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Making the Jump: What Led Agriscience Teachers to Adopt Agriscience Research SAEs?

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Abstract

The purpose of this study was to identify the factors, attitudes, and beliefs that led secondary school-based agricultural education (SBAE) teachers to adopt agriscience research Supervised Agricultural Experiences (SAEs) into their programs. Nine current SBAE teachers from North Dakota participated in semi-structured interviews regarding their experiences with agriscience research SAEs. The interviews were subjected to two rounds of coding and were collapsed into themes during a third round of analysis. A myriad of experiences, beliefs, and factors contributed to teachers' decisions to adopt agriscience research SAEs into their programs. However, the most salient reasons were compatibility with the overall goals of the school district, a commitment to whole-student development, teacher ability and support, multitasking behavior, extensive teacher planning and student support, and positive student buy-in. Though the unique experiences of the participants are not generalizable beyond the present study, we offer recommendations for teacher educators, state staff, and teacher leaders regarding the further adoption and integration of agriscience research SAEs into SBAE programs nationwide.

***Keywords*:** agriscience research SAEs; SAEs; school-based agricultural education; adoption; diffusion of innovations

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Introduction

It is well documented that Supervised Agricultural Experience (SAE) involvement is in decline (Dyer & Osborne, 1995; Lewis et al., 2012; Rank & Retallick, 2016; Retallick & Martin, 2008; Steele, 1997). Yet, active SAE engagement leads to several positive student outcomes including the development of entry-level technical skills (Ramsey & Edwards, 2012), preparation for agricultural jobs (Dyer & Williams, 1997), and fostering relationships with community members (Robinson & Haynes, 2011). Acknowledging the benefits of SAE, the National Council for Agricultural Education established the SAE for All as a framework to engage all agricultural education students in SAE (2015). The goal of SAE for All is to provide a path for 100% student engagement in SAE (National Council for Agricultural Education, 2020). For many students, this will be accomplished through a foundational SAE. However, for some students, an additional immersion SAE has the potential to deepen their agricultural education experience and better prepare them for success in their future career (National Council for Agricultural Education, 2015).

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SBAE teachers have several options to choose when engaging their students in immersion SAEs. Historically, in North Dakota and nationally, SBAE programs have focused their involvement in entrepreneurship and placement SAEs (Phipps et al., 2008). More recently, SAE has evolved to include agriscience research, school-based enterprise, and service-learning, in addition to the more familiar entrepreneurship and placement SAEs (The National Council for Agricultural Education, 2015).

It has been argued the use of agriscience research SAEs could engage more students in SAE due to their flexibility and reduced need for resources and inputs compared to a large-scale entrepreneurship SAE, which requires physical and financial resources, or a placement SAE, which requires a willing employer (Thiel & Marx, 2019). Additionally, agriscience research SAEs could prepare students for in demand agricultural careers in science, technology, engineering, and mathematics (STEM) which account for around 27% of annual job opening in agriculture (Goecker et al., 2015). However, according to data from The Agricultural Experience Tracker (AET), adoption of agriscience research SAEs across North Dakota has been slow (R. Hanagriff, personal communication, September 1, 2020). Even so, there a handful of teachers across the state who have successfully integrated agriscience research SAEs into their programs. Are there lessons we can learn from these agriscience pioneers which may lead more teachers to adopt agriscience research SAEs into their SBAE programs?

Review of Literature

Barriers to SAE involvement have been recorded through prior research (Lewis et al., 2012; Retallick, 2010; Steele, 1997; Wilson & Moore, 2007). Many teachers struggle to manage a well-balanced SBAE program that gives equal attention to classroom instruction, SAE, and FFA (Shoulders & Toland, 2017; Wilson & Moore, 2007). In many cases, SAE is the part of the three-component model that gets placed on the backburner (Shoulders & Toland, 2017). This is exacerbated by the fact that communities tend to support and recognize FFA involvement more than SAE projects due to the visibility of FFA activities (Wilson & Moore, 2007). Additionally, many teachers believe there are limited opportunities for SAE involvement in their communities (Wilson & Moore, 2007) and students often lack the resources necessary to successfully engage in SAE (Retallick, 2010).

As agricultural education becomes more diverse and fewer students come from production agriculture backgrounds (Phipps et al., 2008), teachers must utilize creative solutions to overcome the challenges related to SAE involvement today (Retallick, 2010). The changing demographics of today's agricultural education students means that instructors need to diversify their instructional methods, including the types of SAE opportunities they provide to their students.

It is plausible that agriscience research SAEs may be one way SAE can continue to find relevance and value among current SBAE students and teachers, especially as demand for employees in the STEM fields of agriculture continues to grow (Goecker et al., 2015). Additionally, involvement in agriscience research SAEs contributes to the development of important 21st century skills (Thiel & Marx, 2019) making them academically relevant in a rigorous classroom environment as pressure increases to prepare students to be college- and career-ready upon graduation from high school. Finally, agriscience research SAEs may lead to opportunities for recognition within the FFA including the National Agriscience Fair, agriscience proficiency awards, and Star of Agriscience recognition (National FFA, 2020), which may provide students and educators with an extra incentive to participate.

