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Preservice Agricultural Education Majors' Perceptions of Integrating Science into Agriculture

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PRESERVICE AGRICULTURAL EDUCATION MAJORS' PERCEPTIONS OF INTEGRATING SCIENCE INTO AGRICULTURE

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the Master of Science degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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ABSTRACT

PRESERVICE AGRICULTURAL EDUCATION MAJORS' PERCEPTIONS OF INTEGRATING SCIENCE INTO AGRICULTURE

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Agricultural science has seen a rise in secondary agricultural classrooms and many studies have been done with regards to integrating science into agriculture. Several recommendations have been to assist preservice agriculture education majors with science integration. Preservice agricultural education majors could influence the future of agricultural science due to their perceptions of integrating science into agriculture into the classroom.

The purpose of the study was to assess preservice teachers' perceptions of integrating science into agriculture curriculum based on the theory of planned behavior. An online survey was administered to the population of agricultural education majors at South Dakota State University. The survey included constructs for courses taken, social norm, perceived control, and perceptions of integrating science into agriculture.

On average, students took more science courses than what was required for secondary graduation and variable amounts of science and agriculture courses taken at the post-secondary level. Social norm and perceived control were found to be significant to the perceptions of integrating science into agriculture. Social norm and perceived control were found to be significant influencers of the perception of integrating science into agriculture curriculum.

Future research recommendations include assessing preservice teachers from multiple preparation programs in multiple states, what is beneficial for science integration for both in-service and preservice teachers and assessing post-secondary agricultural education professors' perceptions of science integration into agriculture curriculum.

Chapter I

Introduction

Secondary agriculture curriculum has seen fluctuations between science and vocational focus. Vocational agriculture was part of vocational education which focused on preparing students to enter the workforce (National Research Council, 1988). During the 1800s, agriculture was in need of scientific advances which led to the Hatch Act. The Hatch Act started agriculture experimental stations that provided instruction to students and scientific applications to agriculture (Hillison, 1996). Hillison (1996) stated that the Hatch Act of 1887 was the driving force for more agriculture education in the country along with the many scientific advancements. Secondary programs, colleges, and extension continued to grow and advance agriculture science during the late 1800s into 1900s. In 1917, the Smith-Hughes Act passed and changed agricultural education into vocational agriculture education (Hillison, 1996). With an emphasis on vocations, agriculture education reflected workforce needs. In 1988, the National Research Council decreed that "Teaching science through agriculture would incorporate more agriculture into curricula, while more effectively teaching science" (p.11) in their publication, *Understanding Agriculture: New Directions for Education.* This change was determined due to vocational agriculture curriculum being outdated and changed to meet future workforce needs that include scientific and technical content. This recommendation led to what we identify as agriscience.

In 1988, agriscience was not a new idea, but evolved from multiple definitions. Early agriscience was based on the scientific method (True, 1929), the idea that agriscience is its own science (Bricker, 1914), or is an applied science (Bricker, 1915).

Early agriculture education was taught by science teachers and content commonly focused on scientific principles and experiments (Robinson,1911; True, 1929; Moore, 1985). Agriscience has always consistently incorporated science concepts into the agriculture curriculum. Early agriscience coursework included: agricultural chemistry, botany, zoology, geology, animal physiology, mineralogy, farm mechanics, surveying, theoretical agriculture, and stock breeding (True,1929). A more recent definition of agriscience from Conroy and Walker (1998) defined agriscience as "Identifying and using concepts of biological, chemical, and physical science in the teaching of agriculture, and using agriculture examples to relate these concepts to the student" (p. 12). After *Understanding Agriculture*, initial findings from early research indicated agriculture educators had positive thoughts of integrating science into their curriculum (Newman & Johnson, 1993).

The transition from vocational agriculture to agriscience took time and initial changes included implementing pilot courses and determining in-service agriculture teachers' perceptions of agriscience. Newman and Johnson (1993) studied Mississippi in-service agriculture teachers' perceptions of integrating science with pilot agriscience courses. Peasley and Henderson (1992) studied Ohio's level of agriscience curriculum, the perceptions of agriscience, and knowledge of agriscience of in-service agriculture teachers. They found that in-service agriculture teachers were teaching a moderate amount of agriscience content and had positive attitudes of agriscience. With this rise in agriscience, many studies have researched the integration of science into agriculture (Wilson & Curry, 2011). These studies have focused on teachers' perceptions, barriers, and impact on student enrollment regarding science integration (Balschweid &

Thompson, 2002; Myers & Washburn, 2007; Peasley and Henderson, 1992; Roberson, Flowers, & Moore, 2000; Thompson, 1998; Thompson & Balschweid, 2000; Thompson & Warnick, 2007; Thoron & Myers, 2010; Welton, Harbstreit, & Borchers, 1994; Wilson, Kirby, & Flowers, 2001), other stakeholders perceptions of science integration in agriculture curriculum (Osborne & Dyer, 1998; Warnick & Thompson 2007; Warnick, Thompson, & Gummer 2004; Johnson & Newman, 1993; Thompson, 2001; Dyer & Osborne, 1999; Woodard & Herren, 1995), and preservice agriculture teachers' perceptions of science integration (Thoron & Myers, 2010).

