AN ABSTRACT OF THE DISSERTATION OF

Mark Allen Balschweid for the degree of Doctor of Philosophy in Education presented on March 18, 1998. Title: Agriculture and Science Integration: A Pre-service Prescription for Contextual Learning.

Abstract approved: Signature redacted for privacy.

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The purpose of the study was to determine if the delivery of an integrated agriculture and science curriculum to the Agricultural Education MAT (Master of Arts in Teaching) students, increased their desire and ability to integrate their curriculum and collaborate with other teachers once they started teaching, and to identify social and cultural barriers in existence between secondary teachers in agriculture and science.

The research question and null hypotheses used to guide the investigation were as follows:

1. What were selected demographics for the participants in the treatment and control groups?

Ho_1: There was no significant difference in the need felt by the 1996-97 MAT cohort to update their curriculum through integration and collaboration efforts to include more scientific principles in their agriculture curriculum when compared to cohorts from the previous five years.

Ho_2: There was no significant difference in the perception of social and cultural barriers that exist between agriculture and science teachers at the secondary level as

recognized by the 1996-97 MAT cohort when compared to the previous five years' cohorts.

Ho_3: There was no significant difference in the amount of collaboration and curriculum integration conducted by members of the 1996-97 MAT cohort when compared with cohorts from the previous five years.

The population for the treatment group consisted of all graduate students enrolled in the 1996-97 MAT Agricultural Education cohort at Oregon State University. The control group consisted of the previous five MAT Agricultural Education cohorts at OSU.

The research combined a series of personal interviews with the treatment group in addition to the written questionnaire administered to the treatment and control groups. The questionnaire served as the comparison for the groups. Data were analyzed using descriptive statistics.

Although all three null hypotheses failed to be rejected, evidence indicated that the treatment group was positive about integrating science into the agriculture curriculum and they were more willing to attend workshops about the integration of science than were members of the control group. Furthermore, the treatment group felt the difference in years of teaching experience was a barrier in working with the science teacher in their school.

Agriculture and Science Integration:
A Pre-Service Prescription for Contextual Learning

by

Mark Allen Balschweid

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DEDICATION

This research is dedicated to Mae Anne Balschweid. A great nurse, teacher, judge, interior decorator, mechanic and courier. She is a stay-at-home mom who has truly put the health and interests of her family above her own. She proves that you don't have to posses a degree to be considered wise.

Agriculture and Science Integration:
A Pre-service Prescription for Contextual Learning

CHAPTER 1
INTRODUCTION

Most of you are secondary school administrators. You, like me, have been preoccupied most of the time with college entrance expectations. Vocational-technical education teachers and administrators have been either scorned or condemned and we have been silent. There is illogic here as well as a massive injustice.

How can we blame vocational educators for the hundreds of thousands of pitifully incapable boys and girls who leave our high schools each year when the truth is that the vast majority of these youngsters have never seen the inside of a vocational classroom? They are the unfortunate inmates, in most instances, of a curriculum that is neither fish nor fowl, neither vocational nor truly academic. We call it general education. I suggest we get rid of it.

We must purge ourselves of academic snobbery. For education's most serious failing is its self-induced, voluntary fragmentation, the strong tendency of education's several parts to separate from one another, to divide the entire enterprise against itself. The most grievous example of these intramural class distinctions is, of course, the false dichotomy between things academic and things vocational.

Sidney P. Marland Jr., United States Commissioner of Education, January 23, 1971 (Parnell, 1986, p. 53)

Those words, spoken over twenty-five years ago, suggested massive change was about to take place throughout the nation's entire educational system. They reflected the dawn of a new age in teaching and learning that would bridge the gap between things 'academic' and things 'vocational'. Did it happen? It is proposed here that those closely associated with education and educational reform would say nothing has happened. In fact, many would argue that in today's 'education as business' climate, just the opposite is true. With limited capital expenditures, shrinking operating budgets and decreasing confidence from skeptical taxpayers, many educators have found it easier to pull back from progressive collaboration efforts and focus on their first and foremost priority: Keeping their jobs!

