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Perceptions of Preservice Teachers Toward Integrating Science Into School-Based Agricultural Education Curriculum

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Agricultural education is at an interesting point in the cycle of agriscience integration. Current preservice teachers have had the opportunity to be taught in both secondary and post-secondary programs that have fully embraced agriscience integration. This study investigates the perceptions of these budding agricultural educators toward science integration. The perceptions of 191 preservice teachers who responded to the questionnaire concurred with most perceptions of inservice teachers as reported in other studies. Preservice teachers indicate an intention to increase the amount and quality of integration in their future classrooms compared to what they perceive occurring today and that this will result in an increase in student enrollment. They also suggested increasing the number of science courses in the preservice curriculum and placing student teachers with inservice teachers who have successfully integrated science in agriculture.

Introduction

Over the past two decades there has been a call for increased science learning opportunities for students while promoting a reformed method of teaching science in classrooms (American Association for the Advancement of Science [AAAS], 1989; 1993; National Commission on Excellence in Education [NCEE] 1983; National Research Council [NRC], 1996). Effective agricultural programs use science contexts to allow students to think critically, explore phenomena, and solve meaningful everyday problems (Phipps, Osborne, Dyer, & Ball, 2008). Despite this agreed importance of science, Weiss (1997) noted that science education research indicated the tendency to minimize science instruction in curricula not traditionally perceived as core science.

Investigating the next generation of agriscience educators will build upon the current body of knowledge regarding the status of the integration of science into the agriculture curriculum. Preservice teachers' ability to teach topics or units depends on their view and understanding of the subject (Wilson, 1994). Weiss (1997) noted experience and/or background with content and processes are important for science utilization in classrooms. Another study conducted by Davis and Falba (2002) stated a "lack of knowledge" (p. 12) as a reason why preservice teachers do not incorporate science processes.

Davis and Falba (2002) noted the importance of preservice programs that model the experiences for their students. Preservice teachers who felt prepared to integrate technology in their teaching had at least one methods class that modeled the instruction (Willis & Mehlinger, 1996). Preservice teachers are occupied in formulating their teaching strategies based upon beliefs, goals, new knowledge of subject matter, pedagogy, schools, instructional settings, and curriculum (Shulman, 1986). This leads to the importance of the identification of barriers and competencies of preservice teachers providing the profession with a way to gauge integration.

Niess (2001) stated preservice teachers integrate new knowledge with their prior understandings for teaching the subject. Hawkins (1990) pointed out "a loop in history"

(p. 97) by which some children grow to be teachers having been taught science "little and poorly" in lower grades; thus they teach "little and poorly" (p. 97). Taking into account Hawkins' findings, science integration into agricultural education is going to occur slowly as that loop expands and science knowledge and teaching ability increase.

Identification of barriers and competencies of preservice teachers is an important way to gauge integration. Much research has been conducted in agricultural education to indicate benefits or perceived benefits of science integration. Whent and Leising (1988) looked at science integration through secondary agricultural education programs offering science credit for agriculture courses. Additional science integration research indicated benefits or perceived benefits (Conroy & Walker, 2000; Enderlin & Osborne,1992; Enderlin, Petrea, & Osborne, 1993; Johnson, 1996; Roegge & Russell, 1990). Whent (1992) reported teacher reluctance to change from a traditional curriculum due to a perception that integration threatened program viability. Conversely, Thompson and Schumacher (1998) stated that science integration could improve the image and quality of agriculture programs.

Thompson (1998) studied the results of agriscience in public schools determining integration of science will "academically strengthen vocational courses and make academic courses more relevant" (p. 77). Chiasson and Burnett (2001) followed up with a study in Louisiana, reporting that agricultural education helped increase science scores on state standardized tests. Conners and Elliot (1995) also found that students enrolled in agriscience education scored better on standardized tests than peers not enrolled in agriscience.

A significant amount of research has been conducted to establish attitudes and perceptions of current teachers toward science integration (Balschweid, 2002; Balschweid & Thompson, 1999; 2002; Connors & Elliot, 1994; Dyer & Osborne, 1999; Johnson & Newman, 1993; Layfield, Minor, & Waldvogel, 2001; Myers, Thoron, & Thompson, 2008; Myers & Washburn, 2008; Newman & Johnson, 1993; Peasley & Henderson, 1992; Thompson, 1998; Thompson & Balschweid, 1999; Warnick & Thompson, 2007; Washburn & Myers, 2008; Welton, Harbstreit, & Borchers, 1994). Studies overwhelming report the willingness of teachers to integrate and positive perceptions toward science integration in agricultural education.

Agriscience education is at a unique point of the loop as described by Hawkins (1990). Preservice teachers learn and have learned from mentors and former teachers (Shulman, 1986). So if the next generation of teachers is shaped by the previous, it becomes understandable why integration takes decades (or generations). The agriscience loop is unique because after nearly twenty years agricultural education is starting to develop preservice teachers who were taught in classrooms with openly recognized science integration. This loop in time makes it valuable to gauge preservice perceptions and begin to address integration and teacher perceptions.

Ajzen and Madden's (1986) Theory of Planned Behavior served as the theoretical frame for this study. The theory states that one's behavior is directly driven by one's intention to perform the behavior. Attitude, subjective (social) norm, and perceived behavioral control influences intention. Based on the study conducted by Myers and Washburn (2008), attitudes are operationalized as preservice teacher perceptions toward integration of science. Subjective (social) norms were operationalized from the stakeholder groups' perceived support toward the agricultural education program. Preservice teacher perceived barriers to integrate science and integration's effect on student enrollment operationalized perceived behavioral control. The assumption to the research is that negative preservice teacher attitudes toward integration, perception of norms contrary to integration, negative stakeholder impact, or lack of control of curriculum would create a negative perception to integrate science.

Purpose and Objectives

The purpose of this research was to ascertain how preservice agriscience teachers perceived barriers to science integration, attitudes toward integration, level of support from stakeholder groups, perceived competence of preservice agricultural education teachers in integrating science, and perceived impact integration has on student groups in agricultural programs. To successfully meet the purposes of the study the following research objectives were developed:

1. Describe the perceptions of preservice agricultural education teachers toward the integration of science into the agricultural education curriculum.
2. Describe the perceptions of preservice agricultural education teachers regarding barriers to integrating science into the agricultural education curriculum.
3. Describe preservice agricultural education teachers' perceptions concerning the impact of science integration on student enrollment in agricultural education programs.
4. Describe preservice agricultural education teachers' perceptions concerning the impact of science integration on the support they receive from various groups.
5. Describe the perceived competence / preparation level of preservice agricultural education teachers to integrate science into the agricultural education curriculum.

Methods

A descriptive survey research design was used in this study. In one section an index was created to better describe impact of integration on support. The instrument utilized in this study was based on an instrument used by researchers in agricultural education studying varying groups of agriscience teachers (Thompson & Schumacher, 1998). The items in the instrument were modified slightly, when appropriate, to meet the objectives of the study. The instrument was modified to have language appropriate for preservice teachers as compared to the original instrument being created for inservice teachers. Teacher responses were measured on a summated rating scale consisting of five categories. Categories were fully labeled beginning with strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. Faculty, administrators, and graduate students from the state land grant university formed the panel of experts and reviewed the instrument for face and content validity. The authors of the original attitudinal instrument reported internal consistency using Cronbach's alpha of 0.88 (Thompson & Schumacher, 1998). A post-hoc reliability analysis of this administration of the slightly revised instrument revealed a Cronbach's alpha coefficient of 0.81 for all items within the instrument.

The population for the study was preservice agricultural education teachers. A convenience sample was drawn (n = 585) from 29 different institutions across the United States. Every university preparing secondary agriscience teachers was asked to participate through a departmental contact. Information was shared with students via individualized list serve e-mails. Students were asked to participate or opt out. Students from 29 of the 79 teacher training institutions elected to participate.

The instrument was administered through an electronic survey utilizing Dillman's Tailored Design Method (2007) to achieve optimal return rate. Data were gathered from 191 members of the population (33% response rate). Cook, Heath, & Thompson (2000) found similar response rates across their meta–analysis study of web surveys. Response rate was uniformly low across all geographical regions with no region responding at a rate higher than 40%. To help control for non-response error, comparison between early and late responders was utilized using a t-test (Ary, Jacobs, Razavieh, & Sorensen, 2006). The subsequent t-values indicated no statistical significance between early and late respondents across all criteria. Findings from this study are not generalizable to individuals beyond this population. Descriptive statistics were used to analyze the data and one index was created to describe variables for objective four. There was also an open ended comment area.

Findings

Demographic information of the respondents was collected. More than half reported being upper division preservice teachers (62%). Nearly two-thirds were female (63%). The largest percentage of preservice teachers reported they plan to teach high school (74%), followed by a combination of middle and high school (20%); 6% reported planning to teach middle school.