The most common recommendation regarding science integration is to improve preservice agriculture education training in science integration (Tolbert, Conroy, & Dailey, 2000; Thompson & Balschweid, 2000; McKim & Velez, 2017; Scales, Terry, & Torres, 2009; Thoron & Myers, 2010; Warnick & Thompson, 2007; Washburn & Myers, 2008).

Preservice agriculture education programs are charged with preparing the future teachers of agriculture education. With preparing future agriculture educators, understanding students' perceptions and thoughts allows programs to better prepare these students for the field. Shulman (1986) has found that preservice teachers in coursework are occupied in teaching strategies, goals, new knowledge of subject matter, pedagogy, schools, instructional settings, and curriculum. Preservice teachers are occupied with learning and applying their knowledge and understanding their perceptions allows researchers to understand what preservice teachers need. Perceptions allow researchers to understand a person's background, knowledge of a topic, and attitudes. Thoron and Myers (2010) discussed the importance of understanding and recognizing preservice teachers' perceptions of agriscience to help build the future of agriscience in the classroom.

Thoron and Myers (2010) looked at preservice agriculture teachers' perceptions of integration of science, barriers to integrate, impact of student enrollment, and level of competency. Preservice agriculture teachers had positive perceptions of integrating science with a majority agreeing that students understand science concepts more easily than traditional science courses. Barriers that were perceived included lack of experience and insufficient background in science content (Thoron & Myers, 2010). The impact of student enrollment was perceived to increase for all areas which included high and average achieving students (Myers & Washburn, 2008). A majority of preservice agriculture teachers believed to be competent in teaching biological concepts in agriculture. Preservice agriculture teachers had positive perceptions of science integration which aligns with previous research (Conroy & Walker, 2000; Layfield et al., 2001, Myers et al., 2008; Myers & Washburn, 2008; Thompson & Balschweid, 1999; Thompson & Schumacher, 1998).The biggest barrier preservice teachers cited was the lack of science understanding needed to integrate (Thoron & Myers; 2010). Preservice teachers said they did feel competent with teaching biological sciences but were less comfortable with other sciences including physical science (Thoron & Myers, 2010;). Recommendations for preservice teachers included instruction at the undergraduate level on integrating science, an environment for modeling science integration, and early field experiences (Thoron & Myers, 2010, p. 75).

While preservice agriculture teachers could take more science courses or be offered professional development, we must first understand preservice agriculture teacher science integration perceptions, which have not been explored in the past decade. Despite the research just cited, more research is needed to provide a clearer and more current understanding of preservice ag teachers' perceptions of integrating science into agriculture.

Perceptions allow researchers to understand views of a behavior which could determine how likely a person is to act or intend to do the behavior. By assessing preservice agriculture teachers' perceptions of integrating science, intentions may indicate future behavior. "Intentions are assumed to capture the motivational factors that influence a behavior" (Ajzen, 1991). These intentions are indicators of how likely they will act in a certain behavior (Ajzen, 1991). By assessing preservice agriculture teachers' perceptions of integrating science, intentions may indicate future behavior. Preservice agriculture teachers' intentions have an influence on the future of agriscience and should be examined.

Purpose and Objectives

The primary purpose of this study was to assess preservice agriculture teachers' perceptions of integrating science concepts into agriculture based on the theory of planned behavior. The specific objectives of the study were to:

1. Determine what courses preservice agriculture teachers have taken in science and agriculture science
2. Determine the relationship of subjective norm and perceived behavior control to perceptions of integrating science into agriculture curriculum
3. Determine the interrelationships of courses taken, subjective norm, and perceived behavior control on perceptions of science integration into agriculture curriculum.

Definition of Terms

Agriscience – instruction of agriculture with science concepts integrated into the existing curriculum

Attitude – the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question (Ajzen, 1991, p. 188)

Curriculum - the lessons and academic content taught in a school or in a specific course or program (EdGlossary)

Perceived behavior control – the perceived ease or difficulty of performing the behavior (Ajzen, 1991, p. 188)

Perceptions – an individual's views and intentions of a behavior (Ajzen, 1991, p. 188)

Preservice – post-secondary students preparing to become teachers

Subjective or social norm – the perceived social pressure to perform or not to perform the behavior (Ajzen, 1991, p. 188)

Vocational agriculture – the systematic instruction in agriculture for the purpose of preparing persons for initial entry or reentry into agricultural occupations (Phipps, Osborne, Dyer, Ball, 2008)

Chapter II

Literature Review

Agriscience or agricultural science has been a major movement in the past few decades. In 1998, The National Research Council released their publication, *Understanding Agriculture,* which called for more science integration into agriculture education. Buriak (1992) defines agriscience as "instruction in agriculture emphasizing the principles, concepts and ways of science and their mathematical relationships supporting, describing, and explaining agriculture" (p. 4). Agriscience is integrating science concepts into the existing agricultural education curriculum. Agricultural education has been focused on developing agricultural knowledge that students need for their future careers.