Many teachers have found it difficult to justify glitzy curriculum integration projects when it could mean, through consolidation of teaching efforts, they (or a close associate) are no longer needed for their services.

Furthermore, when focus is on "trimming the fat" from a school's budget, the question is what should be first to go: a student's *state required* coursework or the optional *elective* courses? The answer is all too obvious as one vocational program after another has been lost to the economics of education in the late 20th century.

But this is where educational priorities and economics collide. National educational mandates concerned with the future of vocational agriculture have been delivered as recently as 1988 by the National Academy of Sciences (Understanding Agriculture: New Directions for Education). The direction given to agricultural education has not been to "scale back". On the contrary, the National Academy of Sciences has admonished agricultural education in saying:

> New efforts are needed to reform secondary school agricultural programs to better prepare students for agricultural-sector growth industries. In some cases, this will require change in or abandonment of vocational guidelines. Under vocational agriculture, this definition would include greater diversity of career paths, such as scientific research, technology development, medical and social services, finance, law, business, management, and marketing (p. 32).

Further direction was provided by the *academic* community to increase collaboration between science and applied science courses as well (American Association for the Advancement of Sciences, 1993). This, coupled with current brain-based research, indicates students will be best served if they could find meaning to their education. According to Caine and Caine (1994):

> Currently literature, mathematics, history, and science are often seen as separate disciplines unrelated to the life of the learner. Brain-based learning, on the other hand, rests on the fact that the various disciplines relate to each other and share common information that the brain can recognize and organize (p. 4).
>
> Furthermore, they write:
>
> Students must be exposed to subject matter in many different ways, a great number of which must be complex, real projects. These projects should be developmental in nature and link work over time. They should assist in connecting content to the world in which the student actually lives (p. 120).

With mandates such as these given by national academies and researchers, it is surprising that little work is being done to integrate the disciplines. Considering the massive amounts of time and money required to implement educational reform on the national level, it is a wonder that any reform of this type is happening at all.

Administering this type of reform requires release time for teacher training, resources for curriculum development and, most importantly, change in the ideology that most administrators have concerning ‘academic’ and ‘vocational’ courses. Teacher education can do little to influence the thought processes of local school administrators regarding the benefits of school reform. However, there may be functions that teacher preparation institutions can perform that will increase teacher willingness to collaborate with others and help them develop the ability to integrate curriculum through pre-service instruction.

Purpose of the Study

The primary purpose of this study was to determine if the delivery of an integrated agriculture and science curriculum to the Agricultural Education MAT (Master of Arts in Teaching) students, at the pre-service level, increased their desire and ability to integrate their curriculum and collaborate with other teachers once they entered the teaching profession. In addition, this study sought to identify the social and cultural barriers in existence between secondary teachers in agriculture and science.

Research Questions and Hypotheses

The research questions and null hypotheses used to guide the investigation were stated as follows:

1. What were selected demographics for the participants in the treatment and control groups?
2. What was the need felt by secondary agricultural education teacher preparation cohort graduates to update their curriculum through integration and collaboration efforts and to include more scientific principles in their agriculture curriculum?
3. What social and cultural barriers existed between agriculture and science teachers at the secondary level as recognized by Agricultural Education MAT student teacher preparation graduates?

4. What was the level of collaboration and curriculum integration carried out by members of the 1996-97 agricultural education teacher preparation cohort as compared with cohorts from the previous five years?

The following null hypotheses were formulated to test study research questions #2, #3, and #4:

Ho_1: There was no significant difference in the need felt by the 1996-97 secondary agricultural education teacher preparation cohort to update their curriculum through integration and collaboration efforts to include more scientific principles in their agricultural curriculum when compared to cohorts from the previous five years.

Ho_2: There was no significant difference in the perception of social and cultural barriers that exist between agriculture and science teachers at the secondary level as recognized by the 1996-97 agricultural education teacher preparation cohort when compared to the previous five years' cohorts.

Ho_3: There was no significant difference in the amount of collaboration and curriculum integration conducted by members of the 1996-97 agricultural education teacher preparation cohort when compared with cohorts from the previous five years.

Delimiters

For the purpose of this research, the following assumptions were made:

1. Individuals surveyed were the graduates from Oregon State University's Master of Arts in Teaching Agricultural Education Program from 1991-92 until 1996-97. Oregon AST (Agricultural Science and Technology) teachers that were graduates from other teacher preparation institutions were not included in this study.

2. Individuals from the 1996-97 MAT cohort included in this study were those who successfully became full-time secondary agricultural education teachers. However, not all of the graduates stayed in Oregon to teach.

Limitations of the Study

1. Due to the small number of students involved in the 1996-97 Agricultural Education MAT (Master of Arts in Teaching) Program, all students meeting the criteria listed in the delimiters section were used. No other selection process was used.

2. This study had a small population. Furthermore, this study represented only the treatment used at one agricultural education teacher preparation institution in one state. Therefore, the results of this study are not to be generalized to any other population.

3. The researcher made no attempt to control cross contamination between the two groups. The professors involved in teaching the agricultural education teacher preparation courses promoted the concepts of integration and collaboration of science and agriculture to both the control and the treatment group. As a result, a threat to the validity of this study exists.

Definitions of Terms

Academic - pertaining to areas of study that are not vocational or technical; not practical or directly useful; purely theoretical.

Agricultural Science and Technology – the title for Agricultural Education programs in the state of Oregon. Hence, agricultural educators are referred to as agricultural science and technology teachers.

Collaboration - to work with another or others. (e. g., a high school business teacher(s) might work with a high school mathematics teacher(s) to develop a course in business math.)

Integration - to incorporate parts into a whole; to combine to produce a whole or a larger unit. (e. g., a high school agriculture teacher might work independently to include scientific principles into his/her plant science course.)

MAT - Master of Arts in Teaching - the professional teacher education program at Oregon State University utilizing a full-time, twelve month, graduate level program that leads to a Master of Arts in Teaching degree necessary for licensure in the state of Oregon.

Secondary Agricultural Education - any form of delivery of instruction pertaining to agriculture at the high school level. Traditionally referred to as vocational agriculture or Vo-Ag. Has also been referred to as Voc-Ag. Currently referred to as Agricultural Science and Technology (AST), Agricultural Science, AgriScience, and other terms.

Teaching Internship – Used to describe the capstone experience for members of the Master of Arts in Teaching degree program in Oregon. Has also been referred to as student teaching.

Vocational Training - pertaining to the education for any occupation regularly followed for a living; or career oriented.

CHAPTER 2
REVIEW OF LITERATURE

The purpose of this chapter is to present a review of the literature related to agricultural science and the integration of academics into agricultural science and technology (AST) education classes at the high school level. In addition, an analysis of the extent programmatic changes occurred during the last ten years in agricultural education teacher preparation is given. In reviewing the literature, the following topic areas were examined: (a) historical considerations, (b) educational reform, (c) the agriscience movement, (d) agricultural teacher perceptions of agriscience, (e) science teacher perceptions of agriscience, (f) administrator and guidance counselor perceptions of agriscience, (g) barriers to collaboration and integration, and (h) university responsiveness in the form of curricular changes at the pre-service level.

The sources of literature for review included The Journal of Agricultural Education, The Agricultural Education Magazine, proceedings of the American Association of Agricultural Education Meetings, and proceedings of the National Agricultural Education Research Meetings. In addition to this list of publications, a computerized search of Agricola, ERIC and Dissertation Abstracts was conducted. The information provided in these sources has produced the foundation for the review of literature presented in this chapter.

Historical Considerations

More and more young people emerge from high school ready neither for college nor for work. This predicament becomes more acute as the knowledge base continues its rapid expansion, the number of traditional jobs shrink, and new jobs demand greater sophistication and preparation.

National Commission on Excellence in Education in A Nation at Risk: *The Imperative for Educational Reform* (p. 12)

In reviewing the relevant history that governs today's current educational philosophies, it is easy to start with questions. For instance, why are courses at the secondary educational level traditionally labeled *academic* and *vocational*? Why are some courses *required*, while others are *elective*? Why do certain courses meet requirements towards graduation from compulsory education while others do not? Why do certain courses meet university entrance requirements while others do not? Questions like these raise issues regarding the structure, nature, and accessibility of our traditional educational delivery system.

Two very dominant theorists in educational philosophy of the early 20th century were John Dewey and Charles Prosser. The purpose of a general education, according to Dewey, was to emphasize preparation of a democratic, civic-minded individual, whose conscience would be raised to explore and create. Explained Dewey:

> The educative process is all one with the moral process, since the latter is a continuous passage of experience from worse to better. Education has been traditionally thought of as preparation: as learning, acquiring certain things because they will later be useful. The end is remote, and education is getting ready, is a preliminary to something more important to happen later on...These ideas contravene the conception that growing, or the continuous reconstruction of experience, is the only end. If at whatever period we choose to take a person, he is still in process of growth, then education is not, save as a by-product, a preparation for something coming later. Getting from the present the degree and kind of growth there is in it is education. This is a constant function, independent of age. (Reconstruction in Philosophy, p. 183-5)

There are other reasons for not accepting the doctrine of education-as-preparation. In Experience and Education (1938) Dewey argues that:

> Perhaps the greatest of all pedagogical fallacies is the notion that a person learns only the particular thing he is studying at the time. Collateral learning in the way of formation of enduring attitudes, of likes and dislikes, may be and often is much more important...For these attitudes are fundamentally what count in the future. The most important attitude that can be formed is that of desire to go on learning. If impetus in this direction is weakened instead of being intensified, something much more than mere lack of preparation takes place. (p. 49-50)

Conversely, preparation for life-long employment through specific job skills training was the motivation behind the work of Prosser. Development of this concept of vocational education was detailed in the formation of Prosser's sixteen theorems of vocational education (Prosser & Allen, 1925). It was Prosser who penned:

> Education means many things to many men. To the classicist, it is the ability to derive enjoyment from the study of the writings of the ancient philosophers, poets, and writers. To the culturist, it is the ability to enjoy the finer things of life. To the scientist, it often means a command of the special knowledge that goes with his specialty. Lying back of all these conceptions, and of many more that have been held during the history of civilized mankind, has run an underlying idea, often obscured in educational controversy, but persisting nevertheless. This underlying idea may be expressed somewhat as follows: Education is the result of experiences whereby we become more or less able to adjust ourselves to the demands of the particular form of society in which we live and work. (p. 3)

Today, it is easy to see remnants of both philosophers' work in mainstream educational practices. Furthermore, when reviewing the history of agricultural education, it is evident that agricultural instruction has undergone drastic changes since its formal inception in the early 1900's. From a time in 1917 when one-third of the population lived on farms (Understanding Agriculture: New Directions for Education, 1988, p. 25), until today, when less than 2% cite farming as the main source of their income, the need for relevant and applicable methods of teaching students about food and fiber and the business opportunities associated with them have always been a concern.

In the early part of the twentieth century when it was necessary to improve the efficiency and productivity of the family farm, vocational education was there to teach students specific farming practices that would improve the quality of life for those that produced agricultural commodities needed by this country. One of the earliest and most notable pieces of legislation to impact vocational education was the Smith-Hughes Act (Public Law 347 of the 64th Congress) passed in 1917. This legislation provided for a continuing appropriation that would be distributed to the participating states. Each state would receive funds for vocational agriculture according to their proportion of the national total of rural population. Under this legislation, states were required to establish and fund suitable programs involving agricultural, industrial, trade and home economics programs, and the federal appropriations would be used to reimburse the states and the local districts up to one-half of their total expenditures in these program.

Interestingly, by the mid-1930's the minimum requirement for a teacher of vocational agriculture was a bachelor's degree from a college designated as a teacher-training institution by the state board of vocational education. In the field of agriculture and home economics, the actual work experience became secondary to the scientific knowledge gained at the institutions. (Phipps, 1965)

On June 8, 1936, President Roosevelt signed into law another piece of legislation valuable to vocational education, the George-Dean Act. This bill greatly increased the appropriations for vocational education, more than double what the opponents of the bill wanted, but it also broadened the scope of vocational education to include fields other than agriculture, trade and industry, and home economics.

Although legislation for vocational education was routinely updated during and after W.W.II, a major shift in emphasis occurred when President Kennedy signed into law the Vocational Education Act of 1963. What was different about this legislation was that it set minimum expenditures, by state, for the improvement of the quality of vocational education. Specifically, areas targeted as essential to program improvement were teacher education, supervisory training, and program evaluation. A minimum of three percent of the total appropriation was to be set aside insuring the quality of the vocational education delivered. This represented approximately 17 million dollars devoted to program improvement. One more piece of information vital to this research project was that the Vocational Education Act of 1963 allowed for "the expansion of agricultural training programs to include agriculturally related jobs that did not involve the actual tilling of the soil." (McClure, 1985).

Additionally, in October 1976, President Ford signed into law the Educational Amendments of 1976-Public Law 94-482. Title II of this legislation included programs to end sex discrimination and sex stereotyping in state vocational programs and placed a greater emphasis on vocational guidance and counseling. This act would encourage more female students into the vastly male dominated classrooms of vocational agriculture.

The most significant legislation to recently affect vocational education was the Carl Perkins Act. In 1984, Congress passed this bill that gave basic grants and assistance to states and outlying areas to expand and improve their programs of vocational education and provide equal access in vocational education to special needs populations. The populations assisted by basic grants ranged from secondary students in pre-vocational courses through adults who needed retraining to adapt to changing technological and labor market conditions.

In spite of all this attention and legislation a stunning verdict was proclaimed on vocational agriculture in a study commissioned by the National Research Council and performed by the National Academy of Sciences in 1988. This verdict stated that the focus of agricultural education must change. In its report, the members stated:

1. Ongoing efforts should be expanded and accelerated to upgrade the scientific and technical content of vocational agriculture courses. The "vocational" label should be avoided to help attract students with diverse interests, including the college bound and those aspiring to professional and scientific careers in agriculture. Agricultural courses sufficiently upgraded in science content should be credited toward satisfying college entrance and high school graduation requirements for science courses in addition to the core curriculum.

2. New curriculum components must be developed and made available to teachers addressing the sciences basic to agriculture, food, and natural resources; agribusiness; marketing; management; international economics; financial accounting; and tools to improve the efficiency of agricultural productivity. (Understanding Agriculture: New Directions for Education, 1988).

Educational Reform

There has been no louder call for reform of the methods used in teaching agriculture than that issued forth by the National Academy of Sciences, stating:

> New efforts are needed to reform secondary school agricultural programs to better prepare students for agricultural-sector growth industries. In some cases, this will require change in, or abandonment of, vocational guidelines. Under vocational agriculture, this definition would include greater diversity of career paths, such as scientific research, technology development, medical and social services, finance, law, business, management, and marketing (p. 32).

And from the academic community as well, concern has been raised for more collaboration between science and applied science courses (American Association for the Advancement of Science, 1993). This, a result of *A Nation at Risk,* a report critical of this country's educational system published in 1983. Studies have indicated the key to a first-rate science program was allowing students to "construct" their own thoughts on a subject, test those thoughts through experimentation, then confirm or alter their conceptions (Emery & Linder, 1993). Further evidence of the need for reform is found in brain-based research and learning by Caine and Caine (1994), previously written about in the first chapter of this dissertation. In addition, Caine and Caine call for education to recognize the big picture. They add "the part is always embedded in a whole, the fact is always embedded in multiple contexts, and a subject is always related to many other issues and subjects" (p. 7).

The Agriscience Movement

In response to the National Academy of Sciences report on the status of agricultural education in the 1980's, the agricultural education community joined forces and developed *A National Mobilization Plan for Revolutionary Change in Agricultural Education* (The Strategic Plan for Agricultural Education, 1989). The groups involved in the development of this plan for a fresh vision for agricultural education included the American Vocational Association (AVA), the National Association of Supervisors of Agricultural Education (NASAE), the American Association of Agricultural Educators (AAAE), and the National Vocational Agriculture Teachers Association (NVATA) among others. The plan included a resolution to expand the network of relationships between education and science. This idea was formulated to encourage the integration of science into the agricultural curriculum to allow agricultural courses to meet requirements toward high school graduation and university admittance requirements, something that vocational agriculture had never done.

According to Terry (1993) "an agriscience classroom should look more like the high school biology classroom than the vocational agriculture classroom of old" (p. 10). Of particular concern, however, is the image that agricultural education projects. Appealing to a broad audience with various motives for enrolling in agriscience courses should be the driving force in agricultural programs. In considering all students who would be interested in taking an applied science course, it is necessary to evaluate every phase of an agriculture program and make changes in areas that don't welcome students from all backgrounds, rather than just those with farming interests.

Many similarities exist between the "application" of the agricultural classroom and the "principles" of the science classroom. Indeed, the same core concepts are taught in both. Enough so, that some leaders of the agriscience movement caution the industry that dangers exist. Agriscience faces the potential of becoming absorbed within the science curriculum as a class rather than remaining a separate, distinct program (Vaughn, 1993). It remains to be seen how real this phenomenon is, but the fact remains that the effects of such integration should include resource sharing and personal interactions with colleagues in the science department.

Agricultural Teacher Perceptions of Agriscience

There is little doubt that the single biggest influence, at the local level, in the change from traditional production agricultural programs to agriscience programs is the classroom agriculture teacher. The national aims and directives are admirable, but it is the application of those aims, and the attitudes and knowledge of the classroom teacher that will determine if tomorrow's agriculture students will receive instruction in the form of a dynamic, relevant curriculum. Much of the work that has been done with regard to teacher perceptions has been accomplished on a limited state by state basis. However, valuable evidence can be seen in the short time that restructuring has been emphasized.

In Michigan, it was found that agriscience and natural resources instructors in that state only had a "slightly positive" attitude toward the concept of agriscience. Yet of the 108 agricultural science teachers involved in the study, over 78% of the agriscience and natural resources teachers and 60% of horticulture teachers covered at least 75% of the science objectives of the Michigan Agriscience and Natural Resources

(ANR) Curriculum (Connors & Elliot, 1994.) The agriscience and natural resources teachers did agree, however, that the agriscience curriculum was useful and should be recommended to all high school students.

Connors and Elliot's recommendations stated: 1) in-service and technical update sessions should be planned to assist teachers with developing instructional lesson plans that incorporate more objectives of the Michigan ANR curriculum; 2) teachers should be encouraged to attend professional development training and incorporate more hands-on activities into the curriculum; and 3) greater emphasis needs to be placed on disseminating curriculum development information to all Michigan agriscience and natural resources teachers.

In a similar study conducted in Mississippi, it was discovered that agriscience teachers "strongly supported" the offering of pilot agriscience courses, and that they believed the courses were beneficial to all students (Newman & Johnson, 1993). The study concluded that teachers enjoyed teaching the courses and perceived strong support from the stakeholders in their schools. The teachers felt science credit should be awarded for agriscience courses. Agriscience teachers had worked more closely with science teachers since the implementation of the pilot agriscience courses, and most importantly, Mississippi pilot agriscience teachers and science teachers shared resources to a greater extent than teachers nationally (Newman & Johnson, 1993).

In a similar study of Agriculture and Natural Resources teachers conducted in Michigan (Krueger & Wamhoff, 1995), it was reported that a very strong change toward integration of science concepts and principles was reported by agriscience teachers. In addition these teachers reported integrating more concepts and principles taught in other academic areas after the curricular restructuring in their state.

In asking the opinions of Arkansas teachers concerning science credit for their agricultural curriculum, a majority of Arkansas agriscience teachers supported granting certified agricultural teachers an endorsement to teach agriculture for science credit

(Johnson, 1995). In addition, the teachers reported that material taught related to over one-half of the Arkansas science curriculum objectives studied. These teachers also felt that efforts to identify agricultural courses for science credit should focus on those related to the life sciences.

The population of the study consisted of all Arkansas agricultural teachers in the state during the fall of 1994, a total of 259. Johnson concluded that majority support existed for granting certified agricultural teachers an endorsement to teach agriculture for science credit either through blanket certification (certify all teachers holding valid agricultural certificates) or through successful completion of an agriscience education in-service workshop. Even though the blanket endorsement was most popular with teachers, the researcher recommended that certification be earned through successful workshop completion. On average, Arkansas agricultural teachers reported having earned the credit hours and grades necessary to qualify for science certification (biological and general science endorsement). The recommendation further encouraged eligible teachers to complete the NTE (National Teacher Examination) science specialty exam and become science certified, especially if they desired to teach agriculture for science credit. As a group, the teachers reported that they taught material related to over one-half of the Arkansas science curriculum objectives studied. Further research was recommended to determine the depth and rigor of the instruction provided.

From a review of the literature related to teacher perceptions, conclusions could be drawn that current agricultural teachers, on the whole, could make the changes necessary to bring their programs in line with current agriscience reform efforts. Many have already done this and felt good about the curriculum they were offering their students. Furthermore, teachers involved in the integration process enjoyed the experience they gained through increased collaboration with the members of their school's science department.

Science Teacher Perceptions of Agriscience

According to Osborne and Dyer, "curriculum redesign efforts in the 1990's involving agricultural education have converged on identifying promising strategies that incorporate more science into high school agriculture curricula" (Osborne & Dyer, 1995, p. 142). Therefore, an important piece to be examined was the attitudes of traditional science teachers toward the push to include more science concepts into what had traditionally been a vocational program. Osborne and Dyer studied the attitudes of Illinois High School Science Teachers toward the agricultural industry and educational programs in agriculture.

Osborne and Dyer concluded that greater information sharing and collaboration among agriculture and science teachers could improve science teachers' attitudes towards agriscience programs. Furthermore, effective strategies for collaboration should be identified through research and shared with agriculture and science teachers. This process might best be started at university teacher training institutions.

Interestingly, although science teachers will admit the inadequacies of current science curricula and the need for change (Hurd, 1984), not much has occurred to bridge the gap between science theory and the application to agricultural sciences. Hurd states:

> Despite the turmoil over the science curriculum during the past decades, not much has happened. What has stalled the curriculum reform movement is the lack of a coherent vision of what an education in science for effective citizenship should be about, and what every citizen should know. The reform movement of the 1990's calls for an integration of school subjects: a conceptual convergence of the natural sciences, mathematics, and technology with the social and behavioral sciences and the humanities into a coherent whole (Hurd, 1991 p.35).

Perceptions of Administrators and Guidance Counselors Regarding Agriscience

Without question, if agriculture and science teachers would value the importance of each other's programs it would help strengthen the educational reform movement concerning agriscience. Not only should this be important for teachers, but vital to a student's performance. Research findings have supported the claim that integration of science into agriculture curricula is a more effective way to teach science. Studies conducted and duplicated support the findings that students taught by integrating agricultural and scientific principles demonstrated higher achievement than did students taught by traditional approaches (Enderlin & Osborne, 1991; Enderlin, Petrea, & Osborne, 1993; Roegge & Russell, 1990; and Whent & Leising, 1988). However, agriculture and science teachers cannot be content with possessing this knowledge of the benefits of integration on their own. Guidance counselors, principals, superintendents and boards of education, must also be helped to realize the significance of the reform movement in agriculture and science education today.

In Illinois, thirty-nine guidance counselors were asked about their attitudes concerning agricultural education after the inclusion of applied science materials into the agriculture curriculum. The study (Osborne and Dyer, 1994) was performed at schools where agricultural science courses were being taught. It was concluded that counselors believed agriculture courses benefited higher achieving students, and that students could complete an agriculture program and still meet graduation and college entrance requirements. The study also reported that counselors agreed more students should be encouraged to enroll in agriculture courses at both high school and college levels. They also believed that agriculture courses were beneficial for higher achieving students, and that college bound students should be encouraged to enroll in agriculture courses (Osborne & Dyer, 1994).

It was helpful to know that once counselors were aware of the curriculum involved in an agriculture program they were much more likely to encourage students to enroll in those courses. In a study conducted in Mississippi, 123 building level administrators strongly agreed that they supported the new agriscience curriculum. It was indicated that the agriscience teacher had explained the pilot agriscience curriculum to them. Furthermore, the administrators agreed science credit should be awarded for agriscience and felt the agriscience teacher was qualified to teach the courses for science credit (Johnson & Newman, 1992).

Strong emphasis was placed upon the ability of the agriculture teacher to communicate with the counselors and administrators involved in the Osborne & Dyer (1994) and Johnson & Newman (1993) studies, indicating the opinions of both groups improved favorably towards agricultural education when specific instruction was provided by the agriculture teacher. Additionally, the researchers recommended that an assessment of agriculture teachers' knowledge of core science concepts and principles should be conducted. The researchers concluded that such a study would provide a more objective measure of an agriculture teacher's science competency and would provide insight into possible in-service needs.

Barriers to Collaboration and Integration

Although collaboration is being sought from many different directions, the reality and feasibility of such a task are often inconceivable. Differences exist in many school districts that inhibit the ability of teachers to collaborate and integrate their curricula. Hickey (1994) wrote that a number of reasons existed that preclude teachers from sharing their resources and insights with other teachers. A lack of time, poor professional self-esteem, and few personal and professional relationships with colleagues were just three examples given in a study to determine why teachers did not collaborate. In addition, physical distances that separate agricultural facilities from the science departments could be an additional reason for a lack of a collaborative effort. Smith and Scott (1990) used the word collaboration to describe a school's culture. A collaborative school culture is composed of the following elements:

1. The belief, based on effective school research, that the quality of education is largely determined by what happens at the school site,
2. The conviction, also supported by findings, that instruction is most effective in a school environment characterized by norms of collegiality and continuous improvement,
3. The belief that teachers are professionals who should be given responsibility for the instructional process and held accountable for its outcomes, and
4. The involvement of teachers in decisions about school goals and the means for achieving them. (Smith & Scott, 1990, p.2)

The role of teachers within the collaborative schools was defined by Smith and Scott (1990) using "critical practices of adaptability", a term penned by Little (1982) in which:

1. Teachers engage in frequent, continuous, and increasingly concrete and precise talk about teaching practice.
2. Teachers are frequently observed and provided with useful (if potentially frightening) critiques of their teaching.
3. Teachers plan, design, research, evaluate, and prepare teaching material together.
4. Teachers teach each other the practice of teaching (p. 331-332).

Additionally, Friend and Cook (1992) provided six characteristics that further refine the basic definition of collaboration. They include: 1) