Integrating Academics into Agriculture Programs: A Delphi Study to Determine Perceptions of the National Agriscience Teacher Ambassador Academy Participants

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Abstract

This study investigated the perceptions of participants in the National Agriscience Teacher Ambassador Academy as to the next steps the agricultural education profession should take to move forward in the area of integrating academic subject matter into agricultural education courses. All members of the 2007 Academy participated in the study. These expert teachers identified key action items in the area of curriculum, professional development, teacher preparation program, the need for a philosophical shift, and collaboration. Through use of the Delphi technique, consensus was reached on 34 different recommendations in these five areas.

Introduction

Many high school students do not have the math and science skills necessary to be successful in college or to compete in today's high skill careers (Stone, Alfeld, & Pearson, 2007). Authentic learning of academic skills through real-world contexts has been identified as an important avenue for supporting higher student achievement (Edwards, 2004). Research on teaching and learning supports the practices identified within career and technical education that is related to the contextualization of learning. In a 2000 study, Conroy and Walker indicated agricultural education provides relevance and context for student success in academics.

Over the past several decades, a number of consistent themes emerged from educational reform reports and initiatives. Prominent themes include the integration of academic and career and technical education (Rojewski, 2002). In the past decade, federal legislation authorizing funding for Career and Technical Education began to mandate improved academic achievement. The 1990 Carl D. Perkins Vocational Education and Applied Technology Act committed federal funding to integrating academics into vocational education. Each reauthorization of Perkins funding emphasized integrating academics into career and technical education. Additionally, the United States Department of Agriculture funded competitive grants that were designed to strengthen agricultural education by incorporating agriscience into science (U.S. Department of Agriculture, 1999).

Research findings indicate that integration of academics into the agriculture curriculum is an effective way to teach math, science, and reading. Studies support the findings that students taught by integrating agricultural and scientific principles demonstrated higher achievement than students taught by traditional approaches (Chiasson & Burnett, 2001; Enderlin & Osborne, 1992; Myers & Dyer, 2006; Parr, Edwards, & Leising, 2006; Roegge & Russell, 1990; Whent & Leising, 1998). Attitudinal studies of agriculture teachers have all provided information regarding the perceived barriers, attitudes, and needs of integrating science (Conroy & Walker, 2000; Layfield, Minor, & Waldvogel, 2001; Newman & Johnson, 1993; Thompson & Schumacher, 1998; Warnick & Thompson, 2007), math (Miller & Gliem, 1993; Jansen, Enochs, & Thompson, 2006), and reading (Park & Osborne, 2006).

The theoretical model for this study consisted of the perceptions of the National Agriscience Teacher Ambassador Academy Ambassadors toward integrating academics. The theoretical base is grounded in the theory of predicted behavior developed by Fishbein in 1967, and the theory of planned behavior developed by Fishbein and Ajzen in 1975. These theories suggest that beliefs and behavior intentions can best be viewed as consequences of attitude and that knowledge influences values and beliefs, which in turn affect attitudes, intentions and behaviors. These theories affect the study of teachers' perceptions of integrating academics into the agricultural education curriculum. Norris and Briers (1989, p. 42) stated that "teachers' perceptions toward the change process is the single best predictor of the teacher's…decision concerning adoption of the change."

Purpose and Objective

The purpose of this study was to develop a consensus listing of actions that should be completed to move agricultural education forward in the area of math, science, and reading integration. This purpose was operationalized by identifying the recommendations of expert teachers as to what steps should be completed by the profession to meet this goal. An expert panel of 26 teachers from 22 different states and U.S. territories was used to complete the objective of this study.

Methods/Procedures

Developed in the 1950s and 1960s by Dalkey and Helmer (1968), the Delphi method is a structured process used to collect and distill knowledge from a group of experts on a particular topic or area (Ziglio, 1996). Linstone and Turoff (1975) identified several situations in which this technique of investigation would be most appropriate. Items on this list that are applicable in this situation are when "the problem does not lend itself to precise analytical techniques but can benefit from subjective judgments…" and "exposing priorities of …, social goals" (p. 4).

This study used the process outlined by Stitt-Gohdes and Crews (2004). This process was identified by Wilhelm (2001) as the conventional Delphi version. The first step of this process was the selection of the purposive sample to serve as the expert panel. For this study, the expert panel consisted of 26 teachers that had been selected to participate in the National Agriscience Teacher Ambassador Academy. Although a somewhat small sample, when using the Delphi technique, the size of the expert panel will be variable, and good results have been gathered with panels of no more than 10 to 15 individuals (Linstone & Turoff, 1975). Dalkey (1969) reported reliability greater than .80 when the Delphi group size was larger than 13 respondents.

Stufflebeam, McCormick, Binkerhoff, and Nelson (1985) noted the Delphi technique is especially effective in obtaining consensus among a purposively selected group of experts. In this instance, the individuals who had the needed information (e.g., the "experts") were considered to be teachers who had been identified by state agricultural education staff as leaders and innovators in this area and nominated to participate in this program. According to L. Gossen (personal communication, August 30, 2007), the teachers chosen to participate in the National Agriscience Teacher Academy were nominated or approved by their state supervisor for agricultural education. State supervisors were given the following criteria for their nomination/approval for teachers in their state: (a) their best agriscience teachers that were very familiar with science principles or teaching science-based classes, (b) have the respect of the teachers in their state as an excellent instructor, and (c) the commitment to make presentations at professional development meetings. Furthermore, Wicklein (1993) noted that "the success of the Delphi relies on informed opinion," (p. 1050) not random selection.

The study consisted of a series of questionnaires, as is common for this technique (Moore, 1987). The first round of the study used a questionnaire with one open-ended question, "What should the agricultural education profession do to move forward in the area of math, science, and

reading integration?" An open-ended question was used to facilitate the generation of a wide array of response categories. After initial responses were received, all were summarized and categorized by the researchers to produce items for a second-round questionnaire.

In the second round of the study, Delphi panel members were asked to evaluate the statements and rate their level of agreement with the items identified in round one. Panel members rated the items on a 5-point summated scale (1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree). It was determined *a priori* that for an item to continue past the second round, it must have a mean score of 3.50 or greater on the 5-point scale.

The third questionnaire sought to determine consensus. As is typical of Delphi studies, consensus was assumed to be reached when a certain percentage of respondents indicated agreement (Scheibe, Skutsch, & Shofer, 1975). This percentage was set *a priori* as 66%. Panel members were asked to indicate whether they agreed or disagreed with each of the recommendations and to provide comments if they could not agree with the summary findings. Consensus was reached on all 34 items in this round. As noted by McCampbell and Stewart (1992), most Delphi studies reach consensus in the third round.

Data were analyzed with descriptive statistics. Ordinal data collected with summated scales in the second round were treated as interval data and reported as means and standard deviations for classification purposes. Nominal data collected in the third round were reported with frequencies and percentages.

Findings

All participants in the study responded in each round (100% response rate). Thirty-five recommendations were identified by respondents in round one. Recommendations identified by more than two respondents are listed in Table 1. Many of the recommendations dealt with teacher professional development, curriculum and teaching materials, and policy/standards development.

Table 1
Round One: How Should the Profession Move Forward in the Area of Integration (n = 26)

Recommendation	Responses[a]
Teacher professional development focused on integration methods and techniques	19
Include instruction on math, science, and reading integration in preservice teacher programs	11
Develop agriscience curriculum with embedded integration	9
Align agriscience curriculum with state and national standards in math, science, and reading	8
Integration lesson activities/tools/resources posted on website for easy access	6
Require science courses in preservice programs/certification requirements	5
Obtain national "buy-in" on integration concept (philosophical switch)	5
Partner agriscience classes with math, science, and reading courses on cross-curricular projects	3
Invite state/local education officials to local programs to see integration occurring	3
Focus on early career and preservice teacher professional development on integration methods	3
Incorporate appropriate technology (iPods, PDAs)	3

[a]Recommendations identified by only one or two respondent are not included in this listing but were included in round two.

Of the 35 items on the round two questionnaire, 34 were retained for the third round. Means for all items ranged from 4.68 to 3.40 (Table 2). The highest level of agreement (M = 4.68) was reached on "develop agriscience curriculum with embedded integration." The next six highest rated statements provided recommendations dealing with preservice teacher programs, teacher professional development, and national standards alignment.

The only item not retained for round three was "encourage agriscience teachers to obtain certifications in multiple areas" (M = 3.40). This level of agreement was below the *a priori* set level of agreement needed to be retained. As indicated by the high standard deviations for some items, much variability existed. Round two standard deviations ranged from a low of 0.48 for "develop agriscience curriculum with embedded integration" (M = 4.68) to a high of 1.35 for "encourage agriscience teachers to obtain certifications in multiple areas" (M = 3.40). It may be interpreted as being influenced by the situations in each of the individual respondent's states.

Table 2
Round Two: Level of Agreement on Recommendations (n = 26)

Recommendation	*M*	*SD*
Develop agriscience curriculum with embedded integration	4.68	.48
Include instruction on math, science, and reading integration in preservice teacher programs	4.64	.57
Stress the importance of professional development once teaching with preservice teachers	4.60	.50
Align agriscience curriculum with state and national standards in math, science, and reading	4.60	.58
Teacher professional development focused on integration methods and techniques	4.60	.58
Encourage and motivate agriscience teachers to integrate math, science, and reading	4.52	.71
Require science courses in preservice programs/certification requirements	4.50	.51
Focus on early career and preservice teacher professional development on integration methods	4.42	.58
Increase number of open-ended projects/laboratory activities	4.40	.65
Publicize the NATAA	4.40	.76
Acceptance of agriscience courses as science credit for admission to universities	4.40	.91
Increase participation in the agriscience fair competition	4.36	.70
Stress the importance of agriscience teachers being part of the total education community responsible to contribute to student learning (standardized tests)	4.36	.70
Integration lesson activities/tools/resources posted on website for easy access	4.36	.86
Publicize the agriscience fair program	4.32	.69
Increase interaction between agriscience teachers and agriculture corporations	4.32	.75

Recommendation	*M*	*SD*
Include agriscience fair projects as part of agriscience courses	4.32	.80
Utilize current events in curriculum	4.32	.80
Federal legislation granting science credit for agriscience courses	4.29	1.04
State legislation granting science credit for agriscience courses	4.29	.96
Partner agriscience classes with math, science, and reading courses on cross-curricular projects	4.24	.78
Increase laboratory time	4.24	.83
Invite state/local education officials to local programs to see integration occurring	4.24	.92
Develop a CDE in agriscience	4.21	1.06
Obtain national "buy-in" on integration concept (philosophical switch)	4.17	.87
Increase collaboration with math, science, and reading teachers	4.16	.75
Include daily "bell work" targeting math, science, and reading standards	4.08	.83
Develop upper level high school agriscience courses focused on math, science and reading integration	4.08	.96
Incorporate appropriate technology (computer based data collection, iPods)	4.04	.98
Develop agriscience integration based textbooks	4.04	1.06
Publicize scholarships based on integration activities	4.04	1.06
Increase collaboration with academic teacher organizations	3.88	.93
Incorporate fiction and nonfiction publications into the curriculum	3.88	.93
Standardized tests of academic concepts in agriscience courses	3.68	1.07
Encourage agriscience teachers to obtain certifications in multiple areas	3.40	1.35

In round three, participants were asked to provide a dichotomous indication of whether they

agreed or disagreed with each of the recommendations retained from round two. Panel members were also encouraged to provide comments if the recommendation could be further explained or modified to reach greater consensus.

All 34 recommendations included in round three obtained the *a priori* set level of agreement to be deemed a consensus (Table 3). Panel members had 100% agreement on 11 of the recommendations. Those 11 items dealt with issues such as curriculum standard alignment, curriculum/lesson plan development and sharing, teacher professional development, and preservice teacher programs.

Table 3
Round Three: Level of Agreement with Recommendations (n = 26)

Recommendation	Agree %
Align agriscience curriculum with state and national standards in math, science, and reading	100.0
Integration lesson activities/tools/resources posted on website for easy access	100.0
Teacher professional development focused on integration methods and techniques	100.0
Develop agriscience curriculum with embedded integration	100.0
Encourage and motivate agriscience teachers to integrate math, science, and reading	100.0
Stress the importance of professional development once teaching with preservice teachers	100.0
Publicize the agriscience fair program	100.0
Publicize the NATAA	100.0
Require science courses in preservice programs/certification requirements	100.0
Focus on early career and preservice teacher professional development on integration methods	100.0
Increase number of open-ended projects/laboratory activities	100.0
Include instruction on math, science, and reading integration in preservice teacher programs	96.2
Increase interaction between agriscience teachers and agriculture corporations	96.2
Invite state/local education officials to local programs to see integration occurring	96.2
Increase collaboration with math, science, and reading teachers	96.2

Recommendation	Agree %
Obtain national "buy-in" on integration concept (philosophical switch)	96.2
Develop upper level high school agriscience courses focused on math, science and reading integration	96.2
Increase participation in the agriscience fair competition	96.2
Stress the importance of agriscience teachers being part of the total education community responsible to contribute to student learning (standardized tests)	96.0
State legislation granting science credit for agriscience courses	92.3
Utilize current events in curriculum	92.3
Incorporate appropriate technology (computer based data collection, iPods, PDAs)	92.3
Acceptance of agriscience courses as science credit for admission to universities	92.3
Develop a CDE in agriscience	88.5
Increase laboratory time	88.5
Publicize scholarships based on integration activities	88.0
Federal legislation granting science credit for agriscience courses	88.0
Incorporate fiction and nonfiction publications into the curriculum	88.0
Include agriscience fair projects as part of agriscience courses	88.0
Develop agriscience integration based textbooks	84.6
Increase collaboration with math, science, and reading teacher organizations	84.6
Partner agriscience classes with math, science, and reading courses on cross-curricular projects	84.0
Include daily "bell work" targeting math, science, and reading standards	80.8
Formal assessment (standardized tests) of math, science, and reading concepts in agriscience courses	73.1

Conclusions/Implications/Recommendations

The purpose of this study was to develop a list of actions to move agricultural education forward in the area of math, science, and reading integration. The conclusions and recommendations are based on the consensus of the 2007 National Agriscience Teacher Ambassadors. The researchers categorized the conclusions/recommendations into concepts relating to curriculum, professional development, teacher preparation, philosophical, and collaboration.

Curriculum

Academically enhanced textbooks, integrated projects, and laboratory activities will provide resources to expand the program of study in agricultural education. The curriculum should be aligned with standards in math, science and reading, integrate cutting edge technology, utilize current events, and include advanced integrated courses. Additionally, a national Web site that includes lessons, activities, and resources will provide added access for teachers. Developing assessment instruments that evaluate higher order thinking skills will help ascertain student achievement from an integrated curriculum.

The expansion of FFA career development events related to agriscience will assist students in making the connection between agricultural and academic principles while providing relevance to the curriculum. Marketing the agriscience fair competition at the national, state, and local levels will improve exposure and participation in these important events. It was noted that not all members of the expert panel were fully aware of the agriscience award programs coordinated through the National FFA Organization.

Professional Development

Professional development is paramount to moving the profession forward in integrating academics into agricultural education programs. Instruction in integrating math, science, and reading at the preservice and inservice levels are professional growth functions that should be embraced at the national, regional, state, university, and local levels. Additional marketing and promoting professional development programs such as the National Agriscience Teacher Ambassador Academy will help agriculture teachers develop integrated approaches and techniques.

Teacher Preparation Programs

Teacher preparation programs can be a catalyst to help the profession move forward in integrating academics. Stressing continual professional development to preservice teachers is an important component of their professional growth. Teacher educators should investigate university science coursework that will help preservice teachers enhance their knowledge to integrate science into the curriculum. Pedagogically, preservice education should include teaching and modeling strategies on how to integrating academics into the curriculum.

Philosophical Shift

As a profession, agricultural educators need to create “buy-in” from the profession to integrate science, math, and reading into the curriculum. Philosophical transformation within the profession will help teachers, teacher educators, and department of education officials realize the role agriculture programs can play in increasing student achievement. Teachers need encouragement and assistance to develop collaborative efforts that will enhance academic learning within their programs.

Granting science credit has become an unresolved issue in agriscience education. The profession should lobby state boards of higher education to grant science credit for agriscience courses that truly integrate science. Agriculture teachers can help create “buy-in” by inviting state and local education officials into the classroom to witness the advantage of integrated agriscience classes.

Collaboration

Collaboration efforts between academic and agriculture teachers will benefit students. Further, collaborative efforts should be forged between agriculture teacher and math, science, and reading teacher organizations. Collaboration with other academic teachers through cross-curricular projects will help students better understand the academic as well as technical concepts and principles. These collaborative efforts will help agriculture teachers understand the importance and become stronger team members within the total educational community in developing the whole student. Additionally, more interaction between teachers and industry will benefit agriculture programs and students.

Further areas of research include: (a) examining exemplary programs that integrate science and agriculture may yield a model for integrating science, (b) assessing the influence of integrating academics in the agricultural education curriculum on student achievement, and (c) identifying effective collaboration approaches for academic and agriculture teachers. To be most effective, these investigations should be carried out by a coordinated team of researchers within the agricultural education profession. A variety of research designs and methods should be used to gain a more complete understanding of this phenomenon and to develop models that may be generalized to the greater agricultural education community.

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