the content of an educational program (Drennan & Hyde, 2008; Klatt & Taylor-Powell, 2005). In this study, the educational program was the introductory lecture and the Geocaching activity. Since students knew little about critical thinking or GPS technology prior to the introductory lecture and Geocaching activity, it is likely that students would have not possessed enough information to give an accurate picture of their understanding of these subjects on a true pre-test. By presenting students with the information and then asking them to compare their new knowledge with their prior state, the researchers were better able to compare the changes in critical thinking that occurred as a result of the educational program.

Second, the retrospective post was chosen due to convenience and time constraints. Retrospective post studies are versatile and can be used "to evaluate many types of programs for different audiences in varied settings" (Klatt & Taylor-Powell, 2005, p. 2). They are also "less burdensome and intrusive" for participants and take less time to administer, as all data are collected at the same time instead of at two different points (Klatt & Taylor-Powell, 2005, p. 2). This type of research design fit the needs of the study, since all participating schools used schedules that offered class lengths of only 45 to 60 minutes. Including a separate pre-test and post-test, alongside the introductory lecture and Geocaching activity, would not have fit into this single-class time frame. Separating the experience into two days was a possibility, but the researchers rejected this idea for being intrusive on participating agricultural educators, and to manage the potential for incomplete data due to student absences.

The standards for reliability for Cronbach's alpha by Robinson et al.(1991) were utilized to assess the quality of the scales in the instrument: .80 - 1.00 - exemplary reliability, .70 - .79 - extensive reliability, .60 - .69 - moderate reliability, and <.60 - minimal reliability. Using these standards, all scales possessed exemplary or extensive reliability. Internal consistency coefficients for the subscales for the EMI Critical Thinking Disposition Retrospective Post Instrument were 0.89 for Engagement, 0.75 for Maturity, and 0.79 for Innovativeness. Engagment was measured by 13 items on the instrument, Maturity by six, and Innovativeness by 11 (Irani et al., 2007; Ricketts, 2003). The total possible score for Engagement ranged from 13 to 78, Maturity from 6 to 36, and Innovativeness from 11 to 66. The total survey score ranged from 30 to 180.

Data were recorded in Microsoft Excel spreadsheets, which were later transferred to SPSS statistical software (SPSS, IBM Corporation, 2010) for further analysis. An alpha level of 0.05 was used, providing a 95% level of confidence. Inferences (t-tests) were drawn by comparing critical thinking and leadership development mean scores of the different groups.

Findings/Results

Objective One

The GPS lesson for both groups combined yielded statistically significant improvements in the critical thinking dispositions of student engagement, cognitive maturity, innovation, and total critical thinking disposition, albeit with a small effect size according to Cohen (1988). The study participants as a whole scored a total Critical Thinking Disposition (CTD) mean of 90.88 (*SD* = 13.58) for the retrospective assessment, and a mean of 94.03 (*SD* =14.59) for the post-lesson assessment. The Engagement retrospective mean was 38.65 (*SD* = 6.80), and the post-lesson mean was 39.92 (*SD* = 7.10). The Cognitive Maturity retrospective mean was 28.45 (*SD* = 3.99) and the post-lesson mean was 29.23 (*SD* = 4.42). The retrospective Innovation mean score was 23.79 (*SD* = 4.10), and the post-lesson mean was 24.88 (*SD* = 4.34) (Table 1).

Table 1

Critical Thinking Change Resulting from the GPS Lesson

Item	*n*	*M*	*SD*	*SE*	*t*	*df*	*p*	*d*
Retro Total	155	90.88	13.58	1.09	-6.26	154	.00	0.23
Post Total	155	94.03	14.59	1.17				
Retro Engagement	155	38.65	6.80	0.55	-4.63	154	.00	0.19
Post Engagement	155	39.92	7.10	0.57				
Retro Maturity	155	28.45	3.99	0.32	-5.04	154	.00	0.20
Post Maturity	155	29.23	4.42	0.36				
Retro Innovation	155	23.79	4.10	0.33	-5.88	154	.00	0.27
Post Innovation	155	24.88	4.34	0.35				

Note. *$p < .05$, 2-tailed
**Cohen's interpretation of effect size (*d*), 0.2 = Small, 0.5 = Medium, 0.8 = Large

Objective Two

To determine the influence of the integrated Geocaching activity, changes in critical thinking dispositions were measured by comparing the control group mean score and the treatment group mean score. The total mean score for the control group was 91.03 (*SD* = 12.80), and the total mean CTD score for the treatment group was 90.74 (*SD* = 14.40). The Engagement mean score was 38.86 (*SD* = 6.40) for the control group and 38.44 (*SD* = 7.21) for the group receiving the treatment. The Cognitive Maturity mean score was 28.42 (*SD* = 3.66) for the control group and 28.47 (*SD* = 4.32) for the treatment group. The Innovation mean score for the control group was 23.75 (*SD* = 4.19), and was 23.83 (*SD* = 4.02) for the treatment group (Table 2).

Table 2

Critical Thinking Change Resulting from Geocaching Integration

Item	*n*	*M*	*SD*	*SE*	*t*	*df*	*p*	*d*
Control Total	77	91.03	12.80	1.46	-0.13	153	0.89	0.02
Treatment Total	78	90.74	14.40	1.63				
Control Engagement	77	38.86	6.40	.73	-0.39	153	0.70	0.05
Treatment Engagement	78	38.44	7.21	.82				
Control Maturity	77	28.42	3.66	.47	-0.09	153	0.93	0.01
Treatment Maturity	78	28.47	4.32	.49				
Control Innovation	77	23.75	4.19	.48	-0.12	153	0.90	0.02
Treatment Innovation	78	23.83	4.02	.46				

There were no significant differences between the group with the integrated Geocaching activity and the control group who received the GPS lesson minus the activity.

Conclusions and Recommendations

Although research has already shown that technology in the classroom has benefits (Duran & Sendag, 2012; Grunwald & Associates, 2010; U.S. Department of Education, 1998), the use of GPS technology is hasdistinct benefits to students' critical thinking ability (Schwartz, 2006). Using GPS technology requires students to solve problems, overcome obstacles, make decisions, participate actively in the learning process, and apply new uses to technology – all factors that play a role in the development and exercise of critical thinking skills (Angelo, 1995; Harris, 2015; Murawski, 2014; Paul, 1995; Schwartz, 2006).

Study results imply the introduction of GPS technology into the agriscience classroom has potential to improve student critical thinking, especially regarding the quality of Innovativeness. Innovativeness involves one's desire to learn new information through exploration, truth-seeking, research, and questioning (Irani et al., 2007; Ricketts, 2003). Hands-on use of GPS systems required participants to exercise innovativeness as they experimented with unfamiliar tools and concepts and sought answers via trial and error. At first, student participants were unsure about their ability to navigate, but by the end of the lesson they could utilize concepts such as coordinate planes and latitute and longitude while connecting them to uses in the modern agricultural industry. This behavior demonstrates critical thinking as defined by Facione (1990) and Angelo (1995), who both included problem solving, analysis, evaluation, and inference as crucial parts of the critical thinking process. Students were able to quickly and correctly make use of new information and tools in order to gain new understanding.

The Engagement construct of critical thinking saw some development. Engagement concerns itself with a person's ability to identify and solve situations that require logical reasoning,

leadership, and critical thinking. Students in the coordinate activity worked in groups, with each group assigned only one GPS receiver. This naturally led to some students adopting an unofficial leadership position with the group. These leaders often took responsibility for determining positions using the unit while delegating other tasks such as writing coordinates, marking locations, or reading instructions to other members. While there were overall gains in engagement, some students were able to take greater advantage of the situation than others, and perhaps see higher gains in critical thinking than others.

The Cognitive Maturity construct saw the least amount of gain among the three EMI constructs. This construct evaluates a person's awareness of their own biases, their environment, their opinions, and their influences on both their own lives and the lives of others (Irani et al., 2007). This study was not designed to focus on any of these aspects of the Maturity construct, which is most likely the reason that the gain in Maturity scores was the least of all critical thinking gains.

Integrating Geocaching into the lesson did not show any significant benefits to student critical thinking levels. This could potentially be because Geocaching is traditionally a recreational activity, and students saw it as such. Although there are some official Geocaches designed to be educational or to require complex research, inquiry, and puzzle-solving efforts (Groundspeak, 2020), the caches used in this activity were not of this type. Instead, they were representations of the simpler Geocaches that most typically populate the game. After using their GPS receiver to find the general location of a Geocache – a skill already demonstrated in the earlier portion of the lesson – students then physically searched for the hidden container. While this did require students to explore their school grounds and consider where objects could be hidden, usually only one student out of each group made the find while others were unsuccessful. It is possible that the finder alone saw some critical thinking development, or perhaps already possessed higher critical

thinking abilities than the rest of their group.

The researchers recommend further study into the use of GPS technology in agricultural education. Global Positioning Systems play a large role in modern agriculture (GPS.gov, 2018), yet this technology not frequently addressed in agricultural education programs. The researchers recommend course developers in agricultural education consider including lessons and applications for GPS/GIS in agriculture. These lessons should focus on (a) developing critical thinking dispositions in students and (b) exposing students to career-relevant technology and content that will enhance those critical thinking dispositons.

The researchers recommend attempting to study GPS integration outcomes with the use of more GPS units. This was a limitation for the study, as not every student participant was able to personally interact with their assigned GPS receiver for the duration of the lesson. Possessing enough GPS receivers to allow students to work in pairs, or perhaps individually, might impact the level of critical thinking that occurs.

Researchers recommend further study to identify the effectivness of Geocaching and other game-based learning methods with the use of a true pre-post design rather than the retrospective-post design. While a retrospective-post design was chosen to minimize response shift bias bias and fit the needs of the study, the format had a downside. Klatt and Powell-Taylor (2008) report that reflecting upon and evaluating one's prior knowledge can be a difficult task, making a retrospective-post design "difficult or inappropriate for certain learners" (Klatt & Powell-Taylor, 2008, p. 2). A true pre-post design would eliminate this issue and measure student critical thinking growth in a more straightforward manner.