Conceptual Framework

Rogers' (2003) Diffusion of Innovations Theory served as a conceptual framework to guide this study. Within the context of this study, this theory aligns because the research questions are related to teachers choosing to utilize an innovative SAE type to engage students in an SAE. When individuals choose to adopt an innovation, they go through a process called the innovation-decision process (Rogers, 2003). Rogers' (2003) Diffusion of Innovations Theory has been used frequently within literature related to agricultural education (Roberts et al., 2009; Smith et al., 2018; Wilcox et al., 2014) and extension education (Beattie et al., 2019; Taylor & Lamm, 2017; Taylor & Miller, 2016) to explain decisions to use new and innovative practices and/or educational experiences, which are related to the goals of this study.

Because this study focused on identifying beliefs and factors which led to the adoption of agriscience research SAEs into SBAE programs, it is logical to consider how the perceived characteristics of an innovation affect the rate of adoption. Rogers (2003) identified five characteristics which impact adoption of innovations including (a) relative advantage; (b) compatibility; (c) complexity; (d) trialability; and (e) observability. The relative advantage relates to the perceived advantage of this innovation over earlier ideas. Simply put, it answers the question "what will the adopter gain by using this innovation?" Compatibility is concerned with how aligned the innovation is to current values, prior experiences, and the needs of the adopters. Complexity is the perception of how difficult it would be to adopt the innovation. Trialability is the level by which one may experiment with an idea during adoption. Finally, observability relates to how visible the results of the innovation are to others. Thus, in most cases, for a teacher to adopt an innovative idea (such as agriscience research SAEs) into their agricultural education program, they must have a need, see the potential benefits from engaging in the activity, have the ability to adopt the innovation, be able to experiment with the new idea in a supportive environment, and witness others successfully implement the innovation or witness the positive results of the innovation.

Though the perceived characteristics of an innovation affect the rates of adoption, Rogers (2003) also characterizes adopters based upon their personalities and rate of adoption. Within the context of this study, we were interested in evaluating where participants fell along the spectrum of adopter categories. The adopter categories are (a) innovators; (b) early adopters; (c) early majority; (d) late majority; and (e) laggards. Innovators are bold individuals who seek out new ideas, which may lead them to engage with other innovators outside of their local communities. They can tolerate failure and setbacks, are able to understand and apply complex concepts, and can manage through uncertainty. Early adopters have the highest degree of opinion leadership within a social system. They are role models and are respected for their successful use of a new ideas. Their "stamp of approval" on an innovation is what often leads to others' adoption of the innovation. Early majority adopters deliberate about the adoption of a new idea long enough that when they do adopt, it is typically just before the average member of the group adopts the idea. The late majority adopters may not adopt an innovation until it clearly becomes a necessity, or they are pressured to adopt by their peers. Because they are skeptical and cautious, they wait until the innovation has proven to be successful and is highly favored by the group. In some cases, because they may lack the necessary resources or support to adopt an innovation, barriers must be removed and they must feel it is safe to adopt the innovation. Laggards are the last people to adopt an innovation. They are the most locally focused and may be socially isolated. They make decisions based upon what was done in the past. They tend to be suspicious of change and prefer to work with people who share traditional values with them. Often because their resources or support are very limited, they will not adopt an innovation until they are certain the idea will not fail.

Purpose of the Study

The purpose of this study was to examine what leads SBAE teachers to utilize agriscience research SAEs as part of School-Based Agricultural Education. Specifically, the study addressed the following questions:

1. What beliefs and factors led teachers to choose to utilize agriscience research SAEs within their SBAE programs?
2. Are there consistent themes or experiences that led teachers to be successful at the implementation of agriscience research SAEs?

Methods

The intent of this study was to examine the experiences of SBAE teachers which led to the adoption of agriscience research SAEs into their programs. Based upon the experiences of SBAE teachers who have successfully implemented agriscience research SAEs into their programs, we hoped to offer practical recommendations and solutions to the profession regarding further adoption of agriscience research SAEs. With those goals in mind, the design of the study was informed by pragmatism (Patton, 2015). Patton (2015) describes a pragmatic approach to qualitative research as a framework that "directs us to seek practical and useful answers that can solve, or at least provide direction in addressing, concrete problems," (p. 152). Study data were collected through a series of semi-structured, one-on-one interviews conducted by the same researcher. The interviews were conducted both in person and via Zoom or Skype. The interview guide included eight stem questions with 34 potential follow-up questions. The initial stem questions were reviewed for face and content validity through peer review with experts in teacher education, educational psychology, and school-based agricultural education. Discretion was used regarding the use of designed follow-up questions based upon the depth and scope of participants' responses. Stem questions with follow-up questions are included in Table 1. Though Rogers (2003) Diffusion of Innovations was used as a theoretical lens for this study, the framework was not explicitly used to guide the development of every question in the interview guide. Some, such as questions related to openness to change, innovation, school culture, and resources can be connected back to the theory.