Since the change from vocational agriculture to agriscience, the preparation needed for students' futures has taken an integrated approach. Integrated curriculum makes connections to other subjects or real-life. There are multiple ways of defining integrated curriculum but for this study, Shoemaker's (1989) definition will be used. "Integrated curriculum cuts across subject matter lines bringing together various aspects of the curriculum into meaningful association" (Shoemaker, p.5, 1989). An example of integrated curriculum includes plant science and biology concepts (photosynthesis and respiration). With the push for agriscience starting in the late 1980s from various agencies (i.e. the American Association for the Advancement of Science and the National Research Council), research on agriscience has expanded to include everyone who may be affected, such as teachers and students. Teacher perceptions, students' achievements, and preservice teacher perceptions have all been researched in a variety of manners.

Agriculture Teacher Perceptions

Agriculture teacher perceptions of integrating science into agriculture are positive and they feel competent in teaching science (Roberts, Scales, Torres, 2009). Many agriculture teachers also believe that science credit should be awarded for science integrated agriculture courses (Johnson, 1996). There are many positives that agriculture teachers see with integrating science into agriculture including additional support from administration, counselors, and other teachers (Osborne & Dyer, 1998; Warnick & Thompson, 2007; Warnick, Thompson, & Gummer 2004; Johnson & Newman 1993; Thompsonm 2001; Dyer & Osborne, 1999; Woodard & Herren, 1995). An additional benefit is the belief that agriscience coursework is appropriate for all students, whether they were going to college or not (Newman & Johnson, 1993).

Initially, science integration was seen positively from agriculture teachers who ‘felt that the instructional materials and learning activities were appropriate’ (Newman & Johnson, 1993, p. 56). Agriculture teachers were not pleased with the amount of science integration that they were currently incorporating, and a majority said that they would increase the amount of integration from what was done previously (Myers & Washburn, 2008). Agriculture teachers use multiple methods of integration and depend on their preservice preparation coursework to integrate science content into their curriculum (Stubbs & Myers, 2016). One example of integration included using the scientific method in conducting research on growth of plants. Stubbs and Myers (2016) found that teachers used old notes from college agriscience courses that emphasized science and technology, to create new curriculum for their classrooms with assistance from online material. With teachers' perception of science integration being positive, students benefit by understanding science concepts with real life examples (Thoron & Myers, 2010).

Warnick and Thompson (2007) have found many barriers of integrating science into agriculture curriculum. Barriers to integration include lack of time to prepare, materials and funding, lack of science integration prep in preservice programs, and distance between agriculture and science classrooms. Agriculture teachers felt positive about integrating science into agriculture curriculum but are not proficient enough to teach it. Scales, Terry, and Torres (2009) found that less than 10% were proficient in teaching science but with the majority believing they were proficient. The in-service teachers' perceptions of ability to be proficient in science concepts is starkly different than the reality. The lack of proficiency and barriers found in current agriculture teachers led to multiple recommendations to look at more professional development for science integration and preservice preparation program requirements.

Students' Achievements and Attitudes Towards Science Integration into Agriculture

Students' views of science integration into agriculture are also positive. When taking biology with an agriculture focus, students had a favorable view on agriculture and agriscience content (Balschweid, 2002). Students believed they understood biology concepts better with the agriculture focus better than traditional biology courses (Balschweid, 2003). Agriscience students produced similar or better scores than non-agriscience students on the science portion of various standardized tests (Connors & Elliot, 1995; Chiasson & Burnett, 2001; Theriot & Kotrlik, 2009). Mabie and Baker (1996) found that when introducing agriculture with a science focus to elementary students, positive correlations were found in their observational, communication, and comparison science skills. With an increase in science integration in agriculture, student demographics in the classroom could change to include more high achieving and average achieving students (Myers & Washburn, 2008). Along with new student demographics in agriculture courses, agriculture educators perceive a general increase of students enrolled in their programs (Myers &Washburn, 2008) due to the potential of taking agriscience courses for science credit.

Preservice Perceptions of Science Integration

With past research pertaining to in-service and preservice teacher perceptions of science integration into agriculture (Conroy & Walker, 2000; Layfield et al., 2001; Myers et al., 2008; Myers & Washburn, 2008; Thompson & Balschweid, 1999; Thompson & Schumacher, 1998; Thompson & Balschweid, 2000; Thoron & Myers, 2010; Scales, Terry, & Torres, 2009) recommendations for practice have included incorporating more science coursework in preservice programs, assisting preservice teachers obtain their science endorsement, and providing direct instruction on how to integrate science into curriculum (Thompson & Balschweid, 2000; Thoron & Myers, 2010; Scales, Terry, & Torres, 2009). Preservice teachers' perceptions of science integration focus on barriers, with a majority reporting lack of experience of science integration as the primary obstacle (Thoron & Myers, 2010). Other obstacles included lack of science content background, and general dissatisfaction of the agriculture content coursework due to the quality, quantity, and transferability; the general dissatisfaction was due to disconnect between content being taught in the teacher preparation programs and the application of the content to the high school classroom (Rice & Kitchel, 2015). Preservice teachers also felt that they were not experts in all agriculture content but were interested in emphasizing areas in agriculture by receiving additional certifications in the science realm (Rice & Kitchel, 2015). This includes biology in the agriculture field such as plant or animal sciences.