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An Assessment of South Carolina Organic Farmers' Educational Needs,

Perceived Barriers and Growth Opportunities

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An Assessment of South Carolina Organic Farmers' Educational Needs, Perceived Barriers and Growth Opportunities

Abstract

Organic farming has seen a dramatic increase over the last decade and is now practiced all over the world. With this new and innovative farming style growing in demand, it creates a greater need for education and resources for farmers. This study was undergirded by the diffusions of innovations theory, as the Cooperative Extension service aids in the diffusion of practical agricultural information throughout the United States. The purpose of this study is to determine the educational resources necessary for organic farmers. By assessing the community needs, the data can be used to provide cooperative extension with educational materials to help aid organic farmers. A Borich needs assessment was developed to conduct this non-experimental research study through a survey research design, which allowed researchers to rank the educational need. The results of this study indicate that educational resources need to be developed and geared toward managing organic crop diseases, insect pests and weeds in an organic farming system. Extension services play a major role in diffusion of technology and educational resources, as agents need to provide educational resources for organic farmers in addition to conventional farmers. Additionally, educational materials need to be developed to better educate consumers on organic farming and what it means to be certified organic. It is further recommended that an educational needs assessment be performed on extension agents to determine their educational gaps when dealing with organic competencies, bridging the gap between organic education and extension. These findings are very insightful for extension services and other educational agencies to understand where the largest educational need is.

Introduction and Theoretical Framework

The renewed emphasis on environmental protection and agricultural sustainability has created a new wave of interest in organic agriculture (McNeil, 2020). Organic agriculture can be defined as an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity (USDA National Organic Standards Board), which is based on minimal inputs and best management practices that restore, maintain, and enhance ecological harmony (Gold, 2007). Thus, organic farming has increased over the last decade and is now practiced all over the world, with global organic sales reaching $55.1 billion in 2019 (McNeil, 2020). In the U.S., 8.3 million acres are currently certified for organic production, and the organic marketplace allows smaller scale operations and new generation farmers to contribute to global agricultural production (Knutson, 2019).

As organic agriculture continues to grow, the need for education and resources for farmers grows. The Smith-Lever Act in 1914 established Cooperative Extension as part of the land-grant universities, which aim to serve agricultural producers in the state as an educational resource by providing research-based information (Scholl, 2013). Specifically, Clemson University has the obligation ‘‘to teach such branches of learning as are related to agriculture and the mechanical arts... in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life’’ (Act M, 1862). Land grant universities were set up with the intention of providing agricultural education to citizens in the state, with organic farming emerging with unique regulations and required skillsets. Land grant universities need to fulfill their role as an educational resource for these organic farmers. Additionally, literature is lacking on the educational resources being implemented for organic farmers, therefore this study aimed to identify the necessary educational resources for organic farmers.

The continued adoption of organic agriculture will be influenced by policy measures that improve farming education and promote environmental mindfulness, such as farm output

diversification. Therefore, this study was undergirded by the diffusions of innovations theory (Rogers, 2003), as the Cooperative Extension service aids in the diffusion of practical agricultural information throughout the United States (Hillison, 1996). Communication channels and networks play a huge role in facilitating the education to farmers with advanced extension services, organized workshops, and round table meetings among farmers and rural stakeholders (Genius & Pantzios, 2006), ultimately leading to a sustainable adoption (Rogers, 2003) of organic agricultural practices. Currently in South Carolina, increasing demand for organic products helps in the decision process to adopt organic agriculture, while the extensive list of regulations set forth can limit the continual implementation of the process (Rogers, 2003). Known barriers exist within the innovation decision process, including, producing organic crops with alternative pest management solutions, increasing soil fertility, following organic regulations, and implementing no-till methods. Additionally, two of Rogers' (2003) attributes of innovation, trialability and observability, established educational practices of the Cooperative Extension service, help reduce uncertainty about innovations such as organic farming practices. With the proper knowledge, farmers may use small plots of land for their own trials before seeking organic certification. Therefore, it is essential to develop educational material, field trials and training targeted at organic farmers to provide the necessary knowledge to help in the decision and implementation process related to the diffusion of organic agriculture (Rogers, 2003). Specifically, this research aims to understand organic agriculturalists and their needs in South Carolina.

Purpose/Objectives

The purpose of this study was to determine the educational resources necessary for organic farmers. By assessing the needs, the data can be used to provide cooperative extension with educational materials to help aid organic farmers. Three objectives guided this study:

1. Determine the personal and professional demographics of certified organic farmers in South Carolina,
2. Determine the educational resource needs and preferred method of receiving educational resources, and
3. Determine organic farmers' perceived growth and barriers for organic farming.

Methods

A Borich needs assessment was developed to conduct this non-experimental research study, aimed at determining the educational needs based upon a discrepancy model (Borich, 1980). This study implemented a survey research design, which could then be weighted and ranked in order of educational need priority.

Participants

A census approach was implemented to reach South Carolina organic farmers who have been certified through the Clemson University Organic Certification Program ($N = 41$). The frame was obtained from the Clemson University Organic Certification Program, all 41 certified organic farmers in South Carolina were contacted and had equal opportunity to participate. The electronic survey was distributed via email with a letter explaining the survey's purpose and a link to the Qualtrics survey.

Instrumentation

The needs assessment was adapted from Frick's (2008) *Needs Assessment of Saskatchewan Organic Farmers* to meet the organic needs in United States. The survey consisted of a Borich needs assessment with Likert scale questions and open-ended questions to gain an understanding of what educational resources the organic farmers needed. The results identify the discrepancy between organic growers' self-perceived skill level and their desired interest level on organic farming competencies. The survey questions were divided into three main groups to coincide with

the objectives. The first set of questions covered basic demographics, including organic crops grown, total number of acres cultivated, gross revenue, farming experience, age, education level, gender, and location. The second set of questions focused on integral components of organic farming. These questions were divided up into the following categories: natural resources & biodiversity, land requirements, managing soil fertility and soil quality, managing weeds, managing crop insect pests, managing crop diseases, crop rotation and postproduction needs. The third set of questions asked the participants to identify their preferred method for receiving educational materials.

Procedure

The survey was evaluated for content validity by a panel of experts in organic agriculture to ensure the survey questions were relevant to organic produces in South Carolina. In addition, faculty in agricultural and extension education reviewed the instrument for face validity based on their experience with survey design and implementation. Prior to survey distribution, the study was approved by the Clemson University IRB office. Once approved, the initial email was sent to organic farmers in South Carolina ($N = 41$) requesting their participation in the study. Following the tailored design method (Dillman et al., 2014), a second email was distributed two weeks later, followed by a final reminder email two weeks after that. After three rounds of email communication with organic farmers, a final attempt was made to solicit responses via phone, where the farmers were encouraged to participate in the survey that was distributed. Although responses were anonymous, participant email address were recorded to help collect data from non-respondents.

Data Analysis

Following data collection, SPSS Version 26 was used for descriptive data analysis. Microsoft Excel was implemented to calculate a mean weighted discrepancy score (MWDS)

between current skill level and desired interest level. The organic competencies were then ranked using the mean weighted discrepancy scores.

Findings

Objective 1: Determine the professional and personal demographics of certified organic farmers in South Carolina

The survey had a 69% (n = 29) response rate. The responding organic farmers revealed that nearly half (48%) have been certified organic farmers for less than five years. The survey also revealed that nearly half (44.8%) of farmers make over $50,000 in gross organic sales. Nearly all (89.9%) the organic farmers are older than 41 with over half (58.6%) of them having completed a bachelor's degree or higher. The majority (75.9%) of organic farmers are male. The most common organic crops are cucumber, squash, lettuce, tomato, and peppers, all of which producers intend on growing in the future with 55.2% of farmers stating they do not intend to change what they are already producing. The respondents were distributed across 21 counties in South Carolina with varying land sizes (see Table 1).

Table 1

Acreage Allocation of Organic Farmers

# Acres	# Farmers with Cultivated Acres	# Farmers with Other Acres (Forests, Natural Areas, etc.)	# Farmers with Certified Organic Acres
0-1.99	7	13	4
2-5.99	5	0	5
6-9.99	5	1	5
10-19.99	4	2	1
20-49.99	3	0	4
50-99.99	4	6	5
100-499.99	1	4	1
500-999.99	1	1	2
1,000-6,000	2	2	1

The greatest numbers of organic crops grown in South Carolina are tied between cucumber,

pepper, and tomato with seventeen of the organic farmers producing these crops (see Table 2). Sixteen of the organic farmers indicated they produce lettuce and squash, while the least grown crops were melon (10), onion (9), corn (8), asparagus (5), and small grain (5). Three organic farmers intend to add carrot, berry, potato, and asparagus to their list, although the majority (*n* = 16) have no intentions to change their current acreage (see Table 2).

Table 2

Frequencies of Current and Intended Addition of Crops Produced by Organic Crop Farmers

Organic Crop Type	# of Organic Farmers Currently Producing	# of Organic Farmers Intending to Produce Crop
Cucumber	17	1
Pepper	17	1
Tomato	17	1
Lettuce	16	0
Squash	16	1
Bean	15	0
Brassica	14	1
Okra	14	0
Broccoli	13	2
Carrot	12	3
Herb	12	1
Berry	11	3
Potato	11	3
Melon	10	2
Onion	9	1
Corn	8	1
Asparagus	5	3
Small grain	5	3
Hemp	4	1
Stone fruit	3	2
Apple	1	1

Objective 2: Determine the educational resource needs and preferred method of receiving educational resources

Natural Resources & Biodiversity

The educational needs related to natural resources and biodiversity (Table 3) are wetland

wildlife habitat management and removal of invasive species. Education programs should focus on these two educational areas and potentially partner up with DNR or Clemson University Invasive Species Program to cover these two topics. Organic farmers are confident in their upland wildlife habitat management and tree/shrub establishment skills.

Table 3

Rankings of Organic Farmers' Competency Ratings of Natural Resources and Biodiversity Skills Using the Borich Needs Assessment Model (*n* = 26)

		Current[a]		Desired[b]		
#	Organic Competencies	*M*	*SD*	*M*	*SD*	MWDS[c]
5	Wetland wildlife habitat management	2.44	1.26	3.65	1.11	4.09
3	Removal of invasive species	2.67	1.22	3.84	1.32	4.00
4	Implementation of biodiversity efforts	3.04	1.43	3.96	1.19	3.80
1	Stream habitat improvement and management	2.19	1.18	3.31	1.38	3.57
6	Upland wildlife habitat management	2.69	1.49	3.65	1.30	3.07
2	Tree/shrub establishment	2.70	1.12	3.23	1.19	1.68

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Land Requirements

The highest MWDSs for educational need (Table 4) for land requirements are field border development and riparian forest buffer management. Organic farmers are confident in their buffer zone development skills.