Table 1

Semi-Structured Interview Questions

Primary Prompt	Follow-up Prompts
Tell me about yourself as a teacher:	How many years have you been teaching? Where do you teach? What types of classes do you teach? Are you qualified to teach science? What drew you to teaching?
What is your purpose as a teacher? What drives (motivates) you?	What are your thoughts on the three-component model? What are your thoughts on SAEs? How do you integrate SAEs into your program? Do you require all students to maintain an SAE? What benefits do you see students getting out of being involved in Ag Ed? SAE? Agriscience research SAEs?
Tell me about your school culture:	If you created a mission statement for your school, what would it be? Tell me what the administration values most about the school? Ag Program? Tell me what the community values most about the school? Ag Program? Do you see your school as innovative?
How do you perceive your openness to change?	How does your attitude toward change fit within your school/community? Do you feel supported? Not supported?
What has your experience been with Agriscience Research SAEs?	What initially motivated you to begin implementing Agriscience Research projects into your program? Has that motivation changed? How so? Walk me through a year in your program. How are agriscience research projects conducted in your program? What motivated your decision to implement agriscience research projects that way? How has the implementation of agriscience research projects changed since you began implementing them? What barriers do you face when implementing agriscience research projects? How have you overcome barriers?
Some teachers choose to not utilize agriscience research projects. If you were in their shoes, how would you explain their reasoning for making that decision?	What do you believe prevents teachers from using agriscience research projects?
You have successfully implemented agriscience research projects into your program. What do you believe allows you to do that?	What makes you different from other teachers?

Following data collection, we separately and manually completed initial (open) coding of verbatim interview transcripts to identify emergent findings (Saldaña, 2016). Additionally, we established a series of theory-based codes a priori using Roger's Diffusion of Innovations (2003) which included the five characteristics that impact adoption of innovations (relative advantage, compatibility, complexity, trialability, and observability) and the five levels of adopters (innovators, early adopters, early majority, late majority, and laggards). To improve trustworthiness (Patton, 2015), we triangulated our analysis by coding the transcripts individually and then comparing our findings both after the first two interviews were coded and again after completing all nine interviews. Analytic memos were constructed for each of the nine participants during analysis that summarized key codes and emergent findings (Saldaña, 2016). Significant passages from the transcripts were highlighted during analysis. Upon completion of the first round of coding, we shared our first-round of codes in an Excel document broken down by initial stem question. Together, we conducted a second round of coding by using pattern coding to narrow codes into broader categories (Saldaña, 2016). Then, the final pattern codes were collapsed into six resulting themes (Saldaña, 2016).

We each have previous experience as SBAE teachers and acknowledged the biases and assumptions that inherently come from that experience. Thiel taught school-based agricultural education and engaged students in agriscience research SAEs and Marx also taught school-based agricultural education and engaged students in SAEs. Presently, we are involved as SBAE teacher educators and develop pre-service and in-service teachers and their ability to successfully manage a comprehensive SBAE program. We see a value in the expanded use of agriscience research SAEs within SBAE programs and are interested in providing a clearer picture for educators who may be interested in adopting agriscience research SAEs but are unsure how to go about integrating them into their programs. We acknowledge our personal missions and goals intrinsically lead to biases in qualitative research. To maintain integrity in data collection, this study was conducted under the purview of the Institutional Review Board at North Dakota State University. Additionally, the participants were asked to review the findings to ensure accuracy and validity in our interpretation and reporting (Patton, 2015).

Sample and Data Collection

We purposefully selected the participants for this study using criterion-based sampling (Patton, 2015) from current agricultural education instructors in North Dakota who had varied levels of familiarity with agriscience research SAEs and from a range of teaching experiences. The process of screening involved criteria established a priori which included; a) current agricultural education instructor, and b) familiarity with agriscience research SAEs. Interviews were scheduled during the spring and summer of 2018. We utilized face-to-face interviews, as well as virtual meetings to accommodate for participants located at an unreasonable distance from us. Nine (n=9) SBAE instructors participated in the one-on-one interviews.

A brief description of each participant follows for context using the pseudonyms we created to aid in protecting their anonymity. At the time our study commenced, **Becca** had five and a half years of teaching experience. She attended the National Agriscience Teacher Ambassador Academy, is CASE certified, and engages all her students in agriscience research projects in the classroom. **Erica** has eight years of teaching experience. She is licensed to teach agricultural education courses for science credit and requires all students enrolled in agricultural education to be involved in SAE. **Sara**, a 15-year of veteran teacher, requires every student in agricultural education to maintain an SAE. Further, she allows students to participate in agriscience research projects but does not require it as part of a course or SAE. **John** has been teaching at the same school for 22 years and has been engaging students in agriscience research projects for the past 15 years. He has had numerous students compete in Agriscience Fair at the local, state, and national level. **Zach**, an early-career teacher in his second year of teaching, has not

yet involved his students in agriscience research projects, and is working to engage all of his students in SAE. **James** has 14 years of teaching experience. He requires all students to participate in SAE and has incorporated agriscience research projects into his courses. **Amy** has four years of teaching experience. She incorporated agriscience research projects into her program during her first year of teaching. Since then, she has had students compete at the state and national Agriscience Fair competition. **Derek** is an 18-year veteran teacher. He requires SAE involvement for all his students and has included agriscience research projects into his curriculum for several years. **Susan** has 18 years of teaching experience. She has implemented agriscience research projects into her classroom and program for the past 15 years.

Findings

The findings were organized into six themes which describe teachers' experiences and their decision-making process as they chose to adopt agriscience research SAEs into their programs. Though Rogers' theory (2003) was used as a theoretical lens during analysis, the theory-based codes which were established a priori were woven together with other emergent findings when developing the resulting themes. As such, some of the themes relate very little to Rogers' theory (2003).

Theme 1: Agriscience Research Needs to Fit with the School and Community

Adoption is met with resistance if the environment does not support a new idea. The environment in which the SBAE program exists is heavily impacted by the attitudes of the school and community. Therefore, the SBAE program can diversify and flourish or remain stagnant and unchanged based upon the values of those who influence the environment in which the program exists. In fact, Derek admitted, "I probably have the most understanding administration in the state. If I want to do something and I have everything lined up, he says 'Go ahead and do that experiment'." In the case of the participants, many found their goals and wishes to adopt compatible with the philosophies of the communities and schools in which they taught. The participants identified their schools as being driven to prepare students; they valued rigor and academic success. Agriscience research SAEs were viewed as a way to challenge their students towards academic success, which was compatible with the needs and wants of the community and school. Becca, whose school was focused on career and academic readiness, stated that one of the goals for her SBAE program was "to make them not only college ready, but career ready. I try to focus on career readiness because college isn't a necessity for every kid." Additionally, many participants felt their administration and community valued a *diverse curriculum* when it came to the agricultural education program.

Interestingly, most instructors saw a need for the adoption of agriscience research SAEs due to the lack of science fairs at their schools. There was a perceived need for a science fair and the SBAE teachers could fill that need through the adoption of agriscience research projects, which is reflective of Rogers' definition of compatibility. "I was really surprised that [school] didn't [have a science fair], that our students didn't participate," shared Mike. Becca concurred with the sentiment, "We don't have science fair in [town]. I wanted to make this our thing and I really wanted to build on the science content in Ag and I wanted to make it relevant." John said:

> I was blown away that our science program, our science teachers, did not do a science fair because when I was in high school you had a science fair project and we had a science fair. I was really surprised that [town] didn't, that our students didn't participate. That's where it started. I saw an opportunity.

Theme 2: Commitment to Whole Student Development

Teachers who adopted agriscience research SAEs into their programs were committed to student-centered teaching philosophies which led them to focus on the development of the whole student. John remarked, "For me, it's about giving students opportunities," whereas Derek shared, "just making them useful citizens," was a desired outcome for his students through SBAE. It was common to hear participants share comments like Sara's, "I just really think there's a place in agricultural education for every kid. We teach so many different things." Zach said he was drawn to teaching because of:

> The light bulb moment in students and helping them discover their potential. Watching them reach their potential is what really drives me, and them enjoying what they're doing and finding things they enjoy, and discovering who they are as a person, and knowing they can do stuff.

Consistently, participants highlighted broad skill development as a central purpose of SBAE. This led teachers to seek specific learning opportunities for their students which would foster diverse skill development and give them the opportunity to "learn skills that maybe they never would've otherwise learned," remarked Amy. Agriscience research was seen as a vehicle for the development of skills in multiple ways. For example, participation in agriscience research led to the development of technical agriculture skills from the pathway the students chose to conduct their research within and academic content skills such as scientific reasoning and the scientific method. Further, teachers recognized students building upon transferrable skills including responsibility, time management, critical thinking and problem solving, and creativity through their engagement in agriscience research. John concurred that students develop a broad range of skills through agriscience research SAEs, including writing, math, and science. Specifically, he said, "students think that when they're doing a science fair project, they're going to do science. They don't even have a clue how much English and math they're going to do! That's pretty cool. It's all embedded."

The teachers recognized the diverse interests and abilities of their students and identified agriscience research SAEs as a useful tool which could be used to offer individualized experiences for students. John acknowledged his students' uniqueness:

> Every kid is different, every student has different needs, and I want to try to fill the needs for that particular student by giving them as many opportunities as possible. Agriscience research is another opportunity for a student who loves science.

For many teachers, agriscience research SAEs allowed them the opportunity to differentiate their instruction; they could challenge all of their students at the appropriate level. Specifically, the teachers often pointed out agriscience research as a way to challenge their "high flyers." Agriscience research SAEs are "nice because you can push the high achieving students to do bigger, better, harder things. While you can still tailor something simple to those lower achieving students," shared Becca. Sara agreed, "It's a good way to push those kids that need to be pushed. And even a kid that's not that academic can do an agriscience project, they just do it at a different level."

Theme 3: Teacher Ability and Support

Consistent with Rogers (2003), teachers were motivated to adopt agriscience research SAEs through professional development and collaboration. Professional development decreases the complexity of adoption by assisting teachers in the development of skills, which helped them overcome the barriers to implementation. Agriscience research SAEs involve technical science knowledge and require competence in the scientific method and research design. As Zach said, "if you don't have any idea how to start an agriscience research SAE, you're going to be hesitant to throw your student into it." Becca concurred, "it's just a lack of knowledge and confidence to do those things. I still feel that

way sometimes. There is a lack of research knowledge, like how many adults have done research? Very few." That lack of knowledge can be overcome through professional development and training. "I never knew how to tackle [agriscience research SAEs] or even try to tackle them until PDC [summer Professional Development Conference] a few years back, and that's kind of what got me going," said Sara.