Benefits regarding science integration for preservice teachers include: students being better prepared in science after completing a course in agriculture education and ease of understanding an agriscience curriculum (Thoron & Myers, 2010). Preservice teachers' backgrounds and interests allow them to be comfortable teaching certain topics. Preservice teachers identified personal interest in a subject as a motivator when preparing lessons and that the preservice teachers were more likely to teach topics that they enjoy (Rice & Kitchel, 2015).

Conceptual Framework

The theory of planned behavior postulates that a person's behavior is strongly influenced by their intentions to act (Ajzen, 1991). These intentions focus on three items: personal attitudes, subjective (social) norm, and perceived behavior control. The more favorable prior background or attitude and subjective norm, the greater the perceived behavior control (Ajzen, 1991). The more favorable the perceived behavior control, the more likely the intention to the behavior will be acted on (Ajzen, p.188, 1991).

The attitudes of a behavior are influenced by prior background or what the person already knows. Positive attitudes have been an indicator with science integration into agriculture curriculum (Thompson & Balschweid, 2000). Niess (2001) states that preservice teachers integrate new information with prior knowledge of the subject. Stubbs and Myers (2016) found that teacher perceptions were influenced by their education experiences. Tolbert, Conroy, and Dailey (2000) stated "a brand new teacher would fall back on what they are comfortable with teaching" (p. 57). Preservice agricultural educators have indicated that they would not take other courses outside of their comfort zone (Rice & Kitchel, 2017). Davis and Falba (2002) stated a "lack of knowledge" (p.12) is a reason that preservice teachers do not integrate science.

Subjective or social norm is the perceived social pressure to perform the behavior. Subjective norm of integrating science into agriculture curriculum has been evaluated of in-service and preservice agriculture teachers (Conroy & Walker, 2000; Layfield et al., 2001; Myers et al., 2008; Myers & Washburn, 2008; Thompson & Balschweid, 1999; Thompson & Schumacher, 1998). Researchers have found a belief of science concepts being easier to understand in agriculture curriculum, agriculture teachers enjoy teaching agriscience courses, and belief that agriculture is an applied science. Thoron and Myers (2010) found that preservice agriculture teachers perceive that there is positive support with integrating science into agriculture.

Perceived behavior control refers to the difficulty or ease of performing a behavior and reflections from past experiences (Ajzen, 1998). Perceived behavior control is closely related to self-efficacy as it extends off of self-efficacy. "Perceived self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). Self-efficacy is about believing they can perform the behavior with difficult obstacles (Ajzen, 1998). A person's belief of completing a task is similar in determining one's belief of how much ease or difficulty in completing said task. Preservice teachers face difficulties during their coursework and have many foci. Preservice teachers are focused on teaching strategies, goals, new knowledge of subject matter, pedagogy, schools, instructional settings, and curriculum (Shulman, 1986). McKim and Velez (2017) found preservice teachers had low self-efficacy of science. Lack of competence and self-efficacy can be developed by mastery and vicarious experiences (McKim & Velez, 2017).

Figure 1 below shows Ajzen's model for Theory of Planned Behavior. Background factors influence behavioral, normative, and control beliefs which feed into the attitude toward the belief, the perceived norm, and perceived behavioral control respectively. Ajzen (1998) states 'as a general rule, the more favorable the attitude and subjective (perceived) norm with respect to the behavior, and the greater the perceived behavioral control, the stronger should be an individual's intention to perform the behavior under consideration' (p. 188, 1991). The intention and actual control of the behavior will determine the behavior.