The first objective of this study was to describe the perceptions preservice teachers toward the integration of science into the agricultural education curriculum. More than 9 out of 10 respondents (91%) reported they perceive students will be better prepared in science after completing a course in agricultural education that integrated science. Preservice

teachers agreed (87%) that science concepts are easier for students to understand when science is integrated into agricultural education (see Table 1). Additionally, 58% agreed it is easier for students to understand agriculture concepts when science is integrated into the program. Respondents agreed (74%) students learn more about agriscience when science concepts are integral to instruction. Slightly less than two–thirds (62%) of the preservice teachers also noted a perception that integrating science requires more preparation time than a more traditional curriculum (see Table 1).

Table 1
Preservice Teacher Perception Toward Integration of Science in Agricultural Education Curriculum

Statement	%A	%N	%D
Students are better prepared in science after they completed a course in agricultural education that integrates science.	91	8	1
Students are more aware of the connection between scientific principles and agriculture when science concepts are in integral part of their instruction in agricultural education.	88	8	4
Science concepts are easier for students to understand when science is integrated into the agricultural education program.	87	9	4
Students learn more about agriculture when science concepts are an integral part of their instruction.	74	20	6
Integrating science into agriculture classes increases the ability to teach students to solve problems.	73	23	4
Integrating science into the agricultural education program requires more preparation time than teaching a more traditional agriculture curriculum.	62	24	14
Agriculture concepts are easier for students to understand when science is integrated into the agricultural education program.	58	31	11
Students are more motivated to learn when science is integrated into the agricultural education program.	51	37	12
Integrating science into the agricultural education curriculum more effectively meets the needs of special population students.	44	36	20
It is more appropriate to integrate science in advanced courses than into introductory courses.	45	20	35
Less effort is required to integrate science in advanced courses as compared to introductory courses.	32	25	41

Note. n = 191. Original scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA)
Responses were collapsed into: Agree, Neither Agree or Disagree, and Disagree

The second objective of this study was to describe the perceptions of preservice agriculture teachers regarding barriers to integrating science into the agricultural education curriculum. Nearly three-fourths (74%) of respondents reported lack of experience in science integration as a barrier toward science integration. More than half (58%) noted they felt they had an insufficient background in science content (see Table 2). A majority of preservice teachers noted that insufficient time and support to plan for implementation (59%) and lack of perceived funding (59%) were also barriers to integration. Nearly half of the preservice teachers disagreed with the notion that lack of support from administration (45%) would be a barrier (see Table 2).

Table 2
Perceived Barriers to Integration in Agricultural Education Curriculum

Statement	%A	%N	%D
Lack of experience in science integration	74	15	11
Insufficient funding	59	24	17
Insufficient time and support to plan for implementation	59	20	21
Insufficient background in science content	58	28	14
Lack of integrated science curriculum in courses I plan to teach	49	26	25
Reluctance to diminish emphasis on agricultural production	49	25	26
Lack of support from local science teacher(s)	38	27	35
Doubts about students' capacity to handle material	36	26	38
Concerns about large class size	36	25	39
Reluctance to give up the role of primary source of classroom information	33	50	17
Disagreement with the notion that science integration is necessary	31	26	43
Lack of parent and community support for science integration	27	38	35
Lack of administrative support for science integration	23	32	45
Concerns about discipline	21	29	50

Note. n = 191. Original scale: 1 = SD, 2 = D, 3 = Neither A or D, 4 = A, 5 = SA
Responses were collapsed into: Agree, Neither Agree or Disagree, and Disagree

The third objective of this study was to describe preservice agricultural education teachers' perceptions concerning the impact of science integration on student enrollment in agricultural education programs. A majority of preservice teachers (53%) reported they were not content with the level to which their state currently integrates science. More than 96% of respondents noted that they plan to increase the amount of science integration in their curriculum compared to what they see being done in classrooms they visit. No respondent stated that they planned to decrease the amount of integration with the remainder (4%) reporting that they have no current plans to change from what they see modeled during their pre–service observations.

Preservice teachers perceived the greatest enrollment impact of integrating science would be an increase in the number of high achieving students (90%) in agricultural education programs (see Table 3). The second greatest impact would be an increase in the number of average achieving students (66%). A majority of preservice respondents (64%) reported the perception of increased science integration concepts would result in increased overall enrollment (see Table 3).

Table 3
Perceived Impact of Integrating Science on the Enrollment of the Certain Student Groups

Student Group	%I	%N	%D
High achieving students	90	9	1
Average achieving students	66	32	2
Total program enrollment	64	28	8
Social diversity (athletes, "popular" students, etc)	56	40	4
Minority students	33	46	21
Low achieving students	28	29	43

Note. n = 191. Original scale: 1 = Greatly Decrease (GD), 2 = Decrease (D), 3 = Neither Increase or Decrease (N), 4 = Increase (I), 5 = Greatly Increase (GI)
Responses were collapsed into: Decrease, Neither Increase or Decrease, and Increase

The fourth objective of this study was to describe preservice agricultural education teachers' perceptions concerning the impact of science integration on the support they receive from various groups. A majority of teachers perceived that support would increase from all

groups. The greatest increase in support was from administrators followed by parents of students. Respondents were asked to indicate their level of agreement (from greatly decrease = 1 to strongly increase = 5) on six descriptors of administrators, counselors, community members, parents, science teachers, and other teachers. An index was created using six items describing stakeholder support. Reliability analysis for these six items had a Cronbach's alpha of .83. Analysis indicated that the items form a construct, which accounted for 54.32% of the items' variance. Factor loadings were then used to compute the support from stakeholders toward science integration into the agricultural program (see Table 4). The index construction is based on 191 valid responses. A new variable was created to report the grand mean from the factor analysis of 3.93 with SD of .64 indicating perceived support from stakeholder groups to increase.

Table 4
Factor Loadings for Items Measuring Integration of Science into the Agricultural Education Program Support from Stakeholders.

Items	Loading
Local administrators	.66
Community members	.63
School Counselors	.62
Parents of students	.62
Other teachers	.59
Science teachers	.44
Eigenvalue	5.53
Percent of Variance Explained	54.32
Cronbach Alpha	.83

Note. Extraction Method: Principal Component Analysis

The fifth objective of this study was to describe the perceived competence / preparation level of preservice agricultural education teachers to integrate science into the agricultural education curriculum. As seen in Table 5, a majority of the respondents reported that they feel prepared to teach integrated biological science concepts (58%). However, less than half responded favorably toward preparation of teaching physical science concepts (45%). When respondents were asked to comment on teacher preservice activities, 67% suggested placing student teachers in an environment which models science integration, and a majority (54%) also agreed early field experiences should be conducted with cooperating teaching integrating science into their curriculum. Additionally, more than three-fourths of preservice respondents suggested agricultural teacher preparation programs should provide instruction for undergraduates on how to integrate science (88%) concepts / principles in agriculture.

Table 5
Preservice Teacher Perceived Preparation To Integrate Science

Statement	%A	%N	%D
Teacher preparation programs in agriculture should provide instruction for undergraduates on how to integrate science concepts/principles in agriculture.	88	8	4
When placing student teachers, teacher preparation programs should expect cooperating teachers to model science integration.	67	23	10
I feel prepared to teach integrated biological science concepts.	58	22	20
Teacher preparation programs should require that students conduct their early field experiences with a teacher who integrates science.	54	34	12
Teacher preparation programs in agriculture should require students to take more science courses.	46	24	30
I feel prepared to teach integrated physical science concepts.	45	28	27

Note. n = 191. Original scale: 1 = SD, 2 = D, 3 = Neither A or D, 4 = A, 5 = SA
Responses were collapsed into: Agree, Neither Agree or Disagree, and Disagree

Conclusions and Recommendations

The conclusions of this study were based on the responses of the preservice agricultural education teachers participating in the 2008 preservice teacher study for science integration (n = 191). Although other agriculture teachers who integrate science and preservice teachers not participating in the study may have similar perceptions, caution must be exercised when generalizing the results of this study beyond the population. Ajzen and Madden's Theory on Planned Behavior (1986) provides a framework for explaining the potential for integrating science into the agricultural education curriculum. The study concludes that since participants hold positive perceptions toward concepts concerning integrating science, there is potential to integrate more science into their agricultural education curriculum. The planned behavior model indicates that positive perceptions of the preservice participants toward integrating science into the agricultural education curriculum will influence intentions and behaviors.

Slightly less than two-thirds of the preservice teachers in the study were female (63%). Three quarters of the participants agreed there is a need to integrate more science into the curriculum, and 96% of the preservice teachers reported anticipation of teaching science in their curriculum.

Preservice teachers positively reported student benefits increase when science is integrated into the agricultural education curriculum. Findings of this study toward integrating science and agriculture are similar to previous research studying the perceptions of inservice teachers (Conroy & Walker, 2000; Layfield et al., 2001, Myers et al., 2008; Myers & Washburn, 2008; Thompson & Balschweid, 1999; Thompson & Schumacher, 1998). The integration of science into the curriculum will produce more science literate students (Myers et al.). Literate students in science will enable teachers to more easily connect theory into practice in their agricultural program. Additionally, preservice teachers perceived that not only will integration help the agricultural program but will provide students with better science knowledge in other science classes. Many respondents indicated, in the open ended responses, more motivated students in the learning environment creating more opportunities to solve problems when science is taught in the context of agriculture.

According to the preservice participants (see Table 5) the lack of understanding of science content is the biggest barrier to integrating science in the agricultural education curriculum. This is an important barrier as Davis and Falba (2002) stated a "lack of knowledge" as a reason why preservice teachers do not incorporate science processes. Teacher education institutions must heed the call to provide a stronger science background for preservice students.

The *National Science Education Standards* (NRC, 1996) stated, "If reform is to be accomplished, professional development must include experiences that engage prospective and practicing teachers in active learning that builds

their knowledge, understanding, and ability" (p.56). Preservice teachers need to have strong content knowledge (Wilson, 1994), but perhaps more importantly preservice teachers need to learn how to teach the material (Shulman, 1986). Willis and Mehlinger (1996) stressed the importance of preservice programs modeling the science methods. Participants indicted that cooperating teachers should model integration of science. Participants also indicated that teacher preparation programs in agriculture should provide instruction for preservice teachers on how to integrate science. Further, nearly half (46%) all of the preservice participants indicated the need to more science courses at the undergraduate level.

Niess (2001) stated preservice teachers first learn how to teach based on observing how they were taught in school. Preservice programs must expand the loop through modeling methods based upon scientific integration. Studies of Arkansas (Johnson, 1996), Florida (Myers & Washburn, 2008), Indiana (Balschweid & Thompson, 2002), Oregon (Warnick & Thompson, 2007), and South Carolina (Layfield, et al., 2001) indicated agriculture teachers all concurred with this recommendation. Preservice participants recognize the importance of integrating science into the agriculture curriculum. This should serve as an important reminder that teacher preparation programs should consider science integration when placing student teachers.

Preservice teachers indicated the need for more science courses in their teacher preparation program. Myers et al. (2008) also reported participants of the National Agriscience Teacher Ambassador Academy indicated the need for more science courses in the undergraduate program. Adding additional course work in an undergraduate curriculum may be challenging. However, faculty advisors can help students select a course of study that will prepare, challenge, and build their knowledge in science content. As future leaders across the country, it would be beneficial to involve the preservice participants in developing integrated curriculum, providing workshops, and enhancing efforts to integrate more science into the agriscience curriculum along with modeling integration. This finding differs from other studies on this topic when conducted with in-service teachers (Balschweid & Thomson, 2002; Thompson & Schumacher, 1998; Warnick & Thompson, 2007). Furthermore, lack of materials to integrate science was another perceived barrier by participants in this study.

Preservice teachers indicated that integrating science has an impact upon student enrollment in the agricultural education program. Preservice teachers perceived that increased enrollment, specifically from high achieving students, would be a result of integrating science into the agricultural education curriculum. Preservice participants professed that administrators, science teachers, school counselors, parents, other teachers, and community members (stakeholders from the created index) will support agriculture teachers and programs that integrate science. This finding was consistent with previous studies (Johnson, 1996; Johnson & Newman, 1993; Myers et al., 2008; Myers & Washburn, 2008; Thompson & Schumacher, 1998; Warnick & Thompson, 2007).

It is concluded that preservice teachers agree with inservice teachers as indicated in earlier studies (Thompson & Schumacher, 1998). Teacher educators can alleviate preservice concerns by addressing preservice background knowledge for integration through the promotion of undergraduate class selection. Teacher educators must address preservice perceptions by modeling science integration in methods courses. Finally, teacher education programs should select programs that model science integration in their early experience and student teaching.

Change in education takes time as noted by Hawkins (1990). Acknowledgement of the science integration loop, reported studies, and observations at the local level explains agriscience education is making progress in the area of science integration. Preservice and inservice teachers alike report similar perceptions on the matter. Preservice and inservice teachers are positive toward more integration leading to an expansion of the loop and continued integration.

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