Continuing education was also a way to remove barriers to adoption, as evidenced by James' comment, "my master's classes and coursework motivated me to do it." Erica concurred, saying her master's degree gave her confidence "because I'm not so daunted by the lit reviews and such anymore." Professional development such as the National Agriscience Teacher Ambassador Program, National Association of Agricultural Educators Conference, and state-wide Career and Technical Education Professional Development Conference were all mentioned as sources where teachers received professional development which gave them the confidence to introduce agriscience research SAEs. A handful of participants also mentioned their experience of judging agriscience papers and proficiency awards as an experience that made them feel more confident in their ability to teach and advise agriscience research. Susan said, "After I judged agriscience papers and proficiencies, it opened up a whole new perspective. I thought 'Why can't I do some of this?'"

Collaboration with other teachers who had more experience with agriscience research SAEs also helped with implementation. Often, experienced teachers were described as role models, or in the words of Rogers (2013) *opinion leaders*, who the participants looked to for advice and support. Watching other teachers successfully implement agriscience research SAEs made adoption seem achievable and beneficial to their own programs and students. "I toyed around with [agriscience research] but couldn't see the big picture and couldn't make that step…through [observing] peers that have done [agriscience research], I just had to try it again," said Becca.

Theme 4: Agriscience Research Accomplishes Multiple Tasks within SBAE Program

One challenge the teachers mentioned repeatedly was equal integration of the three-component model of SBAE. Zach simply stated, "I tried to talk about [SAE], get everyone doing it, and it kind of was too much all at once." Amy lamented, "I think a lot of programs kind of leave SAE in the dust a little bit, including my own program." The participants overwhelmingly shared their intent to integrate all three components as equally as possible, noting that many did not feel successful in their attempt to do so. "Do I think all three of my circles are perfect? No, but they're all implemented. And I try to incorporate them as much as possible," shared Becca. Erica said, "I love the premise of the three-circle model of ag education, but the actual part of balancing it is a totally different story. I like to think I do my best to try to balance it, but it can be challenging."

For many of the teachers, SAE, including agriscience research SAEs, were integrated into their classroom teaching. Class time was used to identify and develop SAE projects, as well as maintain records throughout a student's agricultural education experience. Additionally, most teachers who utilized agriscience research SAEs did so during class time. Agriscience projects were a graded component of a specific agricultural education course. Participants justified this by identifying the benefits students get out of participating in agriscience research SAEs in the classroom. For example, Becca explained:

> The reason I chose to put [agriscience research SAEs] into my classroom is cause all of my students should benefit from them, not just a select few. If I wouldn't have implemented it then it would only have been my high fliers, my AP (Advanced Placement) kids, and they're already getting those experiences! I need my mechanics kids to get these experiences too.

Because the teachers felt there were academic reasons to incorporate agriscience research SAEs into their classrooms, they were able to accomplish academic content, SAE, and FFA, if the students

advanced to the Agriscience Fair, all at once. Some teachers specifically discussed the advantages of student engagement in agriscience research and it's flexibility in being an FFA event, classroom activity, and SAE area. Amy said:

> I thought agriscience research was a really neat opportunity for my FFA kids because they also get to work on their communication and their speaking skills, as well as the research that they've done. So that was kind of the driving factor right away. Seeing that the kids are gonna get a lot out of it anyway, so they might as well do it for a class assignment.

Theme 5: Success Depends on Teacher Planning and Student Support

Teachers who were successful at engaging students in agriscience research SAEs used scaffolding and extensive planning. Agriscience projects were chunked throughout the year with clear deadlines and checkpoints for each part of the project. Most teachers planned agriscience research SAEs to take place over the course of the entire academic year. Finding the time to supervise projects was a barrier for many of the teachers. James acknowledged the challenges associated with independent projects, "if you expect the kids to do a lot of it out of class time, you're going to have a hard time getting some of that stuff done. You won't have the watchful eye on what's actually happening." According to Susan, "if you don't have a student who has a strong parental base behind them to help run an experiment, then it's all on my [the teacher] shoulders."

Amy said, "agriscience research is not something that you can do in a week or two. It needs to be well-planned out and you need to have time available to allow the students to complete and work on their projects." Derek felt his success was due to working through projects slowly. To teachers who found themselves "stressing out about agriscience research" Derek said, "You started too late. Start it in September and end them in May. Your kids will enjoy them. That way, it's gradual and it's easier for the kids to wrap their heads around." Sara, who had included agriscience research SAEs into the classroom some years but not others lamented:

> [not including them in the classroom] is a little bit of a barrier because when I could spend more time going through the [agriscience project] one section at a time, my overall quality from the kids was higher because everyone was on the same page. When the projects are a little bit more self-driven, quality depends on the drive of the student.

Because of the individual nature of agriscience research SAEs, teacher supervision was critical for success, which offers further explanation to why many teachers chose to incorporate their agriscience research SAEs into the classroom.

Even when agriscience research SAEs were incorporated into the classroom, John shared how supervision can feel like a juggling act due to the diverse nature of the agriscience research projects:

> The problem is that one student can do the research in an afternoon. They bake the bread, hand it out to the students in the hallway, and then it's done. The next student is collecting data for four or five weeks, so that's a challenge.

Further, agriscience research does require a lot of work on the teacher's part according to John:

> It certainly is a lot harder than just grabbing your book and teaching, or lecturing, or working in the lab on a carpentry project for the month…If I just say 'go to work on your science fair project,' it's pretty chaotic.

Additionally, differentiating instruction and scaffolding for students of various ability levels took additional time and supervision by the teachers. Working with and trying to get students of lower ability levels excited about agriscience research SAEs was identified as a barrier to participation by some of the teachers, especially when those projects were conducted outside of class time and without the assistance of resource personnel in the school.

Theme 6: Agriscience Research Implementation is Contingent upon Student Buy-in

Ultimately, agriscience research SAEs could not be adopted into a program without student buy-in. Student buy-in was often determined by how a student viewed the purpose of agricultural education and whether agriscience research SAEs fit within that image. Really, student buy-in can be equated to Rogers' (2003) definition of compatibility: how a student views the purpose of agricultural education and whether agriscience research SAEs fit within that image. Zach expressed his frustration with misconceptions regarding agricultural education:

> I'm still working toward getting the idea out of their heads that ag is not all mechanics and whatnot… you mention soil to the students and they about freak out. They're like 'Why are we in Earth Science?' So I just didn't want too much fight back, I guess and kids not taking ag class because they felt it was a science class.

Amy reflected on push-back she experienced when initially implementing agriscience research SAEs, "The first year I was kind of met with some resistance of 'why,' that 'this shouldn't have to be,' 'this isn't science class.'" In many cases, teachers shared their frustrations with lack of student buy-in due to the misconception that agricultural education should be limited to production agriculture or agricultural mechanics, and should not include agriscience research or science in the curriculum.

Additionally, simply getting students to understand the true value of a classroom activity, whether that be the career skills gained through an SAE or the technical science skills learned through an agriscience research SAE, was a challenge for teachers. As most SBAE programs include primarily elective courses, teachers expressed struggling to balance the fine line between teaching courses that were engaging and fun while also being challenging and relevant. Though teachers recognized the value agriscience research SAEs brought to their classrooms, they had to be cautious to not push students away. Erica expressed, "[agriscience research] seems really cool. I would love to do that. But getting the interest [from students] is a totally different story." Sara said:

> If someone has a magical tool to get kids to understand the true value of an SAE, I would love that key! I used to require agriscience projects for everyone in class and I found it turned some kids off because they were not into the research component at all. I literally would have had no kids sign up for my class if I had kept agriscience research SAEs as a requirement.

At the same time, Sara shared a comment made by one of her students regarding agriscience research SAEs, "Hardest thing I've ever had to do in high school, but the most beneficial, and it prepared me the most for college."

Derek was a teacher who had not struggled to achieve buy-in from his students. In his words, he was able to achieve this by "challenging the kids and making it fun and making it real. Why do kids need geometry? You have to give them a real-world example. Kids like a challenge. Kids don't like school to just be hard."

Coincidentally, in some cases, student buy-in was what led to further implementation of agriscience research projects. Amy reflected about her students who had competed at the National Agriscience Fair, "Students saw it as an incentive like 'hey, if we do this and we actually do a good job, there's a chance that we can win, that we can go on.'" John had a similar experience, "I had a student who loved science. She was very motivated. She had some success at the national level, third in the nation. Then, the other kids could see that and it just built from there."

Discussion

Roger's Diffusion of Innovations theory (2003) served as the conceptualizing framework of this study. Since the purpose of this qualitative study was to assess themes beyond Roger's theory, the

theory itself did not independently drive the development of the interview guide or analysis. Instead, the theory served as the lens through which we viewed agriscience research SAE as a less-common, not widely adopted choice for SAE engagement. Therefore, this study was initiated with the viewpoint that agriscience research is a novel option for the implementation of SAE at the local level. Consistently, comments made by participants which aligned with the various components of Roger's theory, led us to confirm the appropriateness of the theory for this study. Specifically, the five characteristics which impact the adoption of innovations (relative advantage, compatibility, complexity, trialability, and observability) were expressed repeatedly by participants. Most of the participants discussed utilizing agriscience research SAEs to support student's individualized skill development. Teachers saw a *relative advantage* in using agriscience research SAEs to guide their students toward skill development within agricultural education. *Compatability* was evident as agriscience research SAEs aligned with teachers' philosophies of teaching. Teachers expressed the importance of adequate resources of space, time, equipment, and money as being necessary for successful integration of agrsicience research projects, which is another example of *compatability*. Also, having an ability to fail safely is important for adoption to occur. A common attitude shared by the teachers who adopted agriscience research SAEs was their willingness to try something new and potentially fail, which is reflective of *trialability*. The teachers who succeeded in the integration of agriscience research into their programs were open to change and willing to fail.

Nearly all of our teachers discussed the *complexity* of agriscience research. What allowed them to overcome the barrier of complexity was access to professional development, mentorship, continuing education, and prior experience. *Observability* can be a powerful tool in the adoption of new and innovative teaching strategies. Several spoke on the importance of observing their teaching peers successfully implement agriscience research as being a motivating factor for their decision to adopt agriscience research SAEs into their programs. Based upon the experiences shared by the participants in this study, we support the use of Roger's theory (2003) as a guideline for the adoption of future innovations into agricultural education programs.

Conclusions and Recommendations

The purpose of this study was to examine what leads SBAE teachers to adopt agriscience research SAEs into their SBAE programs. This study adds to the body of knowledge regarding teacher behaviors and the instructional decision process as they relate to the adoption of new processes and innovative ideas. At a micro level, examining what led teachers to adopt agriscience research SAEs into their programs provides current and pre-service teachers, state CTE leaders, and teacher educators with a better understanding of how to encourage the utilization of agriscience research SAEs more broadly. This is especially important as the adoption of the SAE for All framework continues nationwide, building potential for an increased interest in agriscience research SAEs as a potential immersion SAE option for students (National Council for Agricultural Education, 2020). On a grander scale, understanding the instructional decision-making process teachers use to adopt emerging and innovative instructional strategies into their programs is critically important for stakeholders in the profession to understand as agricultural education continues to grow and evolve in the 21st century. Agricultural Education will undoubtedly experience changes in the future, and knowing how to navigate those changes and support teachers through the process will be vital to the success of SBAE.

Interestingly, a collective misconception which emerged throughout this project was regarding the definition of an agriscience research SAE. Some would argue if teachers were integrating agriscience research SAEs into their classroom teaching, then they cannot qualify as an SAE. The differences between a classroom project, an agriscience research SAE, and an Agriscience Fair project were indistinguishable among the participants. There was no clear, shared definition of what constituted an SAE or other project among the teachers. In fact, in most cases, we (the researchers) were the ones

to identify the work teachers were doing in their classes as being SAEs. Some teachers still held the misconception that SAEs require documentation in The AET or a proficiency award application to be "counted" as an SAE. Considering SAE for All (National Council for Agricultural Education, 2015), the line between what is defined as an SAE and what is defined as a classroom project will continue to be messy. Ultimately, does calling a learning experience an SAE or a classroom project change or impact the learning outcomes for students? In a survey of Texas agricultural education teachers, Doss et al. (2019) reported 88% of respondents believed in-class hours should count towards students' SAEs. Similarly, we would argue that a student who completes an agriscience research project in the classroom is engaging in an SAE because it meets the intended outcomes of an SAE project. Yet, the historical argument has been SAEs, specifically immersion SAEs like agriscience research, must take place outside of the classroom for a project to be designated as such (National Council for Agricultural Education, 2015; Phipps et al., 2008; Talbert et al., 2007). Our findings lead us to believe that requiring agriscience research SAEs to take place out of class time would lead to reduced student engagement and more teacher burnout, which would perpetuate barriers to SAE engagement identified in previous studies (Retallick, 2010). If the goal of the agricultural education profession is truly to ensure *SAE for All*, perhaps we need to identify and eliminate barriers to student involvement in SAEs and address how teachers interpret what constitutes an SAE. Beyond agriscience research SAEs, we also wonder if similar misconceptions could be causing issues with the implementation and adoption of other SAE areas more broadly. Ultimately, a philosophical conversation of how classroom, SAE, and FFA can overlap and function synchronously is necessary and has the potential to shape how SBAE functions from this point forward. Also, there is a need for clear, well-defined definitions of agriscience research SAEs, agriscience research projects, and Agriscience Fair projects within SBAE.

Prior research has identified unrealistic expectations, a lack of work-life balance, and an unattainable drive for success as a cause of teacher attrition and career dissatisfaction (Lemons et al., 2015; Solomonson et al., 2019; Traini et al., 2019) and has called for research to identify ways to shift the current paradigm and/or system of agricultural education profession to be more balanced (Lemons et al., 2015; Solomonson et al., 2019; Traini et al., 2019). A reimagination of how the three-component model, and specifically SAE, is conceptualized in agricultural education could address some of the systemic contributors to teacher attrition. It is well known many SBAE teachers struggle to equally balance the components of the three-component model (Shoulders & Toland, 2017), which is one of the contributing factors to the nationwide decline in SAE participation (Dyer & Osborne, 1995; Retallick & Martin, 2008; Steele, 1997). Agriscience research SAEs, especially if they can be conducted in the classroom like most study participants chose to do, may offer the opportunity to accomplish many tasks required of an SBAE program with one activity. Not only are students being exposed to a potential career while developing valuable skills and experiences through the SAE component of the project, but they can also be engaged in a graded component of their class, and possibly an FFA activity through the Agriscience Fair. Many teachers discussed FFA as being the component of their programs the community valued most because it was the most visible, which aligns with prior research on agricultural education (Wilson & Moore, 2007). Agriscience research may overcome the perceived challenges associated with trying to maintain a well-balanced SBAE program by intersecting all three components of the Ag Ed model at once. Engagement in agriscience research SAEs could be a way to engage a larger number of students in SAE, incorporate rigor into the classroom, and provide visibility to the program through Agriscience Fair competitions simultaneously.

Though it was not an objective of this study, we were interested in examining where participants fell along the spectrum of adopter categories (Rogers, 2003). However, as we anlayzed the transcripts, it became evident that strict classification of participants would be nearly impossible. In most cases, individuals in the study shared features of multiple categories of adopters. We do, however, believe the participants in this study expressed characteristics of innovators, early adopters, and early majority adopters. Based upon the responses of the participants, we hope their responses are indicative

of future growth in agriscience research SAEs across the state of North Dakota as more early majority adopters begin to incorporate agriscience research SAEs into their programs.

There were limitations to this study. Due to the qualitative methods, the results of this study are not generalizable beyond the participants in the study. Additionally, of the nine participants, only one had not yet adopted agriscience research SAEs into their program. Including more participants who had rejected the use of agriscience research SAEs in their program could have offered unique perspectives which are not included in the results and conclusions of this study.

Finally, we believe the results of this study will be useful in expanding the adoption of agriscience research SAE across the state of North Dakota and the nation. However, we also believe the results of this study can be used beyond the scope of the initial purpose of this study. It is logical that Rogers' theory (2003) could be used as a guide when implementing future change in SBAE. As we have navigated the changes and challenges associated with COVID-19 pandemic over the past year, it is becoming clear that additional changes within education, agriculture, and SBAE will only continue to arise in the future. Thus, stakeholders in the profession need to be prepared to lead the adoption of future innovations within SBAE. We believe the framework of Rogers' theory (2003) offers a useful strategy which can be used by state and national leaders, teacher educators, and teacher leaders in the future.

As we consider the findings of this study, a number of conclusions and recommendations emerged related to the adoption of agriscience research SAEs. First, the SBAE program environment needs to be suitable. Teachers shared the need for administrative and community support, as well as student buy-in, in order for adoption of agriscience research SAEs to be successful. However, even if the environment of a school district is not pushing for adoption, the broader environment the SBAE program operates within may create pressure to adopt. For example, the environment created by agricultural businesses in need of graduates who are prepared for careers in STEM fields or the evolving culture of agricultural education across the state as a whole may be the tipping point towards adoption for programs in stagnant school districts. As requirements for most recent federal Perkins funding are incorporated into state and local programs, outcomes of comprehensive local needs assessments will help inform specific focus areas and justify decisions made by teachers (Advance CTE, 2018). Thus, as needs assessment findings are incorporated and as those innovations are rolled out to SBAE programs, it is essential that consideration is given to the environment in which programs are operating, both within the school and beyond.

The teachers who adopted agriscience research SAEs into their programs shared a common commitment to whole student development. They accomplished their goals by utilizing student-centered teaching strategies, such as inquiry-based instruction and differentiated instruction. They found ways to engage students in projects that mirrored their interests and abilities. Additionally, many of the participants affirmed their commitment to a diverse, well-rounded agricultural education program as being a motivating factor for incorporating agriscience research SAEs into their programs. Although it may be difficult to change teachers' deeply held philosophies of teaching, we recommend an increased focus on student-centered teaching strategies at the pre-service and in-service levels as a way to foster a commitment to unique, whole-student development. Further training on the use of inquiry-based instruction, problem-based learning, and other forms of student-centered teaching strategies would foster the primary tenets of agriscience research and open the potential for teacher adoption into their programs.

A handful of participants shared using agriscience research as a way to differentiate instruction for students based upon ability. Though we do not disagree that agriscience research can be an excellent way to challenge students of all levels, many teachers talked about agriscience being best for high

achieving students, especially when being conducted outside of class time. We ask, what implications does this hold for Agricultural Education? There seems to be a common perception that agriscience research is best suited for advanced students, when really, it can and should be for all students. We recommend further research be conducted to determine how agriscience research can be scaffolded appropriately to serve all students enrolled in SBAE.

Agriscience research can be a challenging activity for teachers to integrate into their programs. The inherent complexity of agriscience research was an explicit barrier identified by a number of the teachers in this study. Teachers without proper training and experience will be less likely to integrate agriscience research into their SBAE programs. Participants in the study shared the importance of professional development, continuing education, and prior experience on the impact of their decision to implement agriscience research into their programs. That barrier can be overcome through training, instruction, and professional development. Therefore, we encourage the development of professional development for in-service teachers and high-quality instruction for pre-service teachers related to teaching the scientific method and supervising agriscience research SAEs. In-service teachers should be encouraged to start small with one or two students participating in agriscience research to get comfortable with the process. We recommend engaging pre-service teachers in low-stakes research projects as an authentic learning experience during their teacher preparation coursework.

The development of formal mentorship programs may also assist in the adoption of agriscience research SAEs as it would lead to greater collaboration between teachers practicing agriscience research in the field. Finally, capitalizing on the idea of observability (Rogers, 2003), identifying opinion leaders or agriscience research role models and highlighting their programs' and students' successes may lead other teachers to replicate agriscience research SAEs within their own programs. Giving successful in-service teachers a voice by spotlighting their successes and experiences will be critical in the process of encouraging further adoption of agricience research SAEs.

The reality is agriscience research is individualized to each student, complicated to teach, and difficult for teachers to manage over time. Therefore, careful up-front planning by the teacher led to greater success in the long run. Teachers who had clear deadlines and expectations throughout the semester or school year, tended to see better results from their students. Common to most of the participants was a need for time. Supervising many groups of students outside of class time just was not feasible for most of the participants. Therefore, the majority of teachers chose to conduct agriscience SAEs in their classrooms. Some teachers did supervise agriscience research projects outside of class time, though their overall involvement in agriscience research SAEs was limited to a few students versus a majority of students in other programs. To encourage adoption, we recommend successful teachers share their teaching timelines, whether conducted in the classroom or not, with other teachers. A tested and successful timeline may assist newcomers to agriscience research with the implementation into their programs.

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