Table 4

Rankings of Organic Farmers' Competency Ratings of Land Requirements Skills Using the Borich Needs Assessment Model (*n* = 26)

		Current[a]		Desired[b]		
#	Organic Competencies	*M*	*SD*	*M*	*SD*	MWDS[c]
1	Field border development	2.96	1.09	3.85	1.03	3.84
3	Riparian forest buffer management	2.70	1.18	3.46	1.28	2.21
4	Riparian herbaceous cover management	2.81	1.24	3.36	1.35	1.82
5	Transitional land development/conservation cover	2.89	1.34	3.46	1.28	1.80
2	Buffer zone development	3.19	1.06	3.58	1.08	1.71

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Managing Soil Fertility and Soil Quality

The highest need of educational resources (Table 5) in managing soil fertility and soil quality are soil biology management to improve existing soil life and soil chemistry management as determined by the MWDS. When developing these resources, soil chemists could be utilized as experts on these topics. The organic farmers are confident in their ability to minimize soil erosion.

Table 5

Rankings of Organic Farmers' Competency Ratings of Managing Soil Fertility and Soil Quality Skills Using the Borich Needs Assessment Model (*n* = 26)

		Current[a]		Desired[b]		
#	Organic Competencies	*M*	*SD*	*M*	*SD*	MWDS[c]
1	Soil Biology – management to improve existing soil life (e.g., Mycorrhizae)	3.19	1.24	4.52	0.97	6.29
2	Soil Chemistry- N, P, K, S Management	3.20	1.02	4.17	0.94	4.16
6	Crop Rotations (green manures and crop rotations for soil fertility)	3.31	1.29	4.24	1.24	4.59
7	Application of soil fertility inputs	3.24	1.11	4.08	1.47	3.91
4	Compost Management	3.20	0.98	4.16	1.22	3.81
3	Manure Management	2.46	1.22	3.38	1.58	3.22
5	Minimizing Soil Erosion	3.44	1.10	4.08	1.15	2.84

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Managing Weeds

The top three educational needs (Table 6) from managing weeds are using biological weed controls (natural and introduced diseases and predators of weeds), designing weed control programs to manage specific weeds, and using cultural weed controls (seeding rates, varieties, cropping management). Organic farmers believe they have a strong skill set in using mechanical weed controls.

Table 6

Rankings of Organic Farmers' Competency Ratings of Managing Weeds Skills Using the Borich Needs Assessment Model (*n* = 26)

#	Organic Competencies	Current[a]		Desired[b]		MWDS[c]
		M	*SD*	*M*	*SD*	
2	Using biological weed controls (natural and introduced diseases and predators of weeds)	2.56	1.10	4.36	0.97	7.81
5	Designing weed control programs to manage specific weeds	2.58	1.18	4.15	1.26	7.14
3	Using cultural weed controls (seeding rates, varieties, cropping management)	3.00	1.10	4.24	1.21	6.00
4	Applying organic Herbicides	2.44	1.17	3.56	1.55	3.70
1	Using mechanical weed controls (Mowing, mulching, grazing, cultivation for weeds)	3.77	0.89	4.29	1.21	3.17

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Managing Crop Insect Pests

The top three educational needs (Table 7) are designing pest control programs to manage specific weeds, enhancing natural pest controls (i.e., encouraging beneficial insects) and using biological pest controls (e.g. releasing insect diseases or predators). The organic farmers have a strong perceived skill level of using mechanical pest control.

Table 7

Rankings of Organic Farmers' Competency Ratings of Managing Crop Insect Pest Skills Using the Borich Needs Assessment Model (*n* = 26)

#		Current[a]		Desired[b]		
	Organic Competencies	*M*	*SD*	*M*	*SD*	MWDS[c]
6	Designing pest control programs to manage specific weeds	2.50	1.12	4.17	1.21	7.42
1	Enhancing natural pest controls (encouraging beneficial insects)	3.33	1.39	4.69	0.67	7.23
4	Using biological pest controls (releasing insect diseases or predators)	2.81	1.30	4.32	1.19	6.56
5	Using non-synthetic controls such as lures, traps, repellents	2.69	1.23	4.12	1.34	5.93
3	Using cultural pest controls (crop rotations, intercrops, crop management)	3.32	1.22	4.20	1.26	4.36
7	Using organic Insecticides	2.96	1.22	3.96	1.34	3.95
2	Using mechanical pest controls (sanitation measures, hand removal)	3.30	1.18	4.04	1.24	3.19

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Managing Crop Diseases

The top two educational resource needs for managing crop diseases (Table 8) are enhancing natural disease controls and improving habitats for natural enemies of pests. The lowest educational need is using cultural disease controls.

Table 8

Rankings of Organic Farmers' Competency Ratings of Managing Crop Disease Skills Using the Borich Needs Assessment Model (*n* = 26)

#		Current[a]		Desired[b]		
	Organic Competencies	*M*	*SD*	*M*	*SD*	MWDS[c]
1	Enhancing natural disease controls (encouraging beneficial bacteria)	2.62	1.21	4.52	0.81	8.66
3	Improving habitats for natural enemies of pests	2.80	1.23	4.44	0.94	7.40
4	Using organic disease material inputs	2.60	1.20	4.16	1.12	6.93
5	Knowledge on Allowed synthetic substances in organic crop production	2.36	0.97	3.80	1.44	5.70
6	Knowledge on Non-synthetic substances prohibited in organic crop production	2.72	1.11	3.96	1.34	5.67
2	Using cultural disease controls (crop rotations, intercrops, crop management)	2.96	1.22	4.20	1.20	5.60

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Crop Rotation

The highest educational need in crop rotation (Table 9) is understanding soil, weed, insect and disease interactions in rotations. The lowest educational resource need is identifying crop rotations that provide erosion control.

Table 9

Rankings of Organic Farmers' Competency Ratings of Managing Crop Rotation Skills Using the Borich Needs Assessment Model (*n* = 26)

#		Current[a]		Desired[b]		
	Organic Competencies	*M*	*SD*	*M*	*SD*	MWDS[c]
1	Understanding soil, weed, insect, disease interactions in rotations	4.32	1.01	3.12	1.09	5.22
3	Maintain or improve organic matter content through specific crop rotations	4.36	1.02	3.23	1.15	5.08
2	Identifying beneficial crop rotations to manage deficient or excess plant nutrients	4.20	1.20	3.19	1.18	4.90
4	Identifying crop rotations that provide erosion control	4.00	1.26	3.16	1.25	4.16

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Post-Production Needs

The highest educational resource need (Table 10) is processing facilities for organic field crops and information on the buyers who are consuming organic foods. The lowest educational resource need is consumer education on organic standards.

Table 10

Rankings of Organic Farmers' Competency Ratings of Managing Post-Production Skills Using the Borich Needs Assessment Model (*n* = 26)

		Current[a]		Desired[b]		
#	Organic Competencies	*M*	*SD*	*M*	*SD*	MWDS[c]
4	Processing facilities for organic field crops	2.52	1.20	3.65	1.43	4.44
2	Information on buyers	2.62	1.30	3.68	1.32	3.97
3	Information on market trends and demands	2.85	1.26	3.67	1.21	3.37
5	Consumer education on organic benefits	3.16	1.32	3.83	1.37	2.87
1	Information on commodity prices and volumes	2.69	1.43	3.43	1.44	2.78
6	Consumer education on organic standards	3.16	1.32	3.63	1.25	1.96

Note. [a] = Current skill level: 1 = least proficient, 5 = most proficient; [b] = Desired interest level: 1 = least important, 5 = most important; [c] = MWDS: Mean Weighted Discrepancy Score

Objective 3:Determine organic farmers' perceived growth and barriers for organic farming.

The third objective was to determine how organic farmers would like to receive educational resources and what barriers and growths do they see for organic farming. A majority (79.3%) of organic farmers indicated they would like the educational resource to be an electronic form (i.e., email, website, orwebinar), while only a small percentage (13.8%) indicated they would like to have personal contact through workshops or farm tours to answer specific questions they have. The remaining 6.9% preferred mail correspondence with educational materials.

The organic farmers were also asked what they percieved to be barriers and opportunities of growth for organic farming. The common barrier stated was lack of education on the consumer side on what organic truly means. One farmer stated "The general misunderstanding of the general public of what organic really "is" especially in confusing organic and local. The public does not

understand the extra costs of production or benefits to themselves and the benefits to the local environment and workers for organic production." An additional barrier mentioned was being able to adapt the individual growing environemnt for individual speices. Another farmer stated "The barrier that I see would be the ongoing knowledge that it takes to adapt to ones growing environment for each individual growing species. Knowing what plants would be beneficial to grow together to help ward off pests would help break down the barrier on achieving success." The opportunities for growth that the farmers stated was society's push for healthier food options and becoming more aware of where their food is coming from. One farmer stated "As everyone seems to be more health conscious. I believe the ability to adapt and lower production costs would be greatly accepted by buyers. As we all continue to learn not just the basics but more advanced organic growing, I feel that Organics will only become more affordable and prosperous." Another opportunity of growth would be educating the consumer on what organic certification really is and what it entials. One farmer stated "The opportunity depends on the education of the public on the benefits on all levels including why customers should patronize them to ensure that the benefits occur. Stressing the difference between local organic and local." The final opportunity of growth that the organic farmers percieve is developing more educational resources related to organic farming, one farmer stated "get extension teams more educated will help make it easier for farmers to try and do organics as there are many questions."

Conclusions, Discussion, and Recommendations

This study mirriored the results of Frick et al. (2008), as South Carolina Organic farmers top areas of need included soil fertility and understanding integrated pest management plans that comabt weeds, insects and diseases. The barriers percieved by the Saskatchewan farmers were similair to the ones discovered in this study including the misrepresentation and lack of understanding of what organic farming is by the public. The growth of organics has renwed the

public interest in food sustainability, which is a great opportunity for organic agriculture.

Extension services play a major role in diffusion of technology and educational resources, as agents need to provide educational resources for organic farmers in additon to conventional farmers. This Extension professional serves as change agents in the adoption of new technology, ultimately promtoing the initial addoption by reduces barriers, providing observability, and supporting farmers for continual adoptionof the technology and practices (Rogers, 2003). The results of our needs assesment suggest organic farmers need educational resources related to §205.206(a)(b)(c) Managing Crop weeds, Insect Pests and Diseases. With focus on the organic competencies of using biological weed controls designing weed control programs to manage specific weeds, designing pest control programs to manage specific weeds, enhancing natural pest controls, enhancing natural disease controls and improving habitats for natural enemies of pests. Current extension programs could adjust and redesign their current education programs and trainings to help close the educational gaps that organic farmers are currently facing. It is reccomended that extension programs create in-depth organic pest management trainings that meet the needs described above and identify exisiting resources and educational materials. Additionally, industry professionals (i.e., soil scientists, organic speciailists, IPM professionsals) should be utilized to cover these topics. Other state extension programs and educational groups should implement similar topics into their educational programs.

