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ABSTRACT

A study explored perceptions of teachers of agriculture regarding resource sharing between secondary school teachers of agriculture and science departments in the United States. Data were collected between October and December 1990 following the Dillman procedure for mail questionnaire administration to a random sample of 400 secondary school teachers of agriculture; the usable response rate was 61 percent (n=244). The questionnaire consisted of three Likert-type summative scales, each containing five indicators representing the followihg conceptual domains or resource sharing categories: instructional services, equipment and supplies, curriculum and instructional materials, program support services, and facilities. The scales measured three sharing dynamics: (1) present sharing of science department resources with teachers of agriculture; (2) present sharing of agriculture program resources with science departments; and (3) projected sharing of science department resources with teachers of agriculture. The questionnaire also contained two checklists of specific shared resources. Instructional services had the lowest mean among resource categories for each of the three sharing dynamics; equipment and supplies had the highest mean. Except for equipment and supplies, teachers perceived they had shared more resources than they had received. Teachers predicted significantly higher science department use in the future. (22 references) (YLB)

Resource Sharing Between Secondary School Teachers of Agriculture and Science Departments: A National Study

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Introduction and Statement of the Problem

Wirt (1991) noted that The Carl D. Perkins Vocational and Applied Technology Act of 1990 called for the integration of academic and vocational education in order to link "thought with action" (p. 426). Before such integration programs are initiated, the current status of academic and vocational program linkages should be determined. In Agricultural Education, a recent focus on agricultural science or agriscience education, has been documented and fostered by The National Research Council (1988). Recent agricultural science efforts include developing agriculture teacher and science teacher partnerships (National FFA Organization, 1991). Research to explore resource sharing between secondary school agricultural education teachers and science departments can provide timely information upon which to base integration efforts and serve as a model for further research of vocational and academic education program linkages.

Related Literature and Theoretical/Conceptual Base

Cooperation between academic and vocational teachers could lead to improved education through a merger of the theoretical with the practical (Miller, 1988; National Commission on Secondary Vocational Education, 1984; Rosenstock, 1991; Truxal, 1984; Washburn & McEwen, 1989). Roegge and Russell (1990) found that students subjected to lessons which integrated biological with agricultural principles demonstrated higher overall achievement, biology achievement, and a more positive attitudes toward the learning experience than students subjected to a traditional approach. They recommended that "agriculture teachers should work closely with science teachers in local schools to share and develop strategies for providing integrated instruction" (p. 30).

Long (1983) discussed the concept of doing more with less in education through innovative resource sharing during times of decreasing financial support. Budke (1991) highlighted how resource sharing between agriculture and science teachers capitalizes on teacher expertise and extends the use of scarce physical resources. Recently developed over-arching national goals for agricultural education include, "To update instruction in agriculture and expand programs about agriculture," and "To provide leadership and cultivate strong partnerships in the total educational system" (National Council for Agricultural Education, 1990, p. 5). Sharing resources between secondary school agricultural education teachers and science departments not only makes fiscal sense by extending their utility, but can directly or indirectly address these science updating, agricultural literacy, and linkage goals.

Malpiedi (1989) stated that "Science in agriculture involves the application of chemistry, biology, and zoology concepts and principles in studies such as agronomy, crop science, animal science, forestry, natural resources, poultry science, and horticulture" (p. 4). Logically, secondary school science departments should have resources to assist teachers of agriculture in teaching the science in agriculture. Agriculture teachers should also have resources to assist science teachers in teaching agriculture in science. Smith (1989) reported the North Carolina Ag in the Classroom Program was infusing agriculture into science to promote agricultural literacy. In Illinois, non-vocational agriculture classes have been developed to address both agricultural and science literacy (Osborne & Moss, 1991). Kramer (1989) found that approximately 25% of the science teachers surveyed in her study utilized agriculture teachers as a source of agricultural information for their classes.

The National FFA Organization (1990) stated that "Agriculture and science are natural partners." Undoubtedly, resource sharing between secondary school agricultural education teachers and science departments is occurring nationally.

For example, 1989 National Agriscience Teacher of the Year, Elizabeth B. Wilson (personal communication, September 11, 1990), mentioned that she has utilized her science department on science-related curriculum matters, for student recruitment, and as a source of curriculum materials. Specialized equipment has been shared in both directions. She promotes cooperative efforts between the FFA and Science Club and combines science projects with Supervised Agricultural Experience Programs (SAEP). In Michigan, science teachers have interacted with agriscience and natural resource teachers in curriculum development and team teaching activities (Elliott, Connors, & Steeby; 1991). The Agriscience Institute and Outreach Program For Science and Agriculture Teachers (National FFA Organization, 1991) represents a germinal national effort to increase interaction between agriculture and science teachers.

A distinct theoretical framework for a study on resource sharing was not found in the literature. However, a conceptualization of resource sharing between secondary school teachers of agriculture and science departments was developed for the study based, in-part, on the review of literature, secondary school resource sharing experiences of the researcher, and input from a panel of experts. The conceptualization contained five conceptual domains: (a) sharing of instructional services; (b) sharing of equipment and supplies; (c) sharing of curriculum and instructional materials; (d) sharing of program support services; and (e) sharing of facilities.

Purpose and Objectives

The purpose of this study was to explore resource sharing between secondary school teachers of agriculture and science departments in the United States. Specific objectives were:

1. To describe present and projected sharing of science department resources with teachers of agriculture and present sharing of agriculture program

resources with science departments.

2. To determine if differences exist between present and projected sharing of science department resources with teachers of agriculture.
3. To determine if differences exist between present sharing of science department resources with teachers of agriculture and present sharing of agriculture program resources with science departments.

Research Methods and Procedures

All secondary school teachers of agriculture from the United States served as the population for the study. Utilizing the Agriculture Teachers Directory (Henry, 1990) as a data base, the population was found to include 11,733 teachers. A sample size of 372 was determined employing the formula of Krejcie and Morgan (1970), and rounded up to 400. A random sample of secondary school teachers of agriculture, stratified proportionally by state to insure state representation, was then obtained utilizing a table of random numbers.

The study utilized descriptive survey methodology. A mail questionnaire was developed with three Likert-type summative scales, each containing five indicators representing the conceptual domains or resource sharing categories of: (a) instructional services; (b) equipment and supplies; (c) curriculum and instructional materials; (d) program support services; and (e) facilities. One scale measured present sharing of science department resources with teachers of agriculture. A second scale measured present sharing of agriculture program resources with science departments. The third scale measured projected sharing of science department resources with teachers of agriculture. Since agriculture teachers would have trouble predicting future utilization of agricultural program resources by science departments, projected sharing of agriculture program resources with science departments was not measured.

Each of the five indicators in each of the three summative scales contained

four response categories coded: 1 (never shared), 2 (shared once or twice), 3 (shared a few times), and 4 (shared many times). The two summative scales measuring present sharing were based on resource sharing during the 1989-90 academic school year. The summative scale measuring projected sharing of science department resources with teachers of agriculture was based on a future academic school year allowing the respondents to predict what their annual utilization might eventually become.

The questionnaire also contained two checklists of specific resources shared in each of the five resource categories. In one checklist, respondents checked all resources that the science department had shared with them for agricultural program utilization during the 1989-90 academic school year. In the other checklist, teachers of agriculture identified all agriculture program resources that they had shared with the science department during that period. Teachers were also asked to list any shared resources not appearing in the checklists.

A panel of experts consisting of two secondary school science teachers, two secondary school teachers of agriculture, a teacher educator in science education, a teacher educator in agricultural education, a statistician, and a state supervisor of agricultural education assessed the content and face validity of the questionnaire. The instrument was then field tested for clarity, validity, and reliability utilizing 31 secondary school teachers of agriculture in New Mexico who were not part of the sample. Cronbach's Alpha reliability coefficients for the scales measuring present sharing of science department resources with teachers of agriculture, present sharing of agriculture program resources with science departments, and projected sharing of science department resources with teachers of agriculture were .81, .88, and .91 respectively.