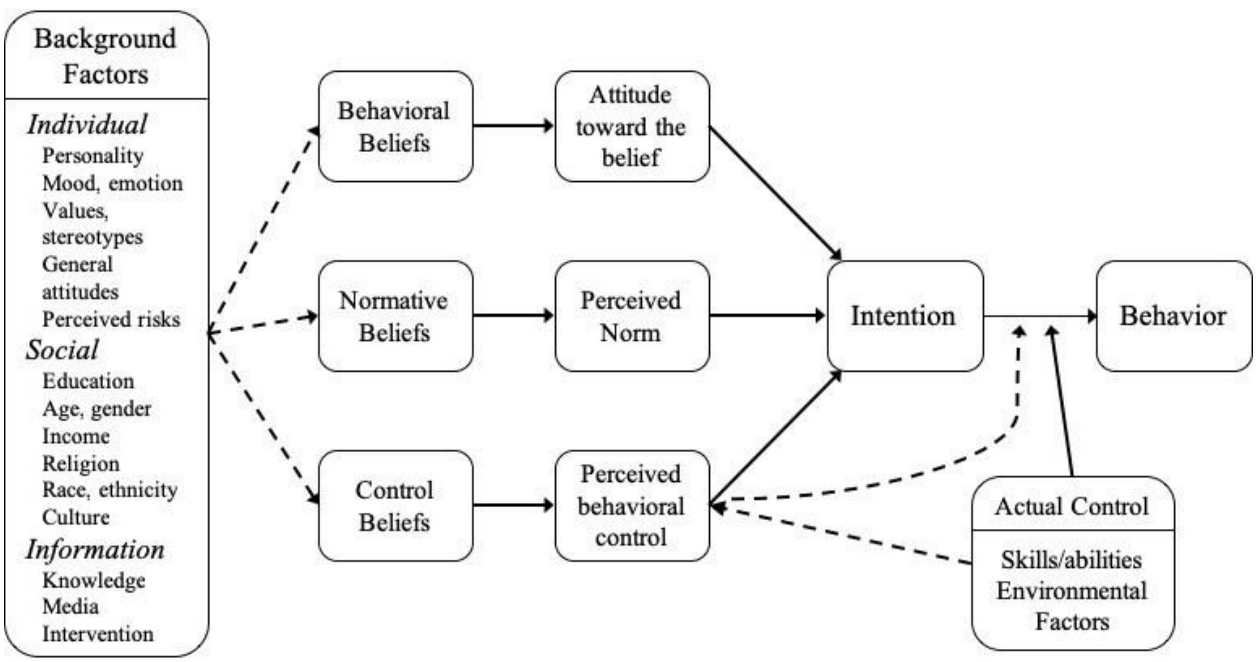

Figure 1. Theory of Planned Behavior

South Dakota State University has made changes for the Agricultural Education program with changes to science coursework, early field experiences, and cooperation with other preservice academic teachers. With these changes, students' perceptions of science integration could be impacted. These changes influence this study as it could result in different perceptions of science integration than previous research has found with preservice agriculture education students.

Since 1988, agriculture education has integrated more science or become agriscience education (Wilson & Curry, 2011). Hawkin's (1990) found that there is a loop in history and when more students are exposed to 'poor integration', or failure to make connections between content areas, they in turn become teachers, that will also have 'poor integration' when teaching. Thoron and Myers (2010) state that the loop has expanded enough to include preservice agriculture teachers to have been exposed to more science integration. Current preservice agriculture education teachers have been exposed to agriscience fully without any gaps of agriscience focus in the field. The model being used for this study is adapted from Ajzen's Theory of Planned Behavior and can be found in Figure 2.

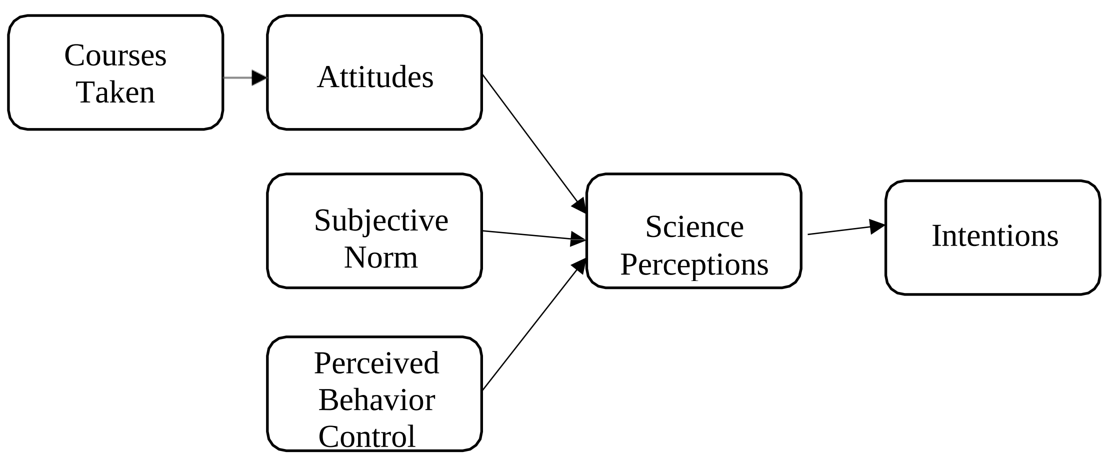

Figure 2. Modified Theory of Planned Behavior

The modified model focuses on how prior background or courses taken influences attitudes and how the attitudes, subjective norm, and perceived behavior control influence the perceptions then intentions. The attitudes of science integration are determined by the amount of science and agriscience coursework taken. The more courses taken during high school and post-secondary, the more favorable attitude. The theory of actioned research works with the theory of planned behavior with focusing on background variables. Background variables can influence behavior by affecting the attitude, normative, and control beliefs (Ajzen & Albarracin, 2007). The modified version was used to breakdown and analyze how each variable (prior background/courses taken, subjective norm, and perceived behavior control) relate to each other. With the purpose of assessing preservice agriculture teachers' perceptions of integrating science concepts into agriculture, the theory of planned behavior allows to understand how prior background, social norm, and perceived control influence the perceptions of integrating science into agricultural education curriculum.