Many findings were related to farmer's needs relating to different cultural practices of organic crops, including field border development, soil biology management, and designing pest control programs to manage specific weeds. Therefore, it is essnetial for the continuation of field trials on various cultivars of organic crops across South Carolina to continue to support organic farmers. These trials provide opportunites for innovation across organic agriculture and provide opportunities for observability, reducing the barriers to adoption (Rogers, 2003). It is

recommended that South Carolina Cooperative Extension agents coordinate closely with organic crop researchers at Clemson University when field days are held to generate awareness and attendance of organic farmers in their respective regions. Further, Cooperative Extension agents may consider developing virtual field days for organic farmers as were held by many land grants across the U.S. during the COVID-19 pandemic.

Furthermore the comments written by the organic farmers suggests there needs to be more education provided to the public on what organic farming is, the disconnect between the public and organic farming was seen as a major barrier to organic growth. Ultimately, education is a pivotal component in the future success of organic production, as the continued adoption of organic agriculture will be influenced by policy decisions often impact by public opinion. Knowing this, extension services are encouraged to provide more general educational materials to the public, discussing what organic farming is and correcting misconceptions, perhaps integrating organic farming concepts into their youth and adult agriculutral programs.

It is reccomended that the needs assesment used in this study be admistered to Extension agents to determine their educaitonal gaps related to organic compentcies. Improving the current gap between organic education and extension agents. This research was developed to better understand the education gaps for organic farming. These results show that educational resources need to be developed and geared toward managing organic crop diseases, insect pests and weeds in an organic farming system. Additionally, educational materials need to be developed to better educate consumers on organic farming and what it means to be certified organic. These findings are very insightful for extension services and other educational agencies to understand where the largest educational need is. The survey revealed electronic form is the most desired vessel of education. This will be key when developing educational materials that farmers will utilize. Altough this study is limited to organic farmers in South Carolina, other states with organic

programs should consdier the findings and conclusions of this study to help guide future implmentation and practices. Replicating this study on a state by state basis would be beneficial to further understand the educational needs, barriers, and opportunites for growth within the organic agricultre community.

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Motivating Students to Conduct High-Quality Supervised Agricultural Experience Programs: A Collective Case Study

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Motivating Students to Conduct High-Quality Supervised Agricultural Experience Programs: A Collective Case Study

Abstract

Supervised Agricultural Experience (SAE) Programs are often regarded to be the most challenging component of the three-circle model of Agricultural Education. The literature reported a strong belief in the philosophy of SAE but a lack of engagement for teachers and students (Retallick, 2010; Wilson & Moore, 2007). This collective case study aims to provide a narrative for how successful teachers motivate students to engage in high-quality SAE programs. The data revealed that within the context of these three cases, requiring SAE as part of a grade, dedication of caring teachers, building SAE programs over time, being flexible in SAE categories, connecting to student interests, and intentional planning were key to successful SAE implementation. These results have implications for how teachers structure SAE programs in their classrooms, how teacher educators prepare pre-service teachers, and the direction of future research in SAE.

Keywords: Supervised Agriculture Experiences, High-Quality SAE, Motivation, Case Study

Introduction

The Supervised Agricultural Experience (SAE) Program is a valued, yet underutilized circle of the three circle model of Agricultural Education (Phipps et al., 2008). Teachers repeatedly reported that time constraints, juggling supervision of many projects, lack of a clear definition of what constitutes a high-quality program, and a stronger pull towards awards-based FFA endeavors limited their success in motivating students to engage in SAE programs (Dyer & Osborne, 1995). However, teachers have continued to preach the philosophical belief in SAE, creating a paradox between theory and practice (Retallick, 2010; Wilson & Moore, 2007). Agricultural educators have reported difficulty implementing SAE in practice even though they have valued it conceptually (Dyer & Osborne, 1995; Retallick, 2010; Wilson & Moore, 2007). This paradox in research and

reported practices creates a lack of clarity in what is truly happening in successful Agricultural Education programs in regards to SAE. This divide of philosophy and practice leads us to question how agricultural educators motivate students to develop and implement high quality SAE programs.

The Council for Agricultural Education identified four factors to consider when determining a student's SAE is "high-quality" (NCAE, 2015). The four factors were: (a) the project must be well-planned, documented, and supervised, (b) the program must be agriculturally-focused, (c) the program should be student-driven rather than teacher-driven, and (d) the program should happen outside of regular classroom instruction (NCAE, 2015). The majority of Agricultural Education research was found by Dyer et al. (2003) to be quantitative in nature, using applied research methods. This collective case study aims to provide a rich narrative describing the phenomenon of student motivation to develop a well-structured SAE program, a need that was suggested by Dooley (2007).

Theoretical Framework

This research was grounded in the theoretical framework of *achievement motivation*. Achievement motivation refers to "striving to be competent in effortful activities" (Elliot & Church, as cited by Schunk, 2012, p. 358). The theory posits that individuals are motivated to act because of a desire to satisfy a need (Schunk, 2012). Under the umbrella of achievement motivation, Atkinson (1957) developed the *expectancy-value theory of achievement.* This theory suggests that an individual's behavior is dictated by their expectancy of achieving a goal or reinforcer as a result of performing a certain task or behavior relative to how much one values the outcome (Schunk, 2012).

According to Atkinson (1957), achievement motivation, is a stable character trait of an individual. Atkinson postulates that tasks that are difficult to achieve create a greater incentive to

work hard at the task. This is motivated by pride at accomplishing difficult tasks (Schunk, 2012). This model makes the prediction that students with high achievement motivation will choose tasks of intermediate difficulty because of their belief in its attainability, which produces a sense of accomplishment (Schunk, 2012). For these students, tasks deemed as too difficult will be avoided because of the unlikely probability of success, while tasks deemed as too easy will provide little sense of accomplishment when achieved. In contrast, students with low achievement motivation tend to choose easy or difficult tasks (Schunk, 2012).

There are likely numerous motivational explanations for student involvement in high-quality SAE programs. In order for teachers to be able to implement SAE programs with efficacy, understanding these motivations is crucial. If teachers can begin to understand how to influence the *expectancy-value theory of achievement motivation* on student SAE engagement, as well as manipulate it, SAE achievement could increase. This study aims to provide a narrative through the lens of achievement motivation about how and why students are motivated to engage in high-quality SAE programs. Specifically, this study aims to provide insight to how teachers can influence a student's tendency to approach an achievement-related goal.

Purpose

The purpose of this study was to investigate how teachers motivate students in Agricultural Education programs to conduct high-quality SAE programs. This collective case study analysis of how agricultural educators implement SAE in [State] sought to answer the following questions:

1. What factors influence a teacher's ability to implement SAE within their Agricultural Education programs?
2. How do teachers motivate students to participate in high-quality SAE programs?

Methods

This research follows a case study model as described by Yin (2014). A case study is one of the most frequently used methodologies in qualitative research. However, given the unique approach of case study research, it does not have a well-defined set of protocols. A case study defines a case as a contemporary phenomenon within its real-life context, whether it be simple or complex in nature (Stake, 2013; Yin, 2014). All cases are defined by the individual teacher in each program and all programs and teachers are unique to the community in which they are located.

Participants

The researchers contacted Agricultural Education State Staff in each of the three agricultural education regions to nominate teachers who they believed conducted high-quality SAE programs as defined by the National Council for Agricultural Education (2015). The qualifications were a well-planned, documented, and supervised program, a program that is agricultural in nature, is student driven, and occurs outside of traditional classroom instruction. Once nominations were received, nominees were contacted via email to complete an eight-question survey instrument that was used for determining their fit for the study. Once the survey was completed, the responses were reviewed by the research committee to determine if each individual nominated met the outlined criteria for conducting high-quality SAE programs.

Data Collection

The teachers who met the criteria were sought after for permission and acceptance to participate in the interview. Two teachers were interviewed through an online video conference software, Google Hangouts while one teacher was interviewed face-to-face. The interviews followed a semi-structured interview format focusing on the individual teacher's philosophy regarding SAE, how SAE was implemented in their programs, and what they believe motivated student to conduct high-quality SAE programs. All interviews lasted between 33 and 59 minutes where teachers engaged in a converstaional interview environment where they freely shared their

thoughts about incorporating SAE into their programs. Interviews were recorded and transcribed for analysis using Temi, an online transcription service.The lead researcher reviewed each transcript for accuracy. During transcription, all participants were given a pseudonym and any other identifiers removed to ensure anonymity was maintained. Weft QDA, a digital qualitative analysis software, was used to code for themes.

To ensure cross-case analysis, Lincoln and Guba's (1985) constant comparative method was utilized. After initial individual analysis, researchers met to discuss findings and compare perspectives. The final themes were shared with the participants to ensure triangulation of the data through member checking and peer debriefing. During this study researchers kept methodological journals to document methodology decisions and reflection to ensure reliability and trustworthiness (Dooley, 2007). In order to establish trustworthiness and rigor, the researchers engaged in prolonged engagement, thick descriptions, and reflexivity (Lincoln & Guba, 1985).

Subjectivity Statement

The researchers were actively involved in agricultural education and believe that SAE is an integral and valuable component of the Agricultural Education model. Having engaged in an SAE as a student as well as fully incorporating SAE programs into their Agricultural Education programs, the researchers believe that all teachers should have every students engaging in an SAE program. The researcher has developed a model for SAE in an urban setting and shared that model with other teachers through professional development workshops.

Findings

Case Study 1: Setting the Context

Ms. Jennifer Roberts excitedly introduced herself, her background, and her teaching career. She came from an Agricultural Education background, having been a student in a strong program with "great teachers" before making the choice to become an agricultural educator. She taught

approximately 170 students in an area she defined as somewhere in between suburban and rural in [State]. All students in her program were required to conduct and maintain a SAEprogram as part of their grade in her classroom. Ms. Roberts taught in a single-teacher program with approximately 1,400 students enrolled at the high school.

Connecting to student interests

She admitted not all students who enter her classroom have an intrinsic interest in agriculture or plan to pursue agriculture as a career after graduation. However, she expressed her strong belief that teachers must take the time to connect agriculture to student interest to assist them in developing their SAE. Ms. Roberts shared, "I have students who are in art, we've got to figure out a way to tie your art in with agriculture, we need to be able to tie in every student, doesn't necessarily have to be the typical ag kids."