Data were collected between October and December 1990 following the Dillman procedure for mail questionnaire administration (1978). Incentives were sent with

all four mailings to increase response rate. A 69% response rate (n = 274) was obtained. Thirty of the questionnaires were unusable because they had gone to an adult educator or administrator (n = 8), they had gone to a teacher who had not taught agriculture the previous year (n = 8), the school had no science department (n = 5), the school had lost its agriculture program (n = 4), or data were incomplete (n = 5). Subtracting unusable questionnaires from those returned left a 61% (n=244) usable response rate. When based on the sample size determined by formula, (i.e., n=372) the usable response rate was 66% (Krejcie & Morgan, 1970). Respondents to the first three mailings (early respondents: n = 215) were compared with respondents to the fourth mailing (late respondents: n = 29) to check for non-response bias utilizing t-Tests for independent observations (Miller & Smith, 1983). No significant differences in responses to the three scales or their component indicators were identified; therefore, the data collected were considered to be representative of the sample.

Objective 1 was analyzed utilizing descriptive statistics. Objectives 2 and 3 were analyzed utilizing t-Tests for dependent observations (comparing means of the summative scales) and Chi-Square tests for paired observations (comparing numbers of teachers and science departments sharing by resource category, between scales). A significance level of .05 was set a priori for all statistical tests.

Findings and Conclusions

Descriptive data for resource sharing during the 1989-90 academic school year and projected sharing during a future academic school year are presented in Tables 1, 2, 3, 4, and 5. In Table 1, Instructional Services was the resource category with the lowest mean for present sharing of agriculture program resources with science departments (X = 1.44), present sharing of science department resources with teachers of agriculture (X = 1.28), and projected sharing of science department resources with teachers of agriculture (X = 1.75). Equipment and Supplies had the highest mean among resource categories for each of these sharing dynamics (X =

1.89, 2.02. and 2.16 respectively). The means for each resource category reported in Table 1 are below or slightly above 2, corresponding to sharing once or twice a year. By resource category, means for projected sharing of science department resources with teachers of agriculture were consistently higher than means for the other two dynamics. Except for equipment and supplies, teachers of agriculture perceived that they had shared more resources with science departments than they had received.

Table 1
Resources Shared Between Teachers of Agriculture and Science Departments

Resource Category	1989-90 Provided by Ag. n	X	SD	1989-90 Prov. by Science n	X	SD	Future Year Prov. by Science n	X	SD
Instructional Services	243	1.44	.91	244	1.28	.60	238	1.75	.85
Equipment and Supplies	243	1.89	.93	244	2.02	.95	238	2.16	.88
Curric. & Instruc. Mat.	243	1.67	.86	244	1.61	.81	235	1.97	.87
Program Support Ser.	243	1.67	.88	244	1.59	.80	235	1.97	.89
Facilities	243	1.67	.92	244	1.33	.67	238	1.79	.87
Summative Scales	243	8.35	3.67	244	7.83	2.82	230	9.58	3.67

Table 2
Teachers of Agriculture and Science Departments That Shared Resources During the 1989-90 Academic School Year (n=243)

Resource Category	Teachers of Ag. f	%	Science Departments f	%	Chi-Square
Instructional Services	58	24	52	21	.58
Equipment and Supplies	141	58	153	63	1.80
Curriculum & Instruc. Mat.	111	45	107	44	.17
Program Support Services	109	45	104	43	.34
Facilities	106	44	55	23	31.34*
Overall Sharing	165	67	179	73	2.25

Note. *Significant at the .001 level.

Frequencies and percentages of teachers of agriculture and science departments sharing resources are reported in Tables 2 and 3. Sixty-seven percent of the teachers had shared some resource(s) with the science department during the 1989-90 academic school year (Table 2). Fifty-eight percent had shared equipment and supplies, while only 24 percent had provided instructional services. Seventy-

three percent of the science departments had shared some resource(s) with the teachers. Sixty-three percent of the teachers reported utilizing science department equipment and supplies, while the percentages of teachers utilizing science department instructional services and facilities were only 21 and 23 percent respectively. Over 50% of the teachers predicted utilization of science department

Table 3
Teachers of Agriculture Utilizing and Predicting Future Utilization of Science Department Resources

Resource Category	n	1989-90 f	1989-90 %	Future Year f	Future Year %	Chi-Square
Instructional Services	238	52	22	121	51	60.26**
Equipment and Supplies	238	151	63	174	73	12.30**
Curric. & Instruc. Mat.	235	106	45	152	65	33.06**
Program Support Ser.	235	103	44	151	64	39.72**
Facilities	238	53	22	125	53	63.22**
Overall Sharing	240	177	74	194	81	5.45*

Note. *Significant at the .05 level; **significant at the .001 level.

Table 4
Resources Provided by at Least 10% of the Teachers of Agriculture to Science Departments (n=243)

Resource Category	Resource	f	%
Equipment and Supplies	Plant science equipment/sup.	77	31.7
Equipment and Supplies	Ag. mechanics equipment/sup.	65	26.7
Program Support Services	Advised students to take science	57	23.5
Curriculum and Instructional Mat.	Films, filmstrips, slides, video	54	22.2
Facilities	Greenhouse	51	21.0
Program Support Services	Informal program advising	46	18.9
Instructional Services	Guest teach. in non-ag. sci. cls.	42	17.3
Facilities	Ag. mechanics laboratory	41	16.9
Equipment and Supplies	Animal science equipment/sup.	39	16.0
Program Support Services	Labor	39	16.0
Curriculum and Instructional Mat.	Textbooks	38	15.6
Facilities	Land laboratory	38	15.6
Curriculum and Instructional Mat.	Catalogs	36	14.8
Program Support Services	Assisted with the science fair	31	12.8
Curriculum and Instructional Mat.	Lesson or unit plans	30	12.3
Equipment and Supplies	Audio-visual equipment	29	11.9
Curriculum and Instructional Mat.	Biological specimens	28	11.5
Curriculum and Instructional Mat.	Curriculum guides	27	11.1

Table 5
Resources Provided by at Least 10% of the Science Department to Teachers of Agriculture (n=244)

Resource Category	Resource	f	%
Equipment and Supplies	Microscope(s)	78	32.0
Program Support Services	Informal program advising	68	27.9
Equipment and Supplies	Glassware or plasticware	50	20.5
Curriculum and Instructional Mat.	Films, filmstrips, slides, videos	50	20.5
Equipment and Supplies	Chemicals or gasses	48	19.7
Equipment and Supplies	pH meter or paper	43	17.6
Curriculum and Instructional Mat.	Catalogs	43	17.6
Equipment and Supplies	Balance	40	16.4
Curriculum and Instructional Mat.	Textbooks	39	16.0
Equipment and Supplies	Thermometer(s)	38	15.6
Equipment and Supplies	Audio-visual equipment	36	14.8
Instructional Services	Team teaching in an ag. class	34	13.9
Facilities	Biology laboratory	34	13.9
Program Support Services	Advised students to take ag.	30	12.3
Equipment and Supplies	Distilled water	29	11.9
Curriculum and Instructional Mat.	Charts	29	11.9

resources during a future academic school year for each of the resource categories (Table 3). Eighty-one percent of the teachers predicted that they would utilize some science department resource(s) in a future year. The frequencies of science departments sharing resources during the 1989-90 academic school year are slightly different in Tables 2 and 3 due to more complete data for the analysis in Table 2

Specific resources shared by teachers of agriculture with science departments are reported in Table 4. Plant science and agricultural mechanics equipment and supplies were provided by over 25% of the teachers. While all five resource categories are represented in Table 4, six (33%) of the 18 resources listed are in the Curriculum and Instructional Materials category.

Specific resources shared by science departments with teachers of agriculture are reported in Table 5. Microscopes and informal program advising were provided by over 25% of the science departments. While all five resource categories are represented in Table 5, eight (50%) of the 16 resources listed are in the Equipment and Supplies category.

Objectives 2 and 3 are analyzed in Tables 2, 3, and 6. The means for the three summative scales utilized to determine the mean differences analyzed in Table 6 can be found in Table 1. During the 1989-90 academic school year, perceived sharing of agriculture program resources with science departments was significantly higher than perceived sharing of science department resources with teachers of agriculture (Table 6). There was also a significantly higher percentage of teachers of agriculture sharing facilities with science departments than the percentage of teachers utilizing science department facilities (Table 2).

Table 6
Comparisons Between Summative Scales

Comparison	n	X2-X1	t-value
1989-90 Utilization of Science Dept. Resources (X1)/ 1989-90 Resources Provided to the Science Dept. (X2)	243	.51	2.41*
1989-90 Utilization of Science Dept. Resources (X1)/ Future Year Utilization of Science Dept. Resources (X2)	230	1.65	9.58**

Note. *Significant at the .01 level; **significant at the .001 level.

Projected sharing of science department resources with teachers of agriculture was significantly higher than 1989-90 sharing (Table 6). A significantly higher percentage of teachers predicted future resource utilization than were currently utilizing science department resources for all of the resource categories (Table 3). The overall percentage of teachers predicting future utilization of any science department resource(s) was significantly higher than the percentage of teachers currently utilizing these resources.

Implications and Recommendations

For agricultural educators who feel strongly about infusing more science into agriculture, infusing more agriculture into science, and/or cultivating "strong partnerships in the total educational system" (National Council for Agricultural

Education, 1990, p. 5), these results could be encouraging. According to teachers of agriculture, a majority of the teachers and their science departments are sharing resources. A significantly larger percentage of the teachers are predicting future science department resource utilization than are currently utilizing them. Taken alone, these results do not support a rhetorical hypothesis, common in agricultural education, that secondary school teachers of agriculture are not interacting with other programs at their schools.

However, levels of resource sharing between teachers of agriculture and science departments are low enough to suggest a more cautious interpretation. Average bi-directional resource sharing of once or twice a year or less, observed for each resource category, leaves room for increased activity. Therefore, it is recommended that linkage programs designed to encourage resource sharing between secondary school teachers of agriculture and science departments should focus on increasing resource sharing levels or frequencies. One suggestion is for such programming to focus on improving communication between teachers of agriculture science department faculty. Improved communication could increase awareness of and access to a wider variety of resources. For example, communicating curriculum could augment and facilitate timely resource sharing.

While equipment and supplies were the most often shared resources, instructional services were the least shared resources by both teachers of agriculture and science departments. Based on these results, it is recommended that efforts like The Agriscience Institute and Outreach Program For Science and Agriculture Teachers (National FFA Organization, 1991) and other programs which hope to develop agriculture/science teaching partnerships, be encouraged.

That teachers of agriculture are predicting significantly higher science department resource utilization in a future academic school year suggests that the teachers feel positively about resource sharing and would welcome linkage

enhancing programming. A follow-up to these results should attempt to determine the predictors of present sharing of agriculture program resources with science departments, present sharing of science department resources with teachers of agriculture, and projected sharing of science department resources with teachers of agriculture. The results from such a study could lead to recommendations for increasing sharing levels to guide linkage enhancing programming.

Research to determine the predictors of present sharing of agriculture program resources with science departments and present sharing of science department resources with teachers of agriculture could also help explain why teachers of agriculture percieved themselves to be sharing significantly more resources with science departments than they are receiving. Perhaps teachers of agriculture may not be aware of the resources available through their science departments. Perhaps the science departments have less resources to share. The follow-up study mentioned above could explore these possibilities.

This study dealt with the perceptions of teachers of agriculture. A valuable parallel study would simultaneously measure science teachers' perceptions of resource sharing with teachers of agriculture. Parallel studies measuring resource sharing between other areas of vocational education and appropriate areas of academic education should be undertaken to determine the current status of program linkages before implementing enhancement programming.

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