INTEGRATING SCIENCE IN THE AGRICULTURE CURRICULUM: AGRICULTURE TEACHER PERCEPTIONS OF THE OPPORTUNITIES, BARRIERS, AND IMPACT ON STUDENT ENROLLMENT

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Abstract

The essential nature of public school student performance on standardized examinations is becoming increasingly apparent. As schools across the nation are examined more closely based on the science achievement of students, career and technical education programs will be expected to contribute to this effort. Through the lens of Ajzen and Madden's (1986) Theory of Planned Behavior, this study examined 217 Florida agriculture teachers' perceptions of science integration in the agriculture curriculum as it pertains to attitudes, perceived barriers, impact on enrollment, and support from key stakeholders. The study found teachers to have positive perceptions, relatively few perceived barriers, high perceived support, and high perceived behavioral control for the integration of science in the agriculture curriculum.

Introduction

"America's schools are not producing the science excellence required for global economic leadership and homeland security in the 21st century" (USDE, 2006a). This statement underscores the seriousness of science educational reform presented by the No Child Left Behind (NCLB, USDE, 2006b) legislation. Beginning in 2007, NCLB mandates that states measure student progress in science at least four times in a student's progression from third to twelfth grade. The resulting role standardized test performance will play in school funding and student graduation is a phenomenon that permeates all segments of public education (Hamilton, Stecher & Klein, 2002). The repercussion in many cases is a great deal of pressure on public school administrators and consequently on teachers to strengthen the scientific rigor of the whole school curriculum. (Cambron-McCabe & McCarthy, 2005) As a result, career and technical education programs are not only encouraged but expected to justify their curricular contribution to student academic achievement in science, reading and mathematics (Stewart, Moore, & Flowers, 2004). Agricultural education programs are not likely to be exempt from these increased expectations.

A number of researchers (Balschweid & Thompson, 2002; Balschweid, Thompson & Cole, 2000; Conroy & Walker, 2000; Enderlin & Osborne, 1992; Mabie & Baker, 1996; Roegge & Russell, 1990) believe agricultural education, with its natural ties to the biological, chemical, and physical sciences is well-positioned to offer a rigorous and meaningful learning context for applied scientific principles. Hull (1995) purports that contextual learning theory suggests learning occurs only when students process new information or knowledge in such a way that it makes sense in their frame of reference. Furthermore, the mind naturally seeks meaning in context and does so by searching for relationships that make sense and appear useful (Hull). Based on these theoretical assumptions, the use of an agricultural curriculum as a contextual frame for supporting knowledge acquisition in science would increase student learning and the meaning to which students can apply their learning.

The notion of science integration into career and technical curricula is not a particularly novel one. The *A Nation at Risk* report of 1983 (National Commission on Excellence in Education), the 1990 Amendments to the Carl D. Perkins Vocational and Applied Technology Act, and the 1994 School-to-Work Opportunities Act (Phipps, Osborne, Dyer, & Ball, 2008) all called for the curricular integration of academic and career and technical education. In fact, since the early 1990's, a plethora of research (Balschweid, 2002; Balschweid & Thompson, 2002; Edwards, Leising, & Parr, 2002; Johnson, 1996; Johnson & Newman, 1993; Osborne & Dyer, 1998; Thompson, 1998) has examined the potential for such integration specifically in agricultural education.

The current level of science integration in agriculture curricula nationwide remains an elusive notion. However, several state-specific studies have examined various stakeholder perceptions related to the concept of integrating science in the agriculture curriculum. These studies have suggested in their respective states that: teachers felt prepared to teach an integrated curriculum (Johnson, 1996; Thompson & Balschweid, 1999), teachers believed integrating science into the agriculture curriculum benefits students (Enderlin & Osborne, 1992, Newman & Johnson, 1993; Thompson, 1998), agriculture teachers believe students should earn science credit for agriculture courses (Johnson, 1996), science teachers and administrators believe agriculture teachers are qualified to teach science (Johnson & Newman, 1993), and science teachers are uncertain about agriculture teacher qualifications to teach science (Osborne & Dyer, 1998).