By connecting students who are otherwise uninterested in agriculture to SAE programs that meet their needs, Ms. Roberts believed she was able to show students an elevated level of caring. Ms. Roberts noted, "maybe they're (SAE) supposed to be more traditional, but I don't think the student is traditional anymore. So, I don't think that she has to be … sometimes you got a gamer kid. You got to figure out something else that they like." Beyond this, Ms. Roberts explained that perhaps the entire point of SAE is to tie in non-traditional students with a learning opportunity directly connected to agriculture. The best part of SAE programs, to her, was having the opportunity to observe what students can do in agriculture when motivated by an SAE program directly connected to their interests. Ms. Roberts firmly believed, "with student driven and non-traditional kids, I think the really cool part about an SAE is that if I was told that was my homework project and then I could choose what it was, I think I probably would've liked homework." Although Ms. Roberts discussed connecting non-traditional students to SAE frequently, she did not discount the importance of SAE programs for students who may already

have an interest in agriculture or may be conducting a project at home that resembles an SAE. The important thing to her was taking the students' projects to the next level to further expand student opportunities and learning in something they already had as an interest. Ms. Roberts stated, "if you have a kid who already does something in wildlife, the only difference in your project now is we want to develop it with record keeping skills … let's add your expenses, inventory, income, and your time."

Extending learning outside of the classroom through career connection

As Ms. Roberts discussed how she motivated students to engage in high-quality SAE programs, multiple times she brought the conversation back to taking student learning beyond the classroom and connecting SAE programs to student career interests. She explained how students were often more motivated to engage in an SAE if they were given the opportunity to explore career areas in which they were interested. For some students, it was about discovering a career they did not even know they enjoyed. For others, it was about discovering new areas within a career interest. Ms. Roberts excitedly shared, "what's really fulfilling as a teacher is watching them take that even farther. Because there are those that do they make a career out of it. That's what's cool. You know, I don't know that it's always great." This was the case even with non-agriculture related careers. Ms. Roberts gives the example of a student who wants to be a Pre-K teacher. Ms. Roberts discussed setting her up with a local Pre-K teacher to come up with agricultural lessons to teach her students. Mrs. Roberts added, "if a kid says, I wanted to take agriculture because I like it, but I really want to be a Pre-K teacher. I've got some Pre-K teachers and kindergarten teachers who would love for you to come and teach lessons."

Case Study 2: Setting the Context

Ms. Lindsey Carter taught in a high school outside of a major metropolitan area in [State]. The community, on paper, was considered urban; however, agriculture and farming were still

major pillars of the community, with strong agricultural education programs throughout the county. Ms. Carter teaches approximately 120 students in a high school over with 1,400 students. Ms. Carter excitedly discussed how she incorporated SAE in her classes while also vocalizing ideas she has to make her program even better. Her desire to improve does not end with her ideas for SAE, as she is currently working on her doctorate degree while teaching full-time and raising two children. She was willing to share ideas and resources without ever suggesting she is the one with all of the answers.

Breaking from traditional views of SAE programs

While she was a firm supporter of agriculture, and believed that students who continue in her program should have agricultural focused SAE programs, she also believed some leniency was needed to help meet students where they were in their interests and career goals. Ms. Carter shared, "some teachers are determined they don't want kids working at fast food. They don't want them babysitting. I'm okay with it, that first year it's about learning what you want to do, don't want to do, and keeping records." Ms. Carter was not afraid to challenge the status quo and critique the norms that had been put in place for SAE programs. Her belief in helping students achieve success through SAE programs in any way she can allowed her to remain flexible yet keep standards high. Ms. Carter passionately shared, "I've got to meet my kids where they are and sometimes the powers that be may think, oh well that's not qualified to be a state degree. It is all that this kid could do and they need to be rewarded."

Building student SAE programs over time

Much of the interview with Ms. Carter was focused on the early stages of establishing high-quality SAE programs with first year students. The steps she took to set the foundation for these programs was of high-importance, and something she believed was key to the success of her students' SAE programs. Ms. Carter would ask students, "Well what can you do? What's an idea?

What does your parents do? You know, like is there a job that they have that you can go and hang out with them? What do you want to do when you grow up?" Ms. Carter maintained that by planning to build over time and setting a solid foundation in the introductory level classes, she could step back and allow the students to continue in their SAE on their own. Ms. Carter noted, "so at the beginning when we first started it, I pound record keeping in their head, like we log in to AET (Agricultural Experience Tracker) a once a week and I show them how to log their hours and then we do checkpoints."

Setting high expectations

Ms. Carter required that 100% of her students completed an SAE program as part of the class grade. Although this took a vast amount of work to grade and assist students, she refused to allow students to turn in something that was below their ability. Ms. Carter would tell student "if you're not going to do a genuine project, please don't waste my time and I want it to be genuine and if you can't come up with something that is genuine then let's find something." As Ms. Carter discussed working with her students to build SAE programs, it was clear that she cared deeply for them. This care served as a strong motivator for students to do well in their SAE programs and reach the expectations put before them. Ms. Carter shared, "some of my students are so invested in the program and in, in me and they want to impress me. They want to do good for me. They, they want to reach whatever standard that I put for them."

Career skills

Ms. Carter expressed her prioritization of connecting students to opportunities that promoted career knowledge and skill. She believed the experience students gained from a high-quality SAE program opened the door for students to enter a job market that was often difficult to infiltrate without prior experience. Ms. Carter believed, "it's more about two things, giving them the opportunity to get a skill so that they can hopefully get a job. And get some type of experience

to get the job." In addition to this, Ms. Carter also finds SAE to be a valuable opportunity for students to gain opportunities about the careers they are interested in before they make a commitment to pursue a specific field. She finds that through being able to go to a veterinarian's office and shadowing the day-to-day operations, or doing landscaping for a summer job, students can learn the realities of those jobs to decide whether or not the job is right for them. These experiences, can allow students to figure out if the career goals they have are right for them. Ms. Carter stated, for example students who "want to be a veterinarian and they go and they shadow so then when they get to vet school it's not such a shock that they have to know Latin terms or such a shock that these are the equipment."

Case Study 3: Setting the Context

Mr. Jeff Thompson was a veteran teacher who taught middle school agriculture for nearly two decades before moving to high school agriculture for the last seven years. Mr. Thompson taught in a two-teacher Agricultural Education program, with agricultural mechanics being the primary pathway of focus. Between the two teachers at Mr. Thompson's school, 298 agricultural education students were served among a population of 1,200 students. All students in the program were required to develop and maintain a SAE program. When speaking with Mr. Thompson, the typically subdued teacher exuded excitement about SAE programs. This excitement showcased his passion for SAE programs, and his philosophies were clear in the interview.

Well-planned

As Mr. Thompson spoke about how students engage in SAE programs in his program, nearly every interview question prompted him to mention the importance of planning in a successful, high-quality SAE project. He referred to this not only in the beginning planning stages of student SAE programs but also in building the SAE programs over time. Mr. Thompson firmly believed, "we can't just do it for a week or two and be done, but we've got to go back, check and

balances. We've got to have a plan, we got to follow up with the plan." He credited student success in SAE to spending the time to have students plan their SAE programs when they begin. This includes goals, steps in the process, and developing a benchmark for the students to be able to know whether or not they accomplished their goals. Mr. Thompson added, "if they can't see the end result, they're not going to buy into it. They got to say, okay, I'll do this idea, this might work."

Building from student interest

Student interest in their SAE programs was also an important factor in Mr. Thompson's students' success. He stated the importance of doing more than just making it a required portion of their classroom grade to shift the SAE to high-quality. Mr. Thompson added, "so it's going to be something that they're interested in. It's got to be something that gains their interest long term, can't just be something Ima grade it and it goes away." By connecting his students with SAE programs that tap into their interests, Mr. Thompson believes he can show his students what possibilities are out there for starting a career that relates to their interests. This connection allows students to dive deeper into their SAE and develop important soft skills. Mr. Thompson shared, "it's valuable because it gives the kids the hands-on experience that you cannot really teach in class. … It lets them see the real-world application of what they're interested in."

Influence of technological advancement

Mr. Thompson reported the impact of new recordkeeping abilities and structure through the AET. The resource, Mr. Thompson shared, allowed students to continue to think about and work on their SAE programs in a way they had not before. Mr. Thompson shared, "the AET program keeps it in front of them, they have to plan it and follow through because it's on paper, it's on the computer and hopefully next year they can pick up where they left off and continue growing their project." Mr. Thompson also expressed the impact AET on the number of students who turn in their SAE projects each year, and how it has changed how intentional he as well as his students

have been in the SAE planning and implementation process. Mr. Thompson stated, “if you're going to have the SAE projects, you've got to be intentional. My projects have gotten better as a result of AET record keeping. I've got more kids participating, turning projects in.”

Conclusions

Based on these case study findings, there were broad themes that come forth in a cross-case analysis. Although the information presented in this case study is useful, it is important to note that generalizations should not be made beyond the scope of the three cases.

Caring, dedicated teachers

The three teachers each expressed a genuine interest in engaging students in SAE programs because they believed it was a worthwhile and valuable experience for students. The teachers interviewed expressed how much they valued the career skills, personal development, and experience students gained in their SAE programs. The influence of agricultural educators has been suggested time and time again to be a critical component of successful SAE programs (Dyer & Osborne, 1995; Philipps et al., 2008; Retallick, 2010; Rubenstein et al., 2014).

Mandating SAE as part of a classroom grade

Each of the three educators interviewed required SAE programs as part of their classroom grade. This finding was supported by research from Rubenstein and Thoron (2015). This practice was a crucial piece for rebuilding SAE programs and helping students gain the important skills from SAE. In order to accomplish this feat, all of the subjects reported taking the time to allow students to express their interests and future goals at the beginning of the planning process, and helped students develop an SAE that connected to those interests and goals. This allowed the students to receive the grade they desired while simultaneously gaining critical skills and experiences through their SAEs. By receiving a grade for their SAE, students are driven to be

successful due to their need to strive for competence within their SAE program, further supporting achievement motivation as a foundational element to SAE program implementation.

Connection to student career interests and goals

Regardless of whether or not students wanted to go into an agriculturally-related career, all three teachers worked to connect student SAE programs to their future careers. This connection may come through a very specific skills, such as welding or 21st century skill acquisition that students gain through conducting a high-quality SAE program. It has been reported that student interest in SAE programs has contributed to success throughout the history of Agricultural Education (Bird et al., 2013). This conclusion aligns with the work of Atkinson (1957) in expectancy-value, where students are dictated by their expected success of achieving a goal they set for themselves at the beginning of an SAE program.

Flexibility within SAE

Retallick (2010) reported teachers believed the agricultural education system, FFA award system and SAE categories caused issues with the implementation of SAE. All three teachers in this study expressed the need to make connections to student interests and, at times, stretch what might be considered a true SAE. Nonetheless, the teachers vocalized how these projects were still providing students with the same important skills all SAE should provide. While clear themes exist, it appears that all teachers must make informed decisions based upon their own community and program to ensure that SAE continues to thrive.

In order to increase the motivation of students to engage in SAE programs the following recommendations are made for teachers:

1. Provide time in class to plan, design, implement, and record SAE programs,
2. Give students the opportunity to express and match SAE programs to their interests,
3. Require SAE programs as part of the classroom grade,

4. Take the time to connect student interests to agriculture, even if not directly related, and,
5. Reformat FFA award structures to recognize outstanding student SAE that may not fit in a traditional category.

This study brought to light many critical components of motivating students to conduct high-quality SAE Programs. The following are recommendations for future research:

1. Increase the amount of case studies being done to provide a rich narrative of SAE implementation,
2. Conduct research directly with students on their motivations to start and continue with SAE,
3. Study the practices of teacher preparation programs and how they prepare preservice teachers for SAE, and,
4. Investigate the value of reported career skills gained through SAE programs.

In addition to teachers and additional research studies, the following recommendation are for teacher education programs:

1. Perservice teachers need to engage in an SAE program in college to better understand the requirements they are setting for their students,
2. Teacher educators should plan for instruction in SAE to be a core component of their teacher preparation program, and,
3. Preservice teachers should be expected to visit agricultural education programs to see how inservice teachers are conducting high quality SAE program visits.

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Influences and Barriers to Agricultural Education Curriculum Adoption by Ugandan Secondary Teachers

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Abstract

While most developing countries rely on agriculture for survival, many youths lack interest in learning about agriculture or pursuing agricultural careers. Furthermore, the educational system within developing countries often lacks a relevant agricultural curriculum that encourages an interest in learning about agricultural practices or future careers. While numerous studies have investigated how and why educational policy reforms are not effective on large scales through a countrywide adoption of new curriculum, this study sheds light on how an international non-governmental organization (INGO) can have a locally-relevant impact with a small-scale curriculum adoption and implementation process through the lens of Rogan and Grayson's (2003) Framework for Curriculum Implementation in Developing Countries. Through qualitatively interviewing eight teachers from Uganda who adopted and implemented an INGO agricultural-focused curriculum, the following themes emerged: shift from theoretical to practical applications, motivations of teachers, barriers, curriculum meets students' needs, survival, curriculum adoption and changed teaching habits, and shift from negative to positive perceptions of agriculture. It is recommended that further research be conducted to understand if students are more likely to become interested in agricultural careers after being taught using a curriculum focused on critical thinking, project-based learning (PBL), and hands-on approaches. It is also recommended that Field of Hope seek continued partnership with Uganda's Ministry of Education to explore a country-wide adoption of the curriculum.

Introduction

With a growing population estimated to reach 10 billion by the year 2050, food production

is of utmost importance and a growing concern for leaders around the world (Mukembo, 2017). In Uganda, 56% of the population is under 18 years of age and 78% of the entire population is below the age of 30 (Ahaibwe et al., 2013); however, the average age of a Ugandan farmer is 54 years old (Lunghabo, 2016). Knowing the population is growing exponentially and understanding that the average age of a farmer outpaces the median age in Sub-Saharan Africa undermines a positive economic outlook relative to the lack of interest in agriculturally-related careers by youths (Mukembo et al., 2014).

"Obtaining a quality education is the foundation to improving people's lives and sustainable development" (Food and Agriculture Organization, 2017, para. 1). However, in Uganda, the sole emphasis of education is placed on students passing a final examination (Thurmond et al., 2018) rather than providing students with practical knowledge and skills that would support careers, life applications, and self-sustainability upon leaving school (Basaza et al., 2010; Lugemwa, 2014; Mukembo, 2017). Because rural youths are disinterested in agriculture, this is of special concern regarding agricultural education (Bennell, 2007). Additionally, "support for capacity development for youth indirectly productive agricultural activities (especially skills training at all levels) still receives limited support" (Bennell, 2007, p. 4). ActionAid International Uganda, Development Research and Training, and Uganda National NGO Forum (2012) reported that 61.6% of Ugandan youths were unemployed and did not receive skills in school that are necessary to prepare them for the real world.

Even though developing countries often spend 15% to 35% of their national budget on education, educational systems in these countries is inadequate in most instances (Oliveira & Farrell, 1993) due to limited access to knowledge and information (International Movement for Catholic Agricultural and Rural Youth, International Fund for Agricultural Development, & FAO, 2012). In addition, the agricultural education curriculum in developing countries is often outdated,

inadequate, and lacks relevance to a rural context (FAO, 2009). Further, agricultural activities are common practices for punishment in many parts of the world, leading to negative attitudes that affect the aspirations toward agricultural careers (MIJARC et al., 2012). However, agriculture, when appropriately integrated into school curricula using practical activities such as school gardens, can encourage youths to pursue agricultural careers (MIJARC et al., 2012).

While educational reform has been attempted in many developing countries by implementing new curricula (O'Sullivan, 2002; Rogan & Aldous, 2005; Serbessa, 2006; Tabulawa, 1998), these curricula are often mandated by policymakers and the implementation process is often neglected. Outdated curricula leave teachers unprepared to adopt and implement the new pedagogies (Hennessey et al., 2010; Rogan & Aldous, 2005) and lacking the content knowledge needed to accompany curriculum. However, international non-governmental organizations (INGOs) are more locally- and contextually-relevant to schools in developing countries than governments. They often assist in educational development because of their success in the implementing curriculum and learner-centered teaching methods (Raval al., 2010; Rose, 2009). Field of Hope, an American-based international NGO, has a strong partnership in Uganda working primarily with agriculture teachers, women's' groups, and small-scale farmers to "develop agricultural knowledge and enthusiasm among youth and smallholder farmers to sustain nutritionally food secure and economically empowered communities" (Field of Hope Organization, n.d.a., para. 1). After establishing relationships and working with teachers in Uganda, Field of Hope discovered agriculture teachers face many barriers to gathering technical content and information to develop lessons to teach (A. M. Major, personal communication, April 2, 2018). Working together, Field of Hope and Vivayic, a company that designs learning solutions, created a model of how to equip rural Ugandan youth with practical agricultural skills and build their interest in agricultural careers. The two organizations collaborated with Ugandan agriculture teachers to

design, write, and pilot a year-long Senior 1 (S1) agricultural education curriculum incorporating content found within the national-level school exams as well as competencies needed to enter an agricultural career or become a small-scale farmer.

Review of Literature

The diversity of schools in Sub-Saharan Africa (SSA) is quite broad across the multiple countries in the region. In well-populated areas, schools can resemble skyscrapers with magnificent educational programs that would rank highly on a global scale. In rural areas, however, schools can lack electricity, running water, doors or windows, or even books (Rogan & Grayson, 2003). In developing countries, children living in poor, rural villages are four times less likely to be in school than a child raised in a wealthy household (United Nations, 2015). Less than one-third of secondary school-aged children are enrolled in schools in SSA (UNICEF, 2012). In 40% of SSA countries, sixth-grade students reach more than 20% of the desired mastery level for reading literacy, but Ugandan sixth-grade students only reach 10% of desired mastery levels (UNESCO, 2007). World Bank Group (2007) reported that rural education needs the most improvement, but vocational training in education can provide technical skills that are useful in agriculture and help alleviate poverty.

In addition, teachers are important in the overall development of any nation (Fareo, 2013); however, teachers in developing countries have neither the experience nor the expectation of collaborating with peers (Rogan & Grayson, 2003) and may even shy away from collaboration for fear of exposing their weaknesses in teaching skills. The small number of teachers in schools is a challenge in SSA where there is a pupil-to-teacher ratio of 40:1 (UNESCO, 2007). Due to the lack of resources in rural areas, schools employ fewer qualified and experienced teachers and experience higher turnover and vacancy rates than in urban schools (UNESCO, 2007). Currently,

1.2 million students are enrolled in secondary schools in Uganda while there are only 20,000 secondary school teachers, yielding a pupil-to-teacher ratio of 60:1 (NCDC, 2019). Only 81% of secondary school teachers in Uganda meet the requirements to teach secondary school, which are the same requirements as primary school (UNESCO, 2007).

Because many Ugandan classrooms are large and teachers use lectures as the primary teaching method, students miss the opportunity to encounter everyday challenges and real-life scenarios, which is the purpose of education (Whitehead, 1929; Mukembo, 2017). The project-based learning (PBL) approach helps students develop interpersonal communication skills, leadership skills, and problem-solving skills in real-life situations and promotes higher-order thinking skills (Mills & Treagust, 2003). Therefore, introducing PBL in agricultural education through entrepreneurial situations could be an option for teachers to initiate agriculture as a viable employment opportunity for students (Mukembo et al., 2014, 2015) and attract more young people to further their education in agriculture (Mukembo, 2017). However, the use of PBL is foreign to most educators in developing countries (Thurmond et al., 2018). Ugandan education is primarily based on the theory and teaching that is classroom-centered (Basaza et al., 2010; Mukembo, 2017; Thurmond et al., 2018). The school garden or farm is rarely used as a learning environment and, in the current model of education, is often used to punish student misbehavior (Mukembo 2017; Thurmond et al., 2018).

The purpose of the secondary school curriculum created by Vivayic and Field of Hope was to create an S1–S4 Ugandan agricultural curriculum that enhances competency in problem-solving and critical thinking skills (Thurmond et al., 2018). Because the curriculum promotes critical thinking skills, it is of high interest to the ministries of education in Uganda and the National Curriculum Development Center in Uganda. In developing countries, NGOs commonly provide schools with resources. Understanding why and how teachers use those resources to adapt and

innovate to change leads to a deeper need of exploring their motivations.

Theoretical Framework

In order to explore how secondary school teachers who partnered with Field of Hope have implemented the new curriculum, a framework developed by Rogan and Grayson (2003) was used focusing on three main constructs: (1) profile of implementation, (2) capacity to support innovation, and (3) support from outside agencies. Profile of implementation refers to the process of employing a new curriculum is not an all-or-nothing proposition and may include segmented stages for implementation (Rogan & Grayson, 2003). The beginning level, orientation and preparation, addresses the time when teachers and faculty "become aware of and prepare to implement the new curriculum" (Rogan & Grayson, 2003, p. 1181). The next levels refer to the mechanical and routine use where the curriculum can be used with minimal modification to the local context (Rogan & Grayson, 2003). The last stages, refinement, integration, and renewal, represent the teacher's ownership of the curriculum while possibly enriching it with modifications (Rogan & Grayson, 2003).

The capacity to support innovation includes factors supporting or hindering the implementation of new ideas and practices in the new curriculum and recognizes that schools differ in terms of their capacity to implement innovation (Rogan & Grayson, 2003). There are four indicators for the capacity to support innovation: "1) physical resources, 2) teacher factors, 3) student factors, and 4) school ecology and management" (Rogan & Grayson, 2003, p. 186).

The final construct, support from outside agencies, focuses on factors encouraging or limiting support of the implementation of new ideas and practices within the given curriculum (Altinyelken, 2010). Outside agencies are referred to as any organization that is not within the school but helps facilitate innovation by interacting with the school (Rogan & Grayson, 2003). In

developing countries, most often the support from outside agencies comes from American agencies and other developed countries that are providing aid (Rogan & Grayson, 2003).

Guiding Questions

The purpose of this basic qualitative study was to explore and derive meaning from the experiences of the instructors teaching agricultural education in Ugandan secondary schools who partnered with Field of Hope and were given a new Senior One (S1) agricultural education curriculum to implement. While this was a part of a larger thesis study, the two specific questions guiding this research were:

1. What influences impacted teacher adoption of the curriculum?
2. What barriers prevented teachers from adopting the curriculum?

Methodology

Qualitative inquiry was selected as the best method to understand the shared experiences of the teachers delivering a new curriculum provided by Field of Hope within the secondary schools located in northern Uganda. To understand the validity of the interview protocol (Merriam, 2009), a pilot study was completed in North Carolina with two current agriculture teachers who have adopted and implemented a new sustainable agricultural education curriculum. Upon completing the interviews with the participants, the researcher consulted their committee chair regarding the needed alteration of the interview protocol and wording of the questions to fit the needs of the intended data collection (Merriam, 2009).

To “learn a great deal about issues of central importance to the purpose of the inquiry” (Patton, 2002, p. 230), the researcher chose a purposive sample of interviewees. Typical purposeful sampling was used to determine the sample of participants of the basic qualitative study to obtain

rich information to study in-depth (Creswell & Poth, 2018; Merriam, 2009; Patton, 2002). This type of sampling was selected because it "reflects the average person, situation, or instance of phenomenon" (Merriam, 2009, p. 78) and contributes to a better understanding of the research problem and the central phenomenon of the study (Creswell & Poth, 2018, p. 159). To conduct a criterion-based selection of interviewees, the researcher created a list of the essential attributes that included: the teacher taught the S1 curriculum provided by Field of Hope and the teacher attended the teacher training offered by Field of Hope in June 2018. This selection criterion aligned with the purpose of the study to explore and derive meaning from experiences of instructors who were teaching the new S1 agricultural education curriculum and allowed for reflection on the theoretical framework focused on implementation, the capacity to support innovation, and support from outside agencies. A key informant employed by Field of Hope provided the researcher with a document containing the teachers' information regarding their attendance at the training (Gilchrist, 1992; Rogers, 2003). From the key informant, the researcher was able to identify eight teachers meeting the selection criteria identified for the study. With all eight consenting, the researcher conducted one-on-one, semi-structured interviews to "attempt to understand the world from the subjects' point of view, to unfold the meaning of their experience, and to uncover their lived world" (Brinkmann & Klave, 2015, p. 3). The interviews were guided by 25 open-ended questions developed by the researcher and three faculty of North Carolina State University. The faculty all had experience in qualitative research, professional development, instructional strategies, international development, and curriculum development. Interviews lasted 30 minutes to one hour and were conducted during the Train the Trainer professional development held by Field of Hope for teachers using the new curriculum.

Before conducting an interview, the researcher shared that she, like each participant, was also was a teacher in a very rural village in Africa. Sharing this information was part of a deliberate

effort to create a conversation that would allow the participant to feel somewhat connected to the researcher and to build rapport with her. In addition, the researcher took on the characteristic of neutrality to allow the participant to feel comfortable with the interviewer by refraining from letting her personal views about the subject be known (Merriam, 2009). The interview protocol included six types of interview questions to encourage an array of responses and was created using United Nations Educational, Scientific, and Cultural Organization's Framework for Curriculum Implementation in Developing Countries (2017) constructs and sub-constructs and the objectives of the study. The interviews were audio recorded and the researcher took notes during the interviews to capture any reactions, thoughts, or importance of participants' responses (Creswell & Poth, 2018; Merriam, 2009). The researcher conducted unstructured natural-setting observations and utilized reflexivity to triangulate findings emerging from the interviews (Creswell & Poth, 2018; Merriam, 2009; Tracy, 2010). Observations were collected during visits to schools, meetings with school administrators, and professional development sessions provided to the teachers. Field notes were kept during interviews and observations, and a written reflexive journal was recorded each night to capture important memories, conversations, and interactions of the day (Angen, 2000; Creswell & Poth, 2018; Lincoln & Guba, 1985; Merriam, 2009).

Once all interviews were complete, observations were conducted, and field notes were taken, the researcher utilized the three methods of data management as set forth by Reid (1992): (1) data preparation, (2) data identification, and (3) data manipulation. The researcher compiled the audio recordings of participant interviews and utilized a transcription service to receive an editable document of the recorded interview. The researcher then listened to the audio recordings while reading the transcribed interviews and edited or corrected them to have a verbatim transcription for analyzing data. To begin the data evaluation process, the researcher read each transcript and made memos, and noted key concepts that stood out "to build a sense of the data without getting caught

up in the details of coding" (Creswell & Poth, 2018, p. 198).

During the first-round coding, the researcher utilized in vivo coding to "honor the voices of the participants and their perspectives" (Saldaña, 2013, p. 61). To conduct second-round coding, the researcher utilized axial coding methods to reorganize data coded in the first coding cycle to create a categorical, thematic, and conceptual organization of the data (Saldaña, 2013). Axial coding organized repeating patterns that exemplified potential themes across the data (Merriam & Tisdell, 2015). To ensure the observations of the researcher were considered, note-taking and memoing were conducted while coding to create a reflection on the data as a whole (Creswell & Poth, 2018; Merriam & Tisdell, 2015; Yin, 2016). Theoretical schemes were constructed from axial codes that exemplified the "significance of interpretations and conclusions in relation to the literature and previous studies" (Yin, 2016, p. 199). To ensure the themes were "describing, classifying, and interpreting the data" (Creswell & Poth, 2018, p. 189) the themes were analyzed by the researcher.

The three lenses through which the research employed strategies for validating the qualitative study were the: (1) researcher's lens, (2) participant's lens, and (3) reader's or reviewer's lens (Creswell & Poth, 2018). The researcher employed triangulation and engaged in reflexivity through the researcher's lens. Through the participant's lens, member-checking ensured validity and established credibility. Participants were asked to examine rough drafts of the ongoing data analysis process to provide "alternative language, observations, and interpretations" (Stake, 1995, p. 115). Finally, through the reader's or reviewer's lens, the researcher employed rich and thick descriptions to corroborate validity. Finally, while collecting interviews, the researcher listened to the recorded interviews at night and confirmed quotes and attitudes with the participants to check for accuracy the next day. Additionally, after the concluding the findings of the study, the researcher traveled back to Uganda and met with participants to discuss findings and ensure

accuracy and credibility. This step was crucial to provide credibility because participants were from a different cultural background than that of the researcher. Additionally, English, the language in which interviews were conducted, may not have been the participant's native language. Member-checking ensured the credibility of the researcher's preliminary analysis (Creswell & Poth, 2018).

Researcher's Reflexivity

Tracy (2010) defined self-reflexivity as a cognizant awareness of the researcher's own bias as well as the audience of the researcher. "Self-reflexivity encourages writers to be frank about their strengths and shortcomings" (p. 842). The researcher's social position was a young adult, white female, American citizen who had worked, volunteered, and traveled both domestically and internationally with agricultural organizations, mostly non-profit organizations. Upon graduating with a baccalaureate degree, the researcher lived in rural Ghana and worked as a Form 1 integrated science and social studies teacher, 4-H advisor, and Extension agent.

From this experience, the researcher was left with a desire to understand why a nation that relies so heavily on agriculture and whose young students know agriculture struggled to teach agriculture. Because of the in-depth experience living and working in rural Sub-Saharan Africa, the researcher utilized bracketing to "mitigate the potential deleterious effects of unacknowledged preconceptions related to the research and thereby to increase the rigor" (Tufford & Newman, 2012, p. 81). In order to set aside personal experiences, "take a fresh perspective toward the phenomenon under examination" (Creswell & Poth, 2018, p. 78), and approach data collection and analyzation, the researcher took on a transcendental approach, meaning "everything is perceived freshly, as if for the first time" (Moustakas, 1994, p. 34).

Findings

Two primary themes emerged for the two research objectives: the *shift from theoretical to practical applications and barriers.* Within the *shift from theoretical to practical applications* theme, the following sub-themes emerged: *practical applications, allows students to think critically, inclusivity of all learning types, teacher-centered to learner-centered, assessment, and community engagement.* In the *barriers* theme, *lack of resources, additional training needed, support from the school, and support from outside agencies* emerged as the subthemes.

Research Question One: What influences impacted teacher adoption of the curriculum?

Theme 1: *Shift from theoretical to practical applications.* Historically, students come to school, sit at their desks, listen to a teacher's lecture, and watch as they write on the chalkboard. Participants explained this type of learning is theoretical, teacher-centered, and provides students with very little practical application to the subject. The new curriculum provides three class periods of agricultural instruction each week, which is the same as when using the Ugandan curriculum (Ministry of Education and Sports, 2008); however, the new curriculum calls for two of those three days to be spent in the class and one day is "practical," where the students gain real-world application by visiting the closest environment (farms, gardens, community) that matches what they have learned in class that week.

Practical applications. All eight participants expressed that the new curriculum allowed students to be more involved in the learning through different aspects of practical teaching methods. Grace shared that PBL allows her students to apply situations to the real world: "It's also you have to do it, let's make a student think about their home or about the thing and to know what is happening in the surrounding." Tuno shared that his students complete a beekeeping project where they learn to see how a similar enterprise would operate in the real world. Tuno stated his students appreciated

and understood the industry better through practical application, “I came to realize that without, without doing the practical aspects of agriculture learners may not take it more seriously, but when you demonstrate to them and show to them that the things, things that done this way, they learn better than when you tell them in class.”

Allows Students to Think Critically. Participants recognized their role in critical thinking and that their students were thinking in a new manner due to their new behaviors. It was found that students were asking more questions in class than previously, meaning they were considering what to do or believe based on the information presented to them. When asked what skills students were learning, Dowda said, “Critical thinking through writing and their project and, of course, demonstrating in the garden.” Dakar further emphasized her thoughts on critical thinking, “They have to think so that they can . . . always gives them a lot of stress but at the end of the day they learn from their own experiences and that is why I like it so much.”

Inclusivity of All Learning Types. Because of the PBL aspect of the curriculum, many participants agreed that the new methods of teaching were much more beneficial to students at all learning levels. Participants made statements regarding their excitement of students participating that typically did not engage when using the Ugandan curriculum. When using the new curriculum, participants were able to recognize different types of learners had different learning needs, but collectively inclusivity could take place. Kofi shared his beliefs: “The curriculum is able to cater to all students . . . so students that learn on different levels can all learn together from this curriculum.” By recognizing that there were different types of learners, participants were better able to understand their audience and how to address problems their students were facing. Not only did the curriculum allow connections with all students, but the curriculum encouraged teachers to further recognize and identify who needs more specialized assistance.

Teacher-Centered to Learner-Centered. Prior to the new curriculum, participants agreed that the old curriculum was "teacher-centered." When asked what teacher-centered meant, Isha said: "Whereby you give everything fully then we could also have possibly some small groups." Through discussing with teachers their thoughts on using the curriculum, five out of the eight participants agreed that they previously used teacher-centered methods and now use a curriculum that is "learner-centered." Isha also described learner-centered:

> Learner-centered simply means most of the things or most of the activities are done by the students themselves. As they do it, they learn it and then they master it. The teacher is just to guide them on what to do.

Participants expressed their excitement for the new curriculum because it reduced their workload, and students seemed to have more control over the learning.

Assessment. Through observations and interviews, the researcher was able to understand that some students were being assessed beyond tests, examinations, and written answers. Rauf showed the researcher his teaching laboratory and explained that he took weeds out of a field and placed them on a lab table for students to identify and explained the growth stages of the plant. In addition, his students dissected a hen for the poultry curriculum. These along with many other observations support participants' statements that allowed the researcher to understand the practical nature of the curriculum was still reflected in assessments. While Rauf used practical measures to assess students' learning, the majority of participants used exams, projects, and discussions. Tuno explained he uses "home assignment" as a form of assessment by stating, "Each of the agriculture students . . . they would manage it, and we see now the costs and benefits at the end of the day . . . that would motivate them to do, to do agriculture better."

Community Engagement. Communal living, working, and sharing of most parts of life is how

most Ugandans live. Whether as orphans at a children's home or in villages of multiple families, Ugandans live and work alongside their extended family members and neighbors. Participants expressed a sense of increased engagement with the surrounding communities as a result of using the curriculum by taking their students into nearby communities to observe, learn from, and see the practical application from farmers in their fields of the lessons they were learning in class. Grace explained how she has adapted to using PBL and critical thinking in her classroom while connecting students' learning to the real world in a community:

> This activity that they can tell you that you have to make a student to do it or you have to go in a community and then you make a student too to see that thing practicality or to do it using the hand, which you can make a student not to forget about that topic.

Participants also expressed students have an increased excitement for going into the communities to learn from their environments so they can easily apply and replicate what they have learned. Using such practical application through the new curriculum has also heightened teachers' sense of their role in not only a child's future, but the future of the communities the children come from because so many communities rely on the practical aspects of agriculture to feed their families. Dakar expressed this by saying, "It has made me to know the benefit of the application. It also made me, reminded me about my role in the community." Dakar explained how, through implementing the curriculum, teachers have been able to involve the farmers in the community to use the practical nature of the curriculum: "Field of Hope has trained me how to associate with the community by putting a demonstration farm because if I put a demonstration farm, many people will now come and be asking questions on what to do. So, it has already given me how to reach the community."

Research Question Two: What barriers prevented teachers from adopting the curriculum?

Theme 2: ***Barriers.*** While Field of Hope provided participants and their agricultural programs a new curriculum, there were still barriers that participants faced that hindered their complete and full adoption of the curriculum with many being out of the control of the participants.

Lack of Resources. The majority of the S1 curriculum contains practical lessons focused on how to grow plants in a garden setting. All eight participants expressed the need for additional resources and materials to fully implement the curriculum and incorporate critical thinking and PBL into their classrooms. While six of the eight schools reported having a garden, they reported lacking the necessary tools or equipment to work effectively in the garden. Dakar explained the consequences of teaching without the proper resources:

> The only challenge we have is that in Uganda, or in some schools in Uganda we lack some of the apparatus for practicals and it make most of the teachers now to teach agriculture what? Theoretically which it doesn't become meaningful. But agriculture needed to be taught what? Practical.

Equipment is necessary to run any kind of agricultural operation. Kofi had 96 students in S1 which presented a challenge with only a few watering cans for during the dry season which ultimately impacted the school garden. Fred shared, "As teachers we try to improvise or be creative enough, but the actual physical resources are not many except land, land we have."

Additional Training Needed. During interviews, participants expressed appreciation to Field of Hope for supporting, empowering, and following up by visiting schools. Teachers desired further training on a multitude of subjects to better implement the practical nature of the curriculum and increase their knowledge to deliver the curriculum to the best of their abilities. While Uganda has a diverse agriculture industry, participants reported the need for more locally relevant examples in the curriculum. Rauf described his desire to learn more about crops produced in the region in

which he teaches in Uganda:

> Some of the crops that they'll put in the curriculum, which may not be in our region, how to grow them . . . Like uh, we have never grown apples in our country here . . . They grow coffee in Uganda, just maybe not in this region.

In addition, some teachers desired to be trained further on using the curriculum to incorporate more PBL and critical thinking. Fred shared his desire to learn about teaching methods: "So, I realized the teaching method should always be practical, scientific, practical for the learning to be more to the learners even to you as a teacher." Teachers also recognized the need for training that would recruit other teachers to use the curriculum and provide opportunities to highlight Ugandan agriculture.

Support from School. In Uganda, there are a variety of schools including government-funded schools, private schools, and boarding schools, all with varying levels of support for the new curriculum. Fred described having support from his school director but also said that his school "fails to provide what I needed for the lesson or for the curriculum. Being the first time I'm introducing the curriculum, they're not seriously in support, but I hope with time." A few of the teachers also had difficulty convincing administration to allow them to use the new curriculum. Rauf explained how he convinced his school leadership to allow him to use the curriculum provided by Field of Hope: "They thought it was something separate, but now when it's explained. It is, it is incorporated in the syllabus of Uganda and then . . . I brought the curriculum and tried to go with the syllabus and compare to it."

While most teachers who were interviewed reported the lack of school support, there were a few who shared their positive experiences about the support their school gives. Grace, who teaches at a children's home, also reported having positive experiences regarding support of the

school leadership:

> "They love when students are going for practicals or PBL or when they are working in the school garden they encourage, the buy the produce that is the student always produced and it's made it, the students make me to know that, that they are encouraging the curriculum that we have to push on with it."

Support from Outside Agencies. One of the three pillars of the Framework for Curriculum Implementation in Developing Countries is support from outside agencies. Participants were asked if they received support from any other NGOs or private donors to assess the support from outside agencies. Six of the participants reported that they do not receive support from any other agency besides Field of Hope. When asked if their schools received any funds from donors Dakar responded, "Not yet," and Rauf said, "We have not yet received." Fred and his headmaster gave the researchers a tour of the school and explained their relationship with Notre Dame University. Through this relationship, the school has received enough solar panels to provide the entire campus with electricity and Wi-Fi, which only uses approximately one-half of the electrical supply.

Conclusions

From the analysis of interviews with eight teachers, two themes and multiple subthemes emerged in gaining an understanding of the influences and barriers to adopting a new agricultural curriculum. Theme 1, the *shift from theoretical to practical applications*, concluded that the practical application provided by the new curriculum allows students to experience learning in an entirely new way rather than through teaching that was theoretically or lecture-based. Supporting research by Chiasson (2008) and Mukembo (2017), the subtheme *practical applications* highlighted how the new curriculum with practical application allowed students to comprehend what they are learning, construct questions to further their understanding (*think critically)*, and then

go home over the holidays to repeat what they have learned with family or friends. In addition, participants now have the ability to recognize the different levels of learners, creating a more inclusive environment (*inclusivity of all learning types)*. The new curriculum provides diversity in learning through varied instructional styles, which aids in student understanding because participants realized not all students learn best from lectures. The learners are able to take control of their knowledge (*learner-centered)* by applying themselves to the subject through hands-on work during practical days. The teachers are not only using practical methods of teaching but are also using practical methods of assessing students (*assessment)* allowing them to continue to reinforce real-world applications. Through using the curriculum, teachers have become increasingly connected to community members and have been reminded of their role in building the future citizens of the communities from which these children come (*community engagement)*. Teachers encourage students to go into their communities and test out their new knowledge learned on their families' or neighbors' farms.

Teachers have been supported by Field of Hope through the curriculum and training they received; however, they still face *barriers* (theme 2) that prevent them from being able to fully use the curriculum in the way it is intended. Teachers struggle to provide practical applications to their students due to a large number of students, lack of land for gardens, and tools (*lack of resources)*. This conclusion is critical to the success of implementing the curriculum because the FAO (2004) argues that school gardens are encouraged in developing countries as experiential learning tools to improve the quality of education. The participants were thrilled at the practical aspects of the curriculum, but *additional training* is needed relevant to teaching skills and agricultural knowledge to increase their understanding and confidence in delivering information to their students and incorporating more PBL and critical thinking. This conclusion is supported by Hennessey et al. (2010), who argued that the technical expertise of the teacher is critical for any new

implementation to take place. The level of *support from the school* varied among the participants, but the major lack of support related to the funds available to purchase needed supplies related to the instruction supports the research by Rogan and Grayson (2003). The main *source of support from outside agencies* in the study is the INGO Field of Hope, however, several of the schools received support from other agencies which increased the support for the students and the activities. This curriculum implementation and support received from Field of Hope were unique from other studies completed using the Framework for Curriculum Implementation in Developing Countries because there was a constant connection to a supporting agency with ongoing support versus curriculum being distributed and teachers learning to adapt.

Recommendations and Implications

To fully understand the needs of agricultural education in developing countries and curriculum implementation, more research is needed. Using Roger's (2003) Diffusion of Innovations, a study on the transfer of new agricultural knowledge during the holidays would allow teachers to see if their efforts are leading to family and community adoption of agricultural practices (Okikoret al., 2011). Research should also be conducted to follow students who complete S1 through S4 using the Field of Hope curriculum to further understand the impact curriculum is having on students. A capacity instrument should be administered both before and after students are taught the curriculum that contains themes of technical aspects of agriculture, agriculture careers, soft skills, and overall attitudes toward agriculture to measure changes in capacity. To further understand the impact that teacher training and professional development sessions are having on participants, a formal evaluation of training should be conducted to determine the effectiveness and to improve planning.

In addition, more can be done to impact curricular success. To ensure teachers

implementing curricula understand PBL and critical thinking, it is recommended that a formal process for training teachers be developed and acquire local Ugandan trainers who would enable sustainability and potentially elongate the training process. The administrations of schools adopting and implementing curriculum should be involved to ensure full awareness of the NGO's intentions, involvements, and teacher professional development goals as this could spur additional support.

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