COLLABORATION BETWEEN SCIENCE AND AGRICULTURE TEACHERS

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Abstract

The focus of this descriptive study was to determine the type and frequency of collaborative activities occurring between agriculture teachers and science teachers who taught in schools with agricultural education programs. Additional foci of this study included determining the extent to which science and agriculture teachers value collaborative practices, identifying factors that facilitate collaboration, and identifying barriers inhibiting collaboration. Although results indicate that most science and agriculture teachers hold positive attitudes concerning the potential for collaboration, reported collaborative activities between the groups was limited, with science teachers indicating less collaboration occurring than agriculture teachers. The large majority of science teachers indicated that they have not attended workshops demonstrating agriscience integration, and both groups identified lack of preparation time as the most significant barrier inhibiting collaboration. Moreover, both groups indicated that close proximity of facilities, teacher commitment, teacher attitude toward science and agriculture, frequent professional interaction, and administrator support facilitate collaboration.

Introduction/Theoretical Framework

Over the past decade much attention and discussion has been given to the "integration" of agricultural education with academic subjects, especially in the areas of science and mathematics. Roberson, Flowers, and Moore (2001) stated that "vocational and academic integration is a marriage of both types of curricula in order to teach the many skills necessary for students' future successes" (p. 31). Educational reforms of the Perkins Act encourage academic and vocational teacher collaboration for pedagogy revision, multidisciplinary integration, and creating real-life learning experiences (Lankard, 1992). Researchers have concluded that professional collaboration is an essential component of successful schools (Leonard & Leonard, 2003; Leonard & Leonard, 2001; Little, 1982). Dormody (1993) declared, "Isolationism can lead to wasteful duplication of effort and resources and lost opportunities" (p. 58). Furthermore, Farley and Taylor (2004) conjectured that, "If we continue to teach all skills in isolation, we can only reinforce the idea that we acquire different skills for use in different subject areas" (p. 8). Therefore, creating educational models that integrate academic and agricultural education is of concern.

Whent (1994) stated, "The potential for collaboration between agriculture and science teachers is tremendous" (p. 17). Although, many researchers have echoed this statement, little evidence of effective collaboration has been observed (Conroy & Walker, 2000; Dormody, 1992, 1993; Eisenman, Hill, Bailey, & Dickinson, 2003; Farley & Taylor, 2004; Hernandez & Brendefur, 2003; Inger, 1993; Layfield, Minor, & Waldvogel, 2001; Leonard, 2002; Leonard & Leonard, 2003; Leonard & Leonard, 2001; Little, 1982; Osborne & Dyer, 1998; Roberson et al., 2001; Scott & Smith, 1987; Warnick & Thompson, 2007; Warnick, Thompson, & Gummer, 2004; Whent; Wicklein & Schell, 1995). Dormody (1993) called for teachers to eliminate barriers and establish collaborative relationships. Prior research has shown that agriculture and science departments most often reported sharing equipment and supplies, whereas instructional materials and ideas were least shared (Dormody, 1992, 1993; Little; Osborne & Dyer, 1998). Whent further indicated that a significant factor hindering resource sharing was teacher unfamiliarity of curriculum and resource similarities. Research has consistently concluded that vocational programs have encouraging attitudes toward academic integration and recognize collaborative integration benefits (Balschweid & Thompson, 2002; Conroy, 1999; Conroy & Walker; Eisenman et al.; Knobloch & Martin, 2002; Layfield et al.; Osborne & Dyer, 1998; Roberson et al.; Rudd & Hillison, 1995; Schmidt, 1992; Shelley-Tolbert, Conroy, & Dailey, 2000; Thompson, 1998; Thompson & Balschweid, 1999, 2000; Warnick & Thompson; Warnick et al.; Whent; Wilson & Flowers, 2002; Wilson, Kirby, & Flowers, 2002).

Researchers have identified administrators as having a crucial role in effective collaboration (Austin & Baldwin, 1992; Hernandez & Brendefur, 2003; Leonard & Leonard, 2003; Roberson et al., 2001; Scott & Smith, 1987; Wicklein & Schell, 1995). Additionally, adequate administrator support was found to be directly correlated to successful integration (Conroy & Walker, 2000; Thompson, 1998; Thompson & Balschweid, 1999, 2000). However, a lack of teacher and administrator commitment to complete tasks has been observed (Conroy, 1999; Farley & Taylor, 2004; Leonard & Leonard, 2003; Wicklein & Schell).