Since the publication of each of these studies, the NCLB legislation has had a notable impact on the culture of schools as well as teacher and administrator attitudes toward the necessity of an integrated approach. Coupled with this cultural transition resulting from federal legislation are relatively unique situations in Florida that accentuate the need for science integration in the agriculture curriculum.

The first of these unique situations is the presence of an Agriscience Foundations course that is approved to be offered for science credit. This introductory agriculture course is the first course students complete in the sequence of all state-approved agriculture curriculum tracks. Whereas many states offer science credit for upper level agriculture courses and therefore, some degree of teacher specialization is possible,.this course is the required starting point for the agriculture curriculum in Florida. Consequently, virtually all high school agriculture teachers in Florida offer this agriculture course for science credit.

The second unique aspect in Florida is the recent state legislation (Florida DOE, 2006) mandating, effective Fall 2007, the completion of a four-credit "academic major" as a requisite for high school graduation. This legislation requires school districts to design and seek approval for specialized "majors" in career and technical education, fine and performing arts, or in academic content areas. Agricultural Education leaders in Florida are working to establish a unified statewide major in Agriscience that closely reflects state educational standards in science.

These federal and state circumstances necessitate the further review of Florida agriculture teacher attitudes, barriers and concerns regarding impact on student enrollment as a result of integrated science in their agricultural education curricula. The effectiveness of any integration efforts will be contingent upon teacher attitude and preparation to execute such an undertaking.

The theoretical frame for this study is drawn from Ajzen and Madden's (1986) Theory of Planned Behavior. This theory hypothesizes that one's behavior is determined directly by one's intention to perform the behavior. Furthermore, intention is influenced by attitude, subjective (social) norm, and perceived behavioral control. In regard to the present study, the researchers operationalized attitudes as teacher perceptions toward integration of science. Subjective (social) norms were operationalized as support for integration from various stakeholder groups. Finally, teachers' perceived behavioral control was operationalized by both effect of integration on student enrollment and perceived barriers to integrate science. The assumption of the research is that negative teacher attitudes toward integration, perception of social norms contrary to integration, or perception of lack of control to modify the curriculum would have a negative impact on their likelihood to integrate science. As the foundation of a larger study, this study will attempt to describe the current status of Florida agriculture teacher attitudes, perceptions of social norms, and perception of local control toward the integration of science.

Purpose and Objectives

The purpose of this study was to determine the attitudes, needs, and perceived barriers of agricultural education teachers in integrating science in agricultural education programs. The objectives of the study were as follows:

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

Methods

This statewide study used a descriptive survey research design. The instrument used in this study was based on previous instruments used by other researchers in this field of study (Layfield, Minor, & Waldvogel, 2001; Thompson & Balschweid, 1999; Thompson & Schumacher, 1998). The researchers modified items slightly when appropriate to meet the objectives of the study and to address the programs of this state. Teacher responses were measured on a five-point summated rating scale. A panel of experts consisting of faculty, administrators, and graduate students from the University of Florida reviewed the instrument for face and content validity. The authors of the original instrument report internal consistency using Cronbach alpha of 0.88 (Thompson & Schumacher, 1998). A post-hoc reliability analysis of this administration of the slightly revised instrument revealed a Cronbach alpha coefficient of 0.80.

The population for the study consisted of all agricultural education teachers in the State of Florida. The population frame of the study was established by using the state agriscience teacher directory (N=355). Data were gathered from all members of the population. Because this is a census study, the findings are not generalizable to individuals beyond this population, and only descriptive statistics were used to analyze the data.

In an attempt to address non-response error, a total of six respondent contacts were made (Dillman, 2000). These included a pre-study electronic mail contact, instrument mailings, and reminders via both electronic and land mail. Furthermore, 10% of the non-respondents were randomly selected and contacted via telephone (Ary, Jacobs, Razavieh, & Sorensen, 2006). Respondents and non-respondents were compared and no statistically significant difference was found. A total of 217 respondents returned questionnaires for a 61.1% response rate.

