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Factors Influencing Resource Sharing Between Agriculture and Science Teachers Participation in the AgriScience Program

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As American agriculture becomes more scientific and technological, more science knowledge and skills are demanded of its workforce. Neville Clarke, Director of the Texas Agricultural Experiment Station stated, "Today, agriculture needs a new infusion of science and technology and new capabilities that will restore and enhance the competitiveness of U.S. agriculture in the work market place" (Clarke, 1986, p. 37). To address this problem many agriculture teachers have sought to consciously integrate science concepts into the courses they teach. Roegge and Russell (1988) conducted a study to determine how well agriculture and biology could be integrated in a high school setting. They found that the integrated approach was superior to the traditional approach in producing higher overall achievement.

Understanding Agriculture (1988, p. 62) stated, "As students progress through school, instruction should continue to illuminate the links between science, society, and practical problems" and [w]hether vocational agriculture will flourish under the new [educational] requirements will depend at least in part on its own capacity to be flexible and scientifically rigorous." The California High School Task Force stated in Second to None: A Vision of the New California High School (1992, p. 7), "If we have learned anything about educational reform during the decade of the 1980's, it has been that single initiatives cannot simply operate in isolation." They recommended that students "choose an organized program around a special focus that combines academic, applied academic, and field experiences" (p. 21).

Dormody (1991) conducted a national study to explore the resource sharing between secondary school agricultural education teachers and science departments. He found that 60 percent of the teachers surveyed had shared some resource(s) with the science department during the 1989-90 academic year. Fifty-eight percent had shared equipment and supplies, whereas only 24 percent had provided instructional services. A significantly higher percentage of agriculture teachers shared facilities with a science department than utilized science department facilities.

It is not uncommon for agriculture teachers to spend many years teaching in the same school and yet have little or no idea what the biology teachers are doing in their classrooms. With current educational trends mandating a move toward integration in education, consideration should be given to the barriers in teaching that promote isolation between subject areas; research should then be done to determine which procedures/alterations may be effective in breaking down those barriers. The AgriScience Institute and Outreach Program was designed to bridge the gap between agriculture and science education (Whent and Greenler, 1991 and Whent, 1992).

The AgriScience Institute and Outreach program tested a model to integrate agriculture and science education in a variety of high schools across the United States. The program model focused on integrating agriculture and science education in two phases. The first phase involved forming collaborative science and agriculture teaching teams to develop and test AgriScience laboratory exercises. Ten agriculture and science teacher teams attended a two-week AgriScience Institute at the University of Wisconsin, Madison campus. During the institute, the teacher teams working in collaboration with university researchers developed AgriScience instructional materials. In the fall of 1991, the teacher teams returned to their classrooms to field test the instructional materials that had been developed.

The second phase of the program comprised a two-day train-the-trainer meeting at the University of California, Davis. The trained teachers then conducted workshops in their region of the United States. In spring, summer and fall of 1992, a total of 63 Outreach Workshops were conducted in the continental United States and in

Alaska.

Purpose and Objectives

The purpose of this study was to explore resource sharing between agriculture and science teachers who participated in the AgriScience Institute and Outreach Program. Specific objectives were to:

Determine if participation in the program increased the sharing of resources between science and agriculture teacher participants.

Determine differences between sharing of resources and facilities between agriculture and science teachers.

Determine if differences existed between resource sharing between Phase I and Phase II of the program.

Identify specific resources commonly shared by agriculture and science teachers participating in the program.

Identify barriers inhibiting the cooperation and resource sharing between agriculture and science teachers.

Procedures

Ten agriculture/science teacher teams were selected for the study through a national search effort. During the winter of 1991, letters were sent to state agriculture supervisors and department heads in the field of agriculture teacher education throughout the United States. (These state supervisors and teacher educators were asked to nominate agriculture and science teacher teams from their state to participate in this program.) Specific selection criteria included the following:

Teacher teams had to consist of an agriculture teacher and a biological science teacher from the same school district.

Teachers had to make a two-year commitment to the program.

Teachers had to agree to become a continuing resource for other teachers in their region.

Teachers had to summit evidence of:

Teaching excellence
Leadership within their teaching field
A high level of communication skill.
Affiliation with professional associations and local resource networks

Teachers had to provide evidence of their school administrators' support.

Two hundred fifty nominations were received and all were sent application forms. Completed applications were received from 84 teams. A selection committee of four, comprised of agriculture and science teachers and agriculture teacher educators, selected ten teams for this program.

The research methodology used a panel longitudinal research design methodology. Questionnaires were administered three times between July 1991 and December 1992. Two questionnaires were used, both modified forms of the questionnaire developed by Dormody (1991). One questionnaire collected data from science teachers and the other collected data from agriculture teachers. The questionnaires contained two Likert-type scales, each containing five resource-sharing indicators representing the resource categories of 1) instructional services (e.g., team teaching, quest lecturer and teaching as part of a panel): 2) equipment and supplies (e.g., glassware, microscopes and shop equipment); 3) instructional materials (e.g., textbooks, lesson plans and films); 4) program support services (e.g., advise students, member of advisory committee and physical work); and 5) facilities (e.g., land lab, biology lab, and greenhouse (Dormody, 1991). The first scale on the agriculture teacher questionnaire measured use of science department resources while the second scale measured resources shared with the science department. The first scale on the science teacher questionnaire measured use of agriculture department resources and the second scale measured science resources shared with the agriculture department. Responses were recorded using the following four point Likert scale: not all (1), once/twice (2), a few times (3), and many times (4).

Both questionnaires contained a check-list of shared resources for each of the five resource categories. The agriculture teacher questionnaire contained a check-list that identified resources provided by the science department, and the science teacher questionnaire contained a check-list identifying resources provided by the agriculture department. Each check-list provided an additional category wherein teachers could identify shared resources that had not been included on the questionnaire. Cronbach's Alpha reliability coefficients for the two scales measuring sharing of departmental resources and use of other departmental resources were .81 and .88, respectively (Dormody, 1991).

Participants were mailed questionnaires as a pre-measure prior to coming to the two-week AgriScience Institute at the University of Wisconsin, Madison, in July, 1991. Participants were mailed a second questionnaire after completing the field testing of the instructional materials (Phase I). The third questionnaire was mailed to participants after completion of the Outreach Workshops (Phase II). During each of the three mailings above, nonrespondents received personal phone calls asking them to return their survey. Nine of the original ten teams completed the study. Descriptive statistics were calculated using the Statview program for statistical analysis.

Results

The mean age of the agriculture teachers was 37.6, ranging from 28 to 55; and the mean age of science teachers was 41, ranging from 31 through 59 years of age. Science teachers had a mean of 15 years of teaching, ranging from 5 to 24 years. Agriculture teachers had a mean of 12 years of teaching, ranging from 3 to 33 years. The science teachers comprised: 7 white males, one black female, and one Filipino female; the agriculture teachers included 7 white males and 2 white females.

All but two teacher teams taught in the same school. Five teams taught in rural schools (town under 9,999); three teams taught in suburban schools (town/city 10,000 to 50,000); and one team taught in an urban school (city over 100,000). All agriculture teachers in this study but one were from single-teacher agriculture departments. The mean number of science teachers per science department was 5.4, ranging from 1 to 14.

The mean rating of the level of resources used by agriculture and science teachers are presented in Table 1. Table 2 presents the resources shared with another department (agriculture or science). Both tables present mean ratings calculated from data collected during the three measurement periods (pre-measure, mid-measure and post-measure) of resource sharing for both agriculture and science teachers. Combined means on both tables reflect the means of both agriculture and science teachers. The mean totals in both tables indicate an increasing trend in both use of and sharing of resources between the science and agriculture teachers from pre-measure through post-measure. There appeared to be little difference between agriculture and science teachers with regard to use of resources. See Table 2. Agriculture teachers reported slightly higher mean scores on the premeasure, mid-measure and post-measure regarding the sharing of materials with the science department. The dichotomy may be explained by single agriculture teachers sharing resources with several science teachers in a school.

Mean differences were calculated to determine changes from pre-measure, mid-measure and post-measure between science and agriculture teachers in their sharing of resources. A positive difference reflected an increased use of resources from pre-measure to mid-measure during Phase I of the program, and from mid-measure to post-measure during Phase II of the program. Negative differences reflect a decreased use of resources from one measure to the next. Table 3 presents the mean changes of resources used from another department (agriculture or science) during Phases I and II of the program. Table 4 presents the mean changes of resources shared with another department (agriculture or science) during Phases I and II of the program. The science teachers reported a greater change in both their use of agriculture resources and their sharing of science resources during Phase II of the program. These results may be explained by the lower pre-measure means of the science teachers in both tables. The agriculture teachers reported a greater change in both resources sharing with the science department and resources used from the science department

Table 1. Resources Used from Another Department (Agriculture or Science)

Category of Resource	Pre-measure July 1991			Mid-measure February 1992			Post-measure December 1992		
	1[a] Mean	2[b] Mean	3[c] Mean	1 Mean	2 Mean	3 Mean	1 Mean	2 Mean	3 Mean
	N=9	N=9	N=18	N=9	N=9	N=18	N=9	N=9	N=18
Instructional services	1.50	1.17	**1.38**	1.67	1.75	**1.71**	2.12	1.56	**1.82**
Equipment ande supplies	2.90	2.17	**2.63**	3.56	3.14	**3.36**	3.50	3.33	**3.41**
Instructional materials	2.00	1.43	**1.77**	2.78	2.50	**2.65**	2.75	2.67	**2.71**
Program support services	2.20	2.00	**2.11**	2.78	3.00	**2.88**	3.13	3.33	**3.24**
Facilities	1.40	1.88	**1.61**	1.78	2.50	**2.12**	2.10	2.67	**2.41**
Mean Totals	**2.00**	**1.73**	**1.90**	**2.51**	**2.58**	**2.54**	**2.72**	**2.71**	**2.72**

[a]Agriculture Teachers
[b]Science Teachers
[c]Combined

Table 2. Resources Shared with Another Department.

	Pre-measure July 1991			Mid-measure February 1992			Post-measure December 1992		
	1[a] Mean	2[b] Mean	3[c] Mean	1 Mean	2 Mean	3 Mean	1 Mean	2 Mean	3 Mean
	N=9	N=9	N=18	N=9	N=9	N=18	N=9	N=9	N=18
Instructional services	1.50	1.00	**1.28**	1.36	1.13	**1.25**	2.25	1.56	**1.88**
Equipment and supplies	2.67	2.13	**2.41**	3.00	3.00	**3.00**	3.25	3.11	**3.18**
Instructional materials	2.10	1.67	**1.88**	2.63	2.38	**2.50**	3.00	2.33	**2.65**
Program support services	2.00	2.12	**2.06**	3.11	2.63	**2.88**	2.88	2.89	**2.89**
Facilities	2.20	1.63	**1.94**	2.25	2.25	**2.25**	3.00	2.25	**2.64**
Mean Totals	**2.09**	**1.71**	**1.91**	**2.47**	**2.28**	**2.38**	**2.88**	**2.42**	**2.65**

[a]Agriculture Teachers
[b]Science Teachers
[c]Combined

during Phase II of the program. Since Phase II was the inservice phase of the program, it may be speculated that the agriculture teachers were more involved with the growing and supplying of plants and other agricultural materials for the science teachers in preparation for the Outreach Workshops.

Specific resources commonly shared by agriculture and science teachers in the program are presented in Table 5. Responses on the check-list portions of the questionnaires were summarized from the three measurement intervals. In general, more agriculture teachers checked resources received from the science department than science teachers checked resources received from the agriculture department. The instructional services most often shared with other teachers were team teaching and/or teaching the other teacher's class. The most common supplies and equipment provided to science teachers by the agriculture department were growing plants materials. Both groups reported similar levels of sharing program support services. The most commonly reported facilities provided by the science department was the use of biology lab, and the facility most commonly provided by the agricultural department was the agricultural mechanics lab.

Data on barriers to cooperation were collected through open-ended questions. Teachers were asked to list specific barriers to sharing of resources encountered during the program. Four major barriers to sharing of resources were indicated: 1) an initial lack of understanding of what the other teacher teaches and the resources

Table 3. Changes in the Mean Resources Used from Another Department (Science of Agriculture) During Phase I and Phase II of the AgriScience Institute and Outreach Program

Resource category	Phase I Agriculture N=9	Phase I Science N=9	Phase I Combined N-18	Phase II Agriculture N=9	Phase II Science N=9	Phase II Combined N=18
Instructional services	.17	.58	.33	.45	-.19	.11
Equipment and supplies	.66	.97	.73	-.06	.19	.05
Instructional materials	.78	1.07	.88	-.03	.17	.06
Program support services	.58	1.00	.77	.35	.33	.36
Facilities	.38	.62	.51	.32	.17	.29
Total change	2.57	4.24	3.22	1.03	.67	.87

Table 4. Changes in the Mean Resources Shared with Another Department (Science or Agriculture) During Phase I and Phase II of the AgriScience Institute and Outreach Program

Resource category	Phase I Agriculture N=9	Phase I Science N=9	Phase I Combined N=18	Phase II Agriculture N=9	Phase II Science N=9	Phase II Combined N=18
Instructional services	-.14	.13	-.03	.89	.43	.63
Equipment and supplies	.33	.87	.59	.25	.11	.18
Instructional materials	.53	.71	.62	.37	-.05	.15
Program support services	1.11	.51	.82	-.23	.26	.01
Facilities	.05	.62	.31	.75	0	.39
Total change	1.88	2.84	2.30	2.24	.75	1.36

available; 2) the physical distance between the agriculture department and the science department; 3) difficulty in finding time to work together due to preparation periods being scheduled at different times; and 4) a general lack of administrative support for integration.

Teachers were asked if participation in the AgriScience Institute and Outreach Program had increased sharing of resources between departments. All 18 teachers in the study responded that resources sharing had increased. They were then asked to respond to an open-ended question asking which phase(s) of the program most contributed to this increase. Eleven teachers indicated that traveling together, planning, preparing, and presenting the Outreach workshops (Phase II) contributed to increased sharing of resources. Five teachers responded that sharing of resources increased due to the personal friendships that developed during the entire program experience (Phases I and II).

Conclusions

The population for this study consisted of teachers selected through a rigorous process in which teaching skills, instructional materials development experience, and leadership efforts were considered. Teacher teams ranged from barely knowing one another to experiencing a strong relationship before the study. Generalizations and inferences from this population to other populations cannot be made. Some research findings from this study may have logical implications for other populations. The following

Table 5. Other Department Resources Most Commonly Received by Teachers

Agriculture teacher		Science Teacher	
Category	Times received from science	Category	Times received from agriculture
Instructional services received		Instructional services received	
Team Taught	7	Team taught	2
Taught by themselves	4	Taught by themselves	3
Equipment and supplies used		Equipment and supplies used	
Chemicals/glasses	18	Chemicals/glasses	7
Glassware/plasticware	19	Soil, plants, nitrogen test kits	17
Microscopes	14	Biological specimens	7
Balance	10	Instructional materials used	
Instructional materials used		Catalogs	5
Catalogs	20	Periodical	6
Lesson/unit plans	7	Textbooks	6
Textbooks	19	Program support services	
Program support services		Informal program advice	15
Informal program advice	17	Advised students into science	11
Physical work	14	Physical work	8
Facilities		Facilities	
Biology lab	11	Agriculture mechanics lab	9
		Greenhouse	3

conclusions were drawn regarding the cooperation and resource sharing of teacher teams participating

in the AgriScience Institute and Outreach Program.

Participation in the program did increase the cooperation and resource sharing between agriculture and science teacher participants.

Through information sharing, team building, and assigned tasks, it is possible to increase the amount of cooperation and resource sharing of both the agriculture and science teachers to similar levels.

Due to initially low pre-measure means, science teachers had the greatest gains in cooperation and sharing of resources during the team building, instructional materials development, and testing phase of the program (Phase I).

A major factor inhibiting the science teachers from utilizing agriculture department resources was a lack of awareness of both the resources available

and similarities in curriculum.

Agriculture teachers had higher gains in cooperation and sharing of resources during the workshop phase of the program (Phase II).

School administrative policies that are supportive of integration of academic areas; house the agriculture and science facilities in close proximity and schedule the same preparation periods for agriculture and science teachers, may remove barriers to agriculture and science teacher resource sharing.

Implications and Recommendations

Perhaps the most valuable insight gained through this study was a deeper understanding of the differences between the culture of agriculture education and science education. At local, state

and national levels, the needs, approaches, constraints, and challenges of each are very different. Further efforts need to be directed toward enhancing communication as a way to remove barriers and preconceived notions that black integration between science and agriculture teachers alike. Often barriers exist because teachers see collaboration as a threat. When barriers breakdown and integration between subject areas takes place, a win/win situation results and both programs benefit.

Some teachers experienced difficulty in sharing resources and collaboration due to factors associated with the school environment. This study has shown that understanding what the other teacher teaches and the resources available is a major first step to the integration process. The integration of subject areas takes time, effort and resources. Integration cannot take place without the involvement and support of administrators. It is recommended that administrators be included as part of the teacher team in future collaboration/integration efforts. The physical distance between the agriculture and science departments can greatly impede the integration process. It is recommended that schools design or allocate their facilities such that resource sharing and collaboration efforts are encouraged. It is imperative that teachers wishing to integrate subject areas share the same preparation periods to reduce time conflicts.

The potential for collaborations between agriculture and science teachers is tremendous. Teachers are quick to see the links between agriculture and science when they are brought together and their discussion moves to information sharing and specific teaching techniques. Agriculture and science teachers can learn to work together, merge their teaching styles, and students can study agriculture and science in an integrated setting. Ultimately, the success and long-term benefits of the integration between science and agriculture will be reflected in the student performance. If classroom experiences change through increased integration, students will be changed. The excitement of hands-on involvement, and understanding of the overlap of the fields of science and agriculture, and positive experiences within each field can change the way teachers view integration and, perhaps more importantly, learning.

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