Conroy and Walker (2000), Dormody (1993), Inger (1993), Scott and Smith (1987), and Whent (1994) posited that territorial issues often physically separate, socially divide, and limit multidisciplinary collaboration. Furthermore, agricultural education is often tagged as inferior and nonacademic, therefore hindering collaboration between departments (Inger; Shelley-Tolbert et al., 2000). Subsequently, when barriers were removed, interdisciplinary collaboration and integration was found effective (Conroy & Walker; Eisenman et al., 2003; Inger; Schmidt, 1992).

Past experiences, personal training, and knowledge of subject matter have been shown to influence teacher adoption of new curriculum and collaboration (Balschweid & Thompson, 2002; Conroy, 1999; Conroy & Walker, 2000; Dormody, 1993; Inger, 1993; Knobloch & Martin, 2002; Layfield et al., 2001; Rudd & Hillison, 1995; Thompson, 2001; Thompson & Balschweid, 1999, 2000; Wilson & Flowers, 2002; Wilson et al., 2002; Warnick & Thompson, 2007; Warnick et al., 2004). Balschweid and Thompson, Thompson and Balschweid (1999, 2000), Thompson and Schumacher (1998), and Wilson et al. reported findings indicating lack of agriscience workshops as a major barrier to integration. Additionally, time was found to be a significant barrier to teacher integration and collaboration (Conroy; Conroy & Walker; Eisenman et al., 2003; Farley & Taylor, 2004; Inger; Leonard, 2002; Leonard & Leonard, 2003; Leonard & Leonard, 2001; Little, 1982; Roberson et al., 2001; Sadowski, 1995; Schmidt, 1992; Scott & Smith, 1987; Thompson 1998; Whent, 1994). These researchers have suggested that administrators schedule adequate planning time for developing collaboratively integrated curriculum.

"Together teachers have the organizational skills and resources to attempt innovations that would exhaust the energy, skill, or resources of an individual teacher" (Inger, 1993, p. 2). Successful collaboration of science and agricultural education is a noble task. Collaborative efforts have the potential to foster decision making skills, cognitive skills, and critical thinking skills as well as to enhance student comprehension of scientific principles by linking science with real-world applications. However, few researchers have provided plausible collaboration models for science and agriculture teachers to effectively broaden curricula and augment knowledge transfer for improved student learning, retention, and application. Thus, additional research identifying effective collaboration models for science and agriculture teachers has been highly recommended (Hernandez & Brendefur, 2003; Osborne & Dyer, 1998;

Warnick & Thompson, 2007; Warnick et al., 2004; Wicklein & Schell, 1995).

Purpose/Objectives

The purpose of this study was to determine current levels of science and agriculture teacher collaboration and to explore factors facilitating collaboration in secondary schools. More specifically, the study was intended to address the following objectives:

1. Determine to what extent science and agriculture teachers value collaborative practices;
2. Determine the type and frequency of collaboration occurring between science and agriculture teachers;
3. Identify factors that facilitate collaboration; and,
4. Identify barriers that inhibit collaboration.

Methods/Procedures

Descriptive survey methods were used to explore all secondary science teachers (N = 312) who taught in schools with agricultural programs and all secondary agriculture teachers (N = 81) during the 2005-2006 school year in Utah. Science teachers employed at schools with no agricultural program were not included in the population. The state educational offices provided the researchers with a current database containing the name and address of each science and agriculture teacher. Generalizing the study results beyond the identified population should be done with caution.

The literature identified no survey instrument that suitably matched the objectives of this study. Instruments in related literature were reviewed providing guidelines for adapting the Integrating Science Survey Instrument developed by Thompson and Schumacher (1998). To ensure that every participant would accurately interpret and willingly respond, wording of each statement was adjusted specifically for participants by creating two forms of the questionnaire, one for agriculture teachers and one for science teachers (Dillman, 2000). Evidence of face and content validity was acquired by a panel of experts consisting of university agricultural teacher educators and state supervisors of agricultural education. Post hoc analysis using Cronbach's alpha was conducted to estimate reliability of the instrument. Internal consistency for the science form was measured at a = 0.88 and the agriculture form was measured at a = 0.91.

Data were collected using Dillman's (2000) tailored design methods. A prenotice letter was sent to participants 1 week prior to the survey. Questionnaire packets containing a detailed cover letter, a token of appreciation, and a stamped, self-addressed return envelope were sent the third week of October. Thank-you/reminder postcards expressing appreciation to respondents and encouraging nonrespondents to reply were sent one week after the questionnaires. Replacement survey packets were sent to nonrespondents three weeks after the initial survey mailing. Useable responses were received from 157 science teachers (50.3%) and from 63 agriculture teachers (77.8%). A t-test was used to control for nonresponse error by comparing early and late respondents. Participants who responded after the second follow-up where considered late respondents. The summed responses of the 105 early respondents were compared to the summed responses of the 115 (52.3%) late respondents which indicated no statistically significant difference between early and late respondents, $t(217) = -1.641$, $p = .108$ (two tailed) (Linder, Murphy, & Briers, 2001).

The instrument consisted of five parts. Part one addressing the value of collaboration, part three addressing factors facilitating collaboration, and part four addressing barriers inhibiting collaboration requested subjects to respond to statements utilizing 5-point summated scale scores with a 1 representing strongly disagree, 2 for disagree, 3 for neutral, 4 for agree, and 5 for strongly agree. Part two asked subjects to respond to statements concerning types and frequency of collaboration occurring utilizing a 4-point summated scale score indicating 1 for never, 2 for seldom, 3 for sometimes, and 4 for often. Part five called for subjects to report demographic information. Data collected from the instrument were entered into Microsoft Excel and imported into the Statistical Package for the Social Sciences (SPSS version 13.0) and analyzed. Data from objectives 1, 2, 3, 4, and 5 were analyzed using descriptive statistics (frequencies, percentages, means, and standard deviations). To simplify reporting, frequencies and percentages for strongly agree and agree were collapsed into agree and those for strongly disagree and disagree were collapsed into disagree. The 4-point scale was individually reported as never, seldom, sometimes, and often. Responses by question and construct from science and agriculture teachers were compared using the Mann-Whitney *U* Test. The test was chosen because of the ordinal nature of the data (summated scale responses) and the independence of the sample groups (Mertens, 1997). The alpha level for statistical significance was set *a priori* at .05.

Results/Findings

Research objective 1 sought to determine the extent science and agriculture teachers value collaboration (Table 1). Science (77.7%) and agriculture (84.1%) teachers collectively agreed that collaboration allows students to understand the relationship of science and agriculture. The majority of science (77.1%) and agriculture (81.0%) teachers signified that collaboration reduced separation between teachers. Both groups (77.7% science; 79.4% agriculture) agreed that collaboration broadens school curricula. Additionally, 72.0% of science teachers and 77.8% of agriculture teachers concurred that collaboration enhances student comprehension of scientific concepts. Some disagreement was evident since 76.2% of agriculture and 64.3% of science teachers responding positively that collaboration improves student learning.

Table 1
Extent to Which Science and Agriculture Teachers Value Collaboration

Question	Science A / DA %	Agriculture A / DA %	Mann-Whitney *U* *p* value
Collaboration is an appropriate use of teachers' time	65.0 / 8.3	68.3 / 3.2	$U = 3959.0$ $p = .607$
Collaboration broadens school curricula	77.7 / 3.2	79.4 / 3.2	$U = 3996.0$ $p = .664$
Collaboration reduces separation between teachers	77.1 / 1.9	81.0 / 4.8	$U = 3724.5$ $p = .418$
Collaboration will improve student learning	64.3 / 1.9	76.2 / 3.2	$U = 3464.5$ $p = .049$
Collaboration makes learning more meaningful to students	68.2 / 2.5	60.3 / 6.4	$U = 3764.5$ $p = .282$
Collaboration enhances student comprehension of scientific concepts	72.0 / 2.5	77.8 / 1.6	$U = 3857.5$ $p = .392$
Collaboration allows students to understand the relationship of science and agriculture	77.7 / 1.3	84.1 / 3.2	$U = 3859.0$ $p = .382$

Note: A = agree, DA = disagree. Strongly agree and agree are collapsed into the agree column and strongly disagree and disagree are collapsed into the disagree column.

Research objective 2 aimed to determine the type and frequency of collaboration currently occurring. Eleven statements were statistically significant addressing the frequency of collaboration between the groups (Table 2). Statistically significant statements included attending workshops, attending departmental meetings, joint lesson planning, team teaching, observing teachers teach, developing assignments that reinforce science or agriculture, guest lecturing, sharing integrated curriculum, sharing equipment and supplies, asking for assistance, and offering equipment, supplies, facilities, etc. The majority of science teachers reported that they had never guest lectured (82.8%), team taught (80.3%), attended workshops (77.1%), observed agriculture teachers teach (65.6%), jointly planned lessons (65.0%), and attended agricultural departmental meetings (65.0%). Fewer signified that they had seldom asked for assistance (27.4%), shared instructional techniques (26.1%), offered equipment, supplies, facilities, etc. (24.2%), and solved disciplinary problems (23.6%). They reported sometimes offering equipment, supplies, facilities, etc. (26.1%), sharing instructional techniques (24.2%), asking for assistance (21.0%), and sharing science curriculum (21.0%). Furthermore, few science teachers reported they had often shared equipment and supplies (14.6%), shared facilities (2.7%), offered equipment, supplies, facilities, etc. (9.6%), shared science curriculum (7.6%), shared equipment and supplies (14.6%), and attended agricultural departmental meetings (5.1%).

Table 2
Science and Agriculture Teachers' Frequency of Collaboration

Question	Never Sci / Ag %	Seldom Sci / Ag %	Sometimes Sci / Ag %	Often Sci / Ag %	Mann-Whitney *U* *p* value
Attending workshops	77.1 / 9.2	8.9 / 20.6	10.2 / 22.2	0.6 / 7.9	*U* = 3277.0 *p* = .000
Attending departmental meetings	65.0 / 39.7	17.8 / 22.2	8.9 / 19.0	5.1 / 19.0	*U* = 3257.0 *p* = .000
Joint lesson planning	65.0 / 49.2	16.6 / 20.6	10.8 / 15.9	4.5 / 12.7	*U* = 3795.0 *p* = .010
Team teaching	80.3 / 71.4	13.4 / 11.1	2.5 / 11.1	0.6 / 6.3	*U* = 4136.5 *p* = .026
Guest lecturing	82.8 / 71.4	9.6 / 15.9	3.2 / 9.5	0.6 / 3.2	*U* = 4027.0 *p* = .009
Observing teachers teach	65.6 / 47.6	20.4 / 33.3	9.6 / 14.3	1.3 / 4.8	*U* = 3796.5 *p* = .006
Solving disciplinary problems	51.6 / 44.4	23.6 / 25.4	19.1 / 19.0	3.2 / 11.1	*U* = 4263.5 *p* = .148
Developing assignments that reinforce sci/ag	61.1 / 34.9	19.7 / 15.9	14.0 / 34.9	1.9 / 14.3	*U* = 3014.5 *p* = .000
Sharing integrated curriculum	64.3 / 34.9	17.2 / 30.2	12.7 / 23.8	3.2 / 11.1	*U* = 3229.0 *p* = .000
Sharing science/ agriculture curriculum	46.5 / 34.9	21.7 / 28.6	21.0 / 30.2	7.6 / 6.3	*U* = 4222.5 *p* = .148
Sharing instructional techniques	41.4 / 31.7	26.1 / 25.4	24.2 / 36.5	0.6 / 7.9	*U*= 4152.0 *p* = .092
Sharing equipment and supplies	36.9 / 22.2	21.7 / 20.6	24.8 / 30.2	14.6 / 20.7	*U*= 3780.0 *p* = .008
Sharing facilities	49.7 / 47.6	16.6 / 19.0	19.1 / 15.9	2.7 / 17.5	*U* = 4666.0 *p* = .635
Asking for assistance	46.5 / 20.6	27.4 / 34.9	21.0 / 30.2	3.2 / 14.3	*U* = 3267.5 *p* = .000
Offering equipment, supplies, facilities, etc.	36.9 / 22.2	24.2 / 27.0	26.1 / 28.6	9.6 / 20.6	*U* = 3733.5 *p* = .013

The majority of agriculture teachers reported that they had never guest lectured (71.4%), team taught (71.4%), joint lesson planned (49.2%), attended collaborative workshops (49.2%), observed science teachers teach (47.6%), and shared facilities (47.6%). Fewer reported they seldom asked for assistance (34.9%), observed science teachers teach (33.3%), shared integrated curriculum (30.2%), and shared agriculture curriculum (28.6%). They reported sometimes sharing instructional techniques (36.5%), developing science reinforcing assignments (34.9%), sharing equipment and supplies (30.2%), asking science teachers for assistance (30.2%), and sharing agriculture curriculum (30.2%). Furthermore, some agriculture teachers reported they often shared equipment and supplies (27.0%), offered equipment, supplies, facilities, etc. (20.6%), attended science departmental meetings (19.0%), shared facilities (17.5%), developed science reinforcing assignments (14.3%), and asked for assistance (14.3%).

Research objective 3 was designed to identify factors facilitating collaboration. Two statements were statistically significant including science teachers' attitude toward agriculture and reorganizing curriculums to synchronize with science or agriculture. A larger percentage of agriculture teachers (76.2%) than science teachers (58.0%) agreed that participating in agriscience workshops develops collaborative relationships that increase collaboration (Table 3). In addition, 60.5% of science and 69.8% of agriculture teachers agreed that synchronizing science/ agriculture curriculum with agriculture/ science curriculum promotes collaboration.

A majority of science (84.1%) and agriculture teachers (81.0%) agreed that close proximity of facilities promotes collaboration. Additionally, 82.2% of science and 85.5% of agriculture teachers agreed that teacher commitment was essential. Both groups, (81.5% science; 79.4% agriculture) agreed that providing incentives facilitates collaboration. Many science (75.8%) and agriculture (88.9%) teachers indicated that agriculture teacher attitudes toward science influenced collaboration. Moreover, 88.9% of agriculture and 77.1% of science teachers indicated that science teacher's attitudes toward agriculture promote collaboration. Both science (79.6%) and agriculture (82.5%) teachers agreed that administrators allocating resources promotes collaboration. Furthermore, 75.2% of science teachers and 77.8% of agriculture teachers agreed that administrators that schedule ample collaboration time promote collaboration. Approximately three-fourths of agriculture (76.1%) and science (75.8%) teachers agreed that frequent interaction with science/agriculture faculty stimulates collaboration.

Research objective 4 sought to identify barriers inhibiting collaboration (Table 4). Both science (82.8%) and agriculture (77.8%) teachers indicated that lack of preparation time was the most significant barrier. A larger number of science teachers (73.2%) than agriculture teachers (57.1%) indicated that lack of common teacher preparation time was noteworthy. Approximately two-thirds of agriculture teachers (66.7%) and half of science teachers (51.6%) agreed that lack of appropriate equipment was significant. Moreover, the majority of science (70.7%) and agriculture (57.1%) teachers concurred that their lack of awareness of similarities in agriculture and science curriculum inhibited collaboration.

Table 3
Factors Facilitating Science and Agriculture Teacher Collaboration

Question	Science A / DA %	Agriculture A / DA %	Mann-Whitney *U* *p* value
The agriculture teacher's attitude toward science	75.8 / 3.8	88.9 / 1.6	$U = 4357.0$ $p = .155$
The science teacher's attitude toward agriculture	77.1 / 6.3	88.9 / 1.6	$U = 4059.5$ $p = .032$
The agriculture teacher's scientific knowledge	65.0 /10.2	69.8 / 3.2	$U = 4582.0$ $p = .611$
The science teacher's agricultural knowledge	63.1 / 9.6	73.0 / 1.6	$U = 4249.5$ $p = .163$
Administrators that schedule ample time	75.2 / 8.3	77.8 / 11.1	$U = 4609.0$ $p = .727$
Administrators that allocate resources	79.6 / 7.6	82.5 / 7.9	$U = 4737.0$ $p = .860$
Administrators that outline expectations	63.1 / 10.8	69.8 / 12.7	$U = 4585.0$ $p = .574$
Providing incentives	81.5 / 3.8	79.4 / 4.8	$U = 4753.5$ $p = .888$
Close proximity	84.1 / 1.9	81.0 / 3.2	$U = 4671.5$ $p = .781$
Having common preparation	64.3 / 7.0	60.3 / 9.5	$U = 6477.0$ $p = .740$
Frequent professional interaction	75.8 / 5.1	76.1 / 4.8	$U = 4655.0$ $p = .683$
Agriculture teachers with science credentials	65.0 / 7.0	55.6 / 6.3	$U = 4567.5$ $p = .676$
Reorganizing sci/ag curriculum to synchronize with ag/sci	60.5 / 9.6	69.8 / 7.9	$U = 3921.5$ $p = .035$

Note: A = agree, DA = disagree. Strongly agree and agree are collapsed into the agree column and strongly disagree and disagree are collapsed into the disagree column.

Table 4
Barriers Inhibiting Science and Agriculture Teacher Collaboration

Question	Science A / DA %	Agriculture A / DA %	Mann-Whitney *U* *p* value
Lack of adequate funding	59.9 / 12.1	50.8 / 11.1	$U = 4373.0$ $p = .259$
Lack of common teacher preparation time	73.2 / 6.3	57.1 / 17.5	$U = 3964.5$ $p = .023$
Lack of preparation time	82.8 / 5.7	77.8 / 9.5	$U = 4381.0$ $p = .256$
Lack of appropriate facilities	54.1 / 19.7	63.5 / 17.5	$U = 4273.0$ $p = .169$
Lack of appropriate equipment	51.6 / 19.7	66.7 / 17.5	$U = 4040.0$ $p = .050$
Lack of administrative support	45.9 / 20.4	46 / 30.2	$U = 4608.0$ $p = .597$
Lack of awareness of available resources	57.3 / 14.0	61.9 / 20.6	$U = 4763.5$ $p = .949$
Lack of awareness of curriculum similarities	70.7 / 13.4	57.1 / 27.0	$U = 3976.5$ $p = .028$
Lack of agriscience workshops	66.2 / 8.3	55.6 / 12.7	$U = 4048.5$ $p = .055$
Lack of teacher commitment	59.2 / 19.1	54.0 / 12.7	$U = 4659.5$ $p = .742$
Increased years of experience reduce willingness to collaborate	29.3 / 37.6	41.3 / 23.8	$U = 3920.0$ $p = .026$
Misconceptions and superiority ranking of academic departments	24.2 / 38.9	65.1 / 7.9	$U = 2195.5$ $p = .000$
Territorial competition	33.1 / 36.9	52.4 / 17.5	$U = 3230.5$ $p = .000$
Concern of losing SAE and FFA	19.7 / 21.7	49.2 / 26.9	$U = 3600.0$ $p = .005$

Note: A = agree, DA = disagree. Strongly agree and agree are collapsed into the agree column and strongly disagree and disagree are collapsed into the disagree column.

Two-thirds (65.1%) of agriculture teachers and one-fourth (24.2%) of science teachers identified concerns of superiority ranking of academic departments. Agriculture teachers (52.4%) agreed that territorial competition hindered collaboration. Furthermore, 49.2% of agriculture teachers signified a concern of losing SAE and FFA programs. Fewer science teachers (29.3 %) than agriculture teachers (41.3%) agreed that increased years of teaching experience reduced teacher willingness to collaborate.

Conclusions/Implications

Many science and agriculture teachers hold positive attitudes concerning the potential of collaboration. Science and agriculture teachers collectively agreed that collaboration, (a) broadens school curricula, (b) reduces separation between teachers, (c) enhances student comprehension of scientific concepts, and (d) allows students to understand the relationship and importance of science and agriculture in today's society. These findings concur with studies conducted by Dormody (1993), Eisenman et al. (2003), Inger (1993), Leonard (2002), Roberson et al. (2001), Warnick et al. (2004), and Whent (1994).

Study results indicated that effective collaboration is limited, which supports previous research (Conroy & Walker, 2000; Dormody, 1992; Farley & Taylor, 2004; Hernandez & Brendefur, 2003; Inger, 1993; Layfield et al., 2001; Leonard, 2002; Leonard & Leonard, 2003; Leonard & Leonard, 2001; Little, 1982; Osborne & Dyer, 1998; Roberson et al., 2001; Scott & Smith, 1987; Warnick et al., 2004; Warnick & Thompson, 2007; Whent, 1994; Wicklein & Schell, 1995). Science teachers indicated less collaboration occurring than agriculture teachers. The majority of science and agriculture teachers concurred that they had never or seldom guest lectured, team taught, or attended workshops. Furthermore, groups identified offering equipment, supplies, facilities, etc., sharing equipment and supplies, and sharing instructional techniques as collaborative activities that occurred, mirroring findings from previous studies (Dormody, 1992, 1993; Little, 1992; and Osborne & Dyer, 1998). The results of this study indicate that agriculture teachers were more willing to offer equipment, supplies, and facilities and ask for assistance than science teachers.

The large majority of science teachers indicated that they have not attended workshops demonstrating agriscience integration, also coinciding with prior research (Balschweid, 2002; Balschweid & Thompson, 2002; Conroy, 1999; Conroy & Walker, 2000; Dormody, 1992, 1993; Eisenman et al., 2003; Farley & Taylor, 2004; Inger, 1993; Knobloch & Martin, 2002; Layfield et al., 2001; Leonard, 2002; Leonard & Leonard, 2003; Leonard & Leonard, 2001; Little, 1982; Osborne & Dyer, 1998, 2000; Roberson et al., 2001; Rudd & Hillison, 1995; Schmidt, 1992; Shelley-Tolbert et al., 2000; Thompson, 1998, 2001; Thompson & Balschweid, 1999, 2000; Thompson & Schumacher, 1998; Warnick & Thompson, 2007; Warnick et al., 2004; Wicklein & Schell, 1995; Wilson & Flowers, 2002; Wilson et al., 2002) recommending that agriscience inservice workshops be designed to enhance teachers' skills and to promote collaboration.

Similar to prior research, both groups identified lack of teacher preparation time as the most noteworthy barrier inhibiting collaboration (Conroy, 1999; Conroy & Walker, 2000; Eisenman et al., 2003; Farley & Taylor, 2004; Inger, 1993; Leonard, 2002; Leonard & Leonard, 2003; Leonard & Leonard, 2001; Little, 1982; Roberson et al., 2001; Sadowski, 1995; Schmidt, 1992; Scott & Smith, 1987; Thompson 1998; Whent, 1994). The findings indicated that both groups were unaware of similarities in curriculum, therefore supporting Whent's research. Research showed that territorial issues physically separate, socially divide, and limit multidisciplinary collaboration, sustaining research by Conroy and Walker, Dormody (1993), Inger, Scott and Smith, Shelley-Tolbert et al. (2000), and Whent. Moreover, both groups indicated the following facilitators of collaboration: administrators that allocate time and resources, providing incentives, close proximity of facilities, teacher commitment, teacher's attitude toward science and agriculture, and frequent professional interaction.

Recommendations

Based on the findings of this study, the researchers recommend that teacher education programs in agriculture instill positive perceptions toward collaborating with academic teachers. This can be accomplished through the implementation of collaborative projects with preservice science teachers. Inservice workshops should be designed and delivered to enhance teachers' agriscience skills and to promote collaboration between science and agriculture teachers. Workshops should be focused on training teachers to implement agriscience curriculum.

Further analysis of the data from this study should be conducted to determine correlations and relationships of demographic variables as they pertain to teachers' frequency and willingness to collaborate. Further research to investigate personal and environmental factors that facilitate and establish effective collaboration between science and agriculture teachers should be conducted. Additional research to examine territorial contention and competition between academic departments and agriculture departments is recommended. Research should focus on resolving misconceptions and superiority inculcations of academic departments and agriculture departments. It is recommended that a qualitative case study of teachers that collaborate be conducted to determine the predictors of agriculture and science teachers who are currently collaborating. A study to determine which model(s) of science and agriculture teacher collaboration achieves effective results should also be conducted. Results of that study should then be used to determine methods to be emphasized in teacher training workshops and in preservice teacher education.

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