Findings

The gender demographic of the respondent group was found to be approximately even with a slight majority (54%) being male. Respondents reported a mean of slightly over 15 years of teaching experience. A majority (52.3%) reported teaching in high schools with almost a third (32.1%) teaching in middle school agricultural education programs. The remaining respondents (15.5%) reported teaching in blended, both middle and high school, agricultural education programs. The largest percentage of teachers reported their highest level of education as a bachelor's degree (37.5%), followed by a master's degree (26.6%), bachelor's plus some graduate courses (20.3%), master's degree plus some additional graduate courses (12.5%), and 3.2% of the teachers reported holding either a specialist or doctoral degree. Less than one-half (44%) of the teachers reported that their undergraduate major was agricultural education.

The first objective of this study was to describe the perceptions of agricultural education teachers toward the integration of science into the agricultural education curriculum. A vast majority of responding teachers (94%) agreed science concepts are easier for students to understand when science is integrated into the agricultural education program (Table 1). Furthermore, 81% agreed students are better able to understand agriculture concepts when science is integrated into the program. A majority (87%) of teachers also agreed that integrating science increases the ability to teach students to solve problems. Over two-thirds (69%) of teachers also noted a perception that integrating science requires more preparation than a more traditional curriculum.

Table 1
Teacher Perceptions Toward Integration of Science into the Agricultural Education Curriculum

Statement	%A	%N	%D
Science concepts are easier for students to understand when science is integrated into the agricultural education program.	93.5	6.0	0.5
Integrating science into agriculture classes increases the ability to teach students to solve problems.	87.0	10.1	3.0
Students learn more about agriculture when science concepts are an integral part of their instruction.	86.8	11.7	1.5
Agriculture concepts are easier for students to understand when science is integrated into the agricultural education program.	81.3	14.6	4.0
Students are more motivated to learn when science is integrated into the agricultural education program.	71.3	23.1	5.5
Integrating science into the agricultural education program requires more preparation time than teaching a more traditional agriculture curriculum.	69.2	14.6	16.2
Integrating science into the agricultural education curriculum more effectively meets the needs of special population students.	42.9	39.9	17.2
It is more appropriate to integrate science in advanced courses than into introductory courses.	21.3	18.7	60.1
Less effort is required to integrate science in advanced courses as compared to introductory courses.	20.4	26.7	52.9

Note. n = 217. Original scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (A). Responses were collapsed into Disagree (D) and Agree (A).

The second objective of this study was to describe the perceptions of agriculture teachers regarding barriers to integrating science into agricultural education curriculum. Over two-thirds of the respondents reported that insufficient time and support to plan for implementation of integration (70%) and lack of necessary materials for integration (69%) were barriers to integrating science concepts into the agricultural education curriculum (Table 2). A majority of teachers felt insufficient funding (64%), concerns about large class size (59%), and their personal lack of experience in science integration (53%) were also barriers to integration. Most teachers disagreed with the notion that lack of support from local science teachers (54%) and administrators (65%) were barriers.

The third objective of this study was to describe agricultural education teachers' perceptions concerning the impact of science integration on student enrollment in agricultural education programs. When asked "Have you integrated science into your agricultural education program?" approximately 93% of teachers responded positively. Of those teachers who had integrated science, the majority (67.6%) reported no impact on their program's enrollment. In programs where an impact on enrollment was noted, 31% reported an increase in enrollment while almost 2% reported a decrease in the number of students in their program.

A majority of teachers (52.1%) reported they were not content with the level to which they currently integrate science. Almost 75% of respondents noted that they plan to increase the amount of science integration in their curriculum. Only 1% stated that they planned to decrease the amount of integration with the remainder (24%) reporting that they have no current plans to change.

Teachers perceived the greatest enrollment impact of integrating science would be an increase in number of high achieving students (74%) in agricultural education programs (Table 3). The second greatest impact would be an increase in the number of average achieving students (62%). Furthermore, a majority (63%) of respondents reported a perception that the overall enrollment of agricultural education programs would increase with the integration of science concepts. Teachers noted their perception that integration would have little impact on the enrollment of minority students and on the social diversity of students in agricultural education programs. Teachers were almost evenly split on their perception of the impact integration would have on low achieving student enrollment.

The fourth and final objective of this study was to describe agricultural education teachers' perceptions concerning the impact of science integration on the support they receive from various groups. Teachers perceived support would increase from all groups with the exception of community members (see Table 4). The greatest increase in support was from science teachers (76%) followed by administrators (74%), school counselors (69%), parents (66%), and other teachers (53%).

Table 2
Barriers to Integration of Science into the Agricultural Education Curriculum

Statement	%A	%N	%D
Insufficient time and support to plan for implementation	69.6	12.9	17.5
Don't have the necessary materials	68.8	14.4	16.9
Insufficient funding	64.1	14.9	21.0
Concerns about large class size	59.3	15.5	25.3
Lack of experience in science integration	53.1	12.0	34.9
Lack of integrated science curriculum in courses I teach	37.7	20.9	41.4
Insufficient background in science content	33.5	16.5	50.0
Concerns about discipline	30.7	20.1	49.2
Doubts about students' capacity to handle material	28.7	16.4	54.9
Reluctance to diminish emphasis on agricultural production	28.0	16.6	55.4
Lack of parent and community support for science integration	24.7	31.6	43.7
Reluctance to give up the role of primary source of classroom information	23.6	31.2	45.2
Lack of support from local science teacher(s)	22.7	23.2	54.2
Lack of agriscience jobs in the local community	21.9	24.5	53.6
Lack of administrative support for science integration	11.0	24.1	64.9
Disagreement with the notion that science integration is necessary	8.5	20.5	71.1
Have tried it and it was unsuccessful	5.4	28.8	65.8

Note. n = 217. 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 Disagree (D) and Agree (A).

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

Student Group	%I	%N	%D
High achieving students	73.5	26.0	0.5
Total program enrollment	63.0	31.3	5.7
Average achieving students	61.8	37.2	1.0
Social diversity (athletes, "popular" students, etc)	35.7	53.4	10.9
Low achieving students	30.4	37.6	32.0
Minority students	28.4	55.2	16.5

Note. *n* = 217. Original scale: 1 = Greatly Decrease (GD), 2 = Decrease (D), 3 = No Change (N), 4 = Increase (I), 5 = Greatly Increase (GI). Responses were collapsed into Decrease (D) and Increase (I).

Table 4
Perceived Impact of Integrating Science on Support Received from Certain Groups

Group	%I	%N	%D
Science teachers	75.5	15.6	9.0
Local administrators	73.9	25.6	0.5
School counselors	69.2	29.9	0.9
Parents of students	66.2	31.5	2.3
Other teachers	53.3	46.7	0.0
Community members	47.4	52.1	0.5

Note. *n* = 217. Original scale: 1 = Greatly Decrease (GD), 2 = Decrease (D), 3 = No Change (N), 4 = Increase (I), 5 = Greatly Increase (GI). Responses were collapsed into Decrease (D) and Increase (I).

Conclusions, Recommendations, Implications

The "typical respondent" in this study was a male with more than 15 years of teaching experience teaching in a high school. The "typical respondent" was also most likely to hold only a bachelor's degree, and that degree was likely not in agricultural education. As state staff and teacher educators in Florida prepare and deliver professional development opportunities to assist teachers in integrating science, these findings will be useful in guiding their planning decisions. When working with a majority of teachers who did not follow the traditional bachelor's degree in agricultural education pathway to teaching, it is important to keep in mind that differences in philosophy and view of the purpose of agricultural education are likely present.

With 71% of the participants reporting that integration of science into the agriculture curriculum is necessary, the question that immediately comes to mind is whether the existing curriculum is sufficient for teachers to integrate effectively. Certainly this finding is reflective of a positive attitude toward integration, but do teachers have the resources needed to integrate science into the curriculum to the extent they are willing to do so? In relationship to the barriers identified in the study, the answer to this question may be a resounding "no." Respondents reported that insufficient planning time, the lack of necessary materials, and insufficient funding served as barriers to their further integration efforts. The obvious recommendation to practitioners is to seek opportunities to collaborate with other teachers for resources and instructional ideas, and to take advantage of external funding opportunities that support innovations in science integration. Recommendations to teacher educators include making sure pre-service and in-service professional development opportunities reinforce strategies in collaboration and grant proposal development. Anecdotal evidence suggests teachers seldom complain of abundant time, materials, or funding. A more thorough investigation is warranted to determine the legitimacy of these concerns and to rule out the possibility that "lack of resources" is merely a convenient excuse for a labor intensive revision to the existing curriculum and instructional practices.

Considering that 53% of respondents lack experience in science integration, the issue of time required to integrate science may take on new meaning. The obvious question for further research is whether the perception of increased time required for planning integrated activities results from organizing more supplies, laboratory activities, and inquiry based instruction. A second plausible explanation may be that teachers who lack experience integrating science would find integration to take more time than maintaining the status quo in their instruction. Additional investigation is warranted to explore these issues more deeply. Furthermore, implications may result for pre-service and in-service preparation as teacher educators and state staff work to assist teachers in integrating and in planning integrated instruction more efficiently.

The overwhelmingly positive perception that science integration holds potential for increasing student learning in science (94%), agriculture (87%) and problem solving (87%), coupled with the notion that integration is necessary (71%) reflects strikingly positive attitudes regarding integration in support of previous findings (Newman and Johnson, 1993; Thompson & Balschweid, 2000). As science performance becomes increasingly important under NCLB (USDE, 2006b), this positive perception bodes well for teachers' willingness to make an integrated agriculture curriculum an essential component of plans to increase student standardized test scores in science. Further investigation is needed into the reality of this situation. Will agricultural education teachers be able to sufficiently align their instruction with science standards to effectively make agriculture a viable context for students to learn standards-based science content? An increased degree of support in the form of professional development opportunities as well as local teacher support will become critical if teachers work to make these curricular adjustments.

Nearly 60% of the respondents indicated that large class sizes were a potential barrier to integration of science. Anecdotal evidence in Florida suggests that agriculture teachers struggle regularly with classes averaging approximately 30 pupils. Coincidently 93% reported they had already integrated some degree of science in their curricula with 31% of these reporting increased enrollments as a result. Furthermore, three quarters of the participants anticipated they would further integrate science in their curricula in the future. If teachers believe integration of science is likely to increase enrollments, and they have concern for their class sizes, the essential nature of integration in the face of large classes may indicate the perceived rewards of integration are greater than the potential risks. This may be reflected in teachers' perceptions of a changing student clientele, as nearly three quarters anticipated more high and average achieving students would result from increased levels of integration. Results were mixed as to the anticipated impact on low achieving student enrollment, and uncertain regarding the impact on minority students and socially diverse students. As the agricultural education curriculum nationwide becomes increasingly more science oriented, should the profession be concerned about these perceptions? Should agricultural education intentionally target certain achievement levels of students, or are we currently serving a disproportionately high number of low achieving students? Further research is needed to examine the true impact of science integration on student enrollment at various levels of academic ability. Further research is also warranted that examines the impact of science integration and other curriculum modifications on diversifying the pool of agricultural education students.

Teacher perceptions of the impact of integration on support from science teachers, school administrators, guidance counselors, parents and other teachers was also positive and consistent with previous findings (Johnson, 1996; Johnson & Newman, 1993). This suggests a school climate that increasingly sees the importance of standardized student assessment. These findings further suggest that subjective (social) norms may have some influential impact on agriculture teacher willingness to integrate. Interestingly however, the majority of teacher participants in this study reported that integration of science would not change support agricultural education programs receive from community members. Can we infer from this finding that community members will support agriculture programs regardless of the curricular focus, or that community members are largely unaware of the curricular focus of agricultural education in their local schools? Further research regarding community awareness and views of the agricultural education curriculum would be beneficial in addressing these questions.

Through the lens of Ajzen and Madden's (1986) Theory of Planned Behavior, one can conclude that the teachers who participated in this study had intentions to increase the degree to which they integrated science in their curriculum and held positive attitudes toward integration. It can also be concluded that subjective norms, operationalized by stakeholder support for integration also favored further integration of science. Finally, the perceived behavioral control to further integrate the curriculum also appeared to be high when considering the relatively few barriers and the positive perception of school administrator support. Based on this theoretical model, it would be reasonable to assume teacher behavior will continue to reflect greater integration of science in the curriculum.

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