Chapter III

Methods

Purpose and Objectives

The primary purpose of this study was to assess preservice agriculture teachers' perceptions of integrating science concepts into agriculture based on the theory of planned behavior. The specific objectives of the study were to:

1. Determine what courses preservice agriculture teachers have taken in science and agriculture science
2. Determine the relationship of subjective norm and perceived behavior control to perceptions of integrating science into agriculture curriculum
3. Determine the interrelationships of courses taken, subjective norm, and perceived behavior control on perceptions of science integration into agriculture curriculum

Survey

A survey was done to collect information from the sample population. An online survey was chosen as the sample population had easy access to complete the survey (Dillman, 2014). To assess preservice agriculture teachers' perceptions of integrating science concepts into agriculture based on the theory of planned behavior, breaking down the survey into sections for the objectives allowed for ease for the researcher.

Development of Questionnaire

The questionnaire was developed through adaptation of several preexisting instruments. These instruments include Myers and Washburn's (2008) instrument on how in-service agriculture teachers felt about science integration into agriculture. An adapted version was used to measure the subjective norms. An example item was: *I believe* *science concepts are easier to understand in agriculture courses.* The original instrument stated: *Science concepts are easier for students to understand when science is integrated into the agricultural education program.*

The Science Teaching Efficacy Belief Instrument by Riggs and Knoch (1990) was chosen because self-efficacy is closely linked to perceived behavior control. Example items included: *I understand science concepts well enough to be effective in teaching secondary science* and *I believe I am able to answer students' science questions*.

Prior background was collected by using a survey of undergraduate requirements for agricultural education majors, science courses offered in secondary schools in the local tristate area (South Dakota, Minnesota, and Iowa), and an other option to provide other courses students may have taken that are science related that were not listed. The local tristate area was chosen as a majority of students who attend South Dakota State University are from this area. Required and elective science courses and were found on their respective Department of Education websites and included in the instrument. Subjective norm and perceived control used a 6-point Likert scale. Face and content validity were determined by faculty of agricultural education at South Dakota State University along with non-agricultural education undergraduate students.

<u>Pilot Test for Instrument</u>

A pilot test was conducted with the current student teachers from South Dakota State University during the Spring 2019 semester. Nineteen student teachers were contacted over a fourteen-day period. The pilot test group was sent an initial email with five follow-up emails which yielded a response rate of 66.6% (n = 12). Post-hoc analysis found Cronbach's alpha for social norm and perceived control were 0.633 and 0.696

respectively. Nunnally (1978) states with preliminary research, Cronbach's alpha between 0.5 and 0.7 is acceptable. Table 1 below shows the initial findings from the pilot test with averages found. An average of four science courses were taken during high school and an average of fifteen agriculture or science courses was found to be taken during post-secondary. Social norm was found to be positive on the Likert scale to integrate science into agriculture curriculum. Perceived control was also positive on the Likert scale with preservice student teachers believing they could integrate science into agriculture curriculum. The Likert scale ranged from 1 to 6 with 1 being strongly disagree and 6 being strongly agree.

Table 1

Construct Results	*M*	*SD*
Number of High School Science Courses	4.58	1.16
Number of Collegiate Science/Agriscience Courses	15.58	1.78
Social Norm	4.90	0.60
Perceived Control	4.16	0.81

Note. Items were on a 6-point Likert scale.
n = 12

Census Population

The sample population included current agriculture education, communication, and leadership undergraduate majors with a declared emphasis in education, with sophomore or above standing. The population was selected as the students have intentions of becoming agriculture educators and will shape the future of agricultural education. Students' emails for distribution were collected from a university email list serv. The total sample population was 26 students. Demographics were collected from the sample population which included: gender, year in undergraduate, and home state. Eighty preservice agricultural education majors were initially contacted with an initial email with seven follow-ups with a response rate of 32.5% (n=26). The average preservice agriculture education major was a female (73.08%) junior (50.00%) from Minnesota (61.54%).

Distribution of Instrument

An online survey using QuestionPro was administered to the sample population through email. The email contained information about the survey along with a link to the survey. By clicking on the link, participants were implying their consent. The online survey was easily accessible on mobile computing devices which allowed the target population to complete the survey and overcomes the challenge today of electronic surveys (Dillman, 2014). The sample population was offered an initial email with a link to the survey and was sent a reminder six times over a seventy-day period. Dillman (2014) states that when giving web surveys, respondents need to be given an adequate amount of time to respond before reminders are sent. One should also not allow too much time to pass so that the initial request is not forgotten (Dillman, 2014, p. 336).

Data Analysis

Objective 1 for prior background averaged the number of courses for both high school science courses and post-secondary science and agriscience courses. Objective 2 used a Pearson Correlation to find a relationship for social norm and perceived control to the perceptions of integrating science into agriculture curriculum. Objective 3 used a linear regression analysis to determine the perceptions of integrating science into agriculture curriculum with prior background, social norm, and perceived control compared to the perceptions.

Chapter IV

Results

Objective 1 sought out to determine what prior background or courses taken preservice agriculture teachers have for science and agriculture science (see Table 2). The mean score for high school science courses was 4.96 (2.93). The mean score for high school science courses was higher than the required graduation needs for the tristate area (South Dakota, Minnesota, and Iowa). South Dakota, Minnesota, and Iowa require 3 credits of high school for graduation. The mean for post-secondary science and agriculture coursework resulted in 14.07 (7.31). Post-secondary coursework requires a minimum of 14 science/agriculture science courses for graduation. Post-secondary science and agriculture coursework varied due to students at different stages in their post-secondary work while taking the same coursework.

Table 2

Courses Taken	M	SD
High School Science	4.96	2.93
Post-Secondary Agriscience	14.07	7.31

Notes. n = 26

Objective 2 sought out to determine the relationship for social norm and perceived control to perceptions of integrating science into agriculture curriculum. The average for social norm and perceived control were 5.02 (0.69) and 4.34 (0.70) respectively. A Pearson correlation resulted in a significant result (p <.05) for both social norm and perceived control to perceptions (see Table 3).

Table 3

Variable	n	M	SD	*p*	*r*
Social Norm Construct	26	5.02	0.69	0.01	0.54
Perceived Behavior Control	26	4.34	0.70	0.00	0.75

Note. SNM and PBC Scale: 1=Strongly Disagree; 2=Disagree; 3=Slightly Disagree; 4=Slightly Agree; 5=Agree; 6=Strongly Agree
n = 26

Objective 3 sought out to determine the influence courses taken, social norm, and perceived control on perceptions of integrating science into agriculture curriculum. Courses taken was not found to be a significant factor during analysis of the linear regression due it being a constant. The analysis of science integration into agriculture curriculum perceptions resulted in a statistically significant model ($p < 0.5$), which accounted for 61% of the variance (see Table 4). Significant factors included social norm and perceived behavior control to perceptions with courses taken not being significant.

Table 4

Variable	ß	SD	t	*p*
Constant	2.248	0.50	4.50	0.00
Social Norm Construct	0.209	0.10	2.20	0.04
Perceived Behavior Control	0.446	0.09	4.79	0.00

Note. $R^2_{Adj} = .61$ $*p < .05$
n = 26

Chapter V

Discussion

The study has some limitations. Only preservice agriculture education majors from South Dakota State University were surveyed. This does not represent preservice perceptions on the national scale for science integration. Secondly, a limitation is the small sample size and low response rate does not make this a generalizable study. Another limitation is the social desirability bias as students respond positively to science integration due to feeling the need to respond positively. These results are not generalizable and should only be applied to the population of this study.

The first objective sought to determine prior science and agriscience background for preservice agriculture education majors. Prior background was defined as high school science courses and post-secondary science and agricultural science courses completed. Preservice teachers, on average, took more science courses in high school than required in the tristate area (South Dakota, Minnesota, and Iowa). The number of completed post-secondary course work for preservice agriculture majors varied greatly due to students being at different stages in their post-secondary coursework. On average, students had completed 14 courses of science and agricultural science. With above average and average science and agriscience coursework, preservice teachers can integrate new information with prior knowledge (Niess, 2001). The prior knowledge from courses taken in science and agriscience could help preservice teachers more easily integrate science into agricultural curriculum. Future research should explore agriculture courses taken in high school with science courses.

Objective 2 sought to determine if a relationship between the social norm and perceived control of integrating science into agriculture curriculum exists. Preservice teachers on average had agreed with social norm of integrating science into agriculture curriculum. The social norm of integrating science into agricultural curriculum aligns with previous research of in-service agriculture teachers, who held positive attitudes about science integration into agriculture curriculum (Roberts, Scales, Torres, 2009, Osborne & Dyer, 1998; Warnick & Thompson, 2007; Warnick, Thompson, & Gummer 2004; Johnson & Newman 1993; Thompson 2001; Dyer & Osborne, 1999; Woodard & Herren, 1995, Newman & Johnson, 1993).The participants slightly agreed with being able to integrate science (the perceived control construct). Previous research of in-service agriculture teachers' barriers of integrating science follow a similar trend of positive perceived control. Perceived control of preservice agriculture education majors could be attributed to not feeling like content experts in agriculture but wanting to provide a science emphasis (Rice & Kitchel, 2015).

There was significant correlation for social norm and perceived control for the perceptions of integrating science into agricultural curriculum. Ajzen's Theory of Planned Behavior postulates that the more positive the attitude and social norm, the more positive perceived control (1998). With a positive social norm and slightly positive perceived control, correlations for social norm to perceptions and perceived control to perceptions was significant. Due to the high correlation between perceived control and perceptions, agricultural education professors could provide more experiences to build on the perceived control or ability of science integration as recommended from previous research (Thompson & Balschweid, 2000; Thoron & Myers, 2010; Scales, Terry, & Torres, 2009).

Objective 3 sought out to determine the influence of prior background, social norm, and perceived control on perceptions of integrating science into agriculture curriculum. Prior background was not deemed statistically significant due to everyone taking the same coursework. Social norm and perceived control are influential for the 61% variance among those surveyed. This aligns to previous research of perceptions of in-service and preservice agriculture teachers and recommendations (Conroy & Walker, 2000; Layfield et al., 2001; Myers et al., 2008; Myers & Washburn, 2008; Thompson & Balschweid, 1999; Thompson & Schumacher, 1998; Thompson & Balschweid, 2000; Thoron & Myers, 2010; Scales, Terry, & Torres, 2009). Ajzen (1998) states, 'as a general rule, the more favorable the attitude and subjective (perceived) norm with respect to the behavior, and the greater the perceived behavioral control, the stronger should be an individual's intention to perform the behavior under consideration' (p. 188). Social norm and perceived control were found to be significant factors in the perceptions for preservice agriculture education majors.

The prior background or courses taken for preservice agriculture education majors is seen as average or above average dependent on their completion of their program. Future research for prior background includes analyzing high school agriculture courses taken along with science courses and post-secondary coursework. Another area of study for the prior background is to analyze post-secondary science and agriculture coursework from agriculture education programs across the nation.

The high social norm aligns with previous research of preservice and in-service agriculture teachers with science integration being apparent in post-secondary coursework, in-service agriculture teachers' classrooms, and agriculture educators enjoying science integration(Osborne & Dyer, 1998; Warnick & Thompson, 2007; Warnick, Thompson, & Gummer 2004; Johnson & Newman 1993; Thompsonm 2001; Dyer & Osborne, 1999; Woodard & Herren, 1995). Perceived control of science integration with the social norm agrees with Scales, Terry, & Torres (2009) findings of in-service teachers believing that they are able integrate science but not being proficient to do so. Future research includes assessing preservice agriculture education majors' knowledge of science content with a standardized test to see if they are proficient enough to teach science content.

With positive perceptions of integrating science into agricultural curriculum from preservice agriculture education majors, the profession can start expanding on areas of improvement for science integration for preservice teachers. Thoron and Myers (2010) found positive perceptions of preservice agriculture education majors for science integration in to agriculture curriculum with needs to increase science content and preparation of science integration. With an expansion of the loop of preservice agriculture teachers being exposed to agriscience, more positive perceptions can be seen in the profession. Future research recommendations include assessing preservice teachers from multiple teacher preparation programs in multiple states. Secondly, assess what is beneficial for science integration. This could include assessing perceptions of needs for science integration from beginning in-service agriculture teachers (1-5 years of teaching) that teach agriscience or agriculture curriculum with science integration. This could include courses taken, professional development, and emphasis in preparation program. Another recommendation is to assess post-secondary agricultural education professors' perceptions of science integration into agricultural curriculum. Agriculture education professors' perceptions could influence preservice and in-service teachers' perceptions of science integration.

Positive perceptions of science integration into agricultural curriculum for preservice agriculture education teachers aligns with prior research of preservice and in-service perceptions. Agricultural education professors can continue to evaluate preservice needs for science integration, match preservice teachers with in-service teachers who integrate science into agriculture curriculum, and provide collaboration with preservice science teachers. The continued support and evaluation for preservice agriculture teachers could result in positive intentions to integrate science into agricultural curriculum.

Appendix

Survey Instrument

What grade level are you in? (drop down)

1. Sophomore
2. Junior
3. Senior
4. Other

Where are you originally from (drop down)

1. South Dakota
2. Minnesota
3. Iowa
4. North Dakota
5. Nebraska
6. Other

What is your gender (Drop down)

1. Male
2. Female
3. Prefer not to say

Do you intend to pursue science certification? (multiple choice

1. Yes
2. No

What science classes did you complete in high school? (select all that apply)

1. Physical Science
2. Earth/Space
3. Biology
4. Biology 2 or Anatomy/Physiology
5. Chemistry
6. Chemistry 2 or Organic Chemistry
7. Physics
8. Environmental Science/Ecology
9. Zoology
10. AP Courses
11. Dual Credit
12. Other ___________

What college courses have you taken or currently enrolled in? (select all that apply)

1. Biology 101
2. Biology 103
3. Biology 151

4. Biology 153
5. Chemistry 106
6. Chemistry 108
7. Chemistry 112
8. Geography 131
9. Geography 132
10. Physics 101
11. Animal Science 101
12. Livestock & Marketing
13. Meat Science
14. Horticulture
15. Crop Production
16. Soils
17. Dairy Foods
18. Dairy Science
19. Food Science
20. Wildlife & Fish Management
21. Intro to Natural Resources Management
22. Electricity
23. Engines
24. Welding
25. Construction
26. Other science based courses at SDSU please list

Please answer each statement
Science Concepts definition: not limited to or bounded by these means, just examples: Photosynthesis/respiration, reproduction, chemical reactions, nutrition, classifying, ecosystems, scientific method, erosion, physical properties of matter, simple and complex machines.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
I have observed science concepts in an agriculture classroom						
My agriculture teacher demonstrated science concepts in class						
I believe agriculture is an applied science						

I enjoy agricultural science/agriscience						
My agriculture professors make connections to science concepts in lecture/lab						
I have seen peers use science concepts in a lesson						
I believe science concepts are easier to understand in agricultural courses						
I believe agriculture is easier to understand with science concepts						
I believe science credit should be offered for agricultural courses						

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
I want to know the steps necessary to teach science concepts effectively						
I want to find better ways to teach science						
I am not very effective in monitoring science experiments						

I understand science concepts well enough to be effective in teaching secondary science						
When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better						
When teaching science, I usually welcome student questions						
I intend to teach a science lesson						
I believe I am able to answer students' science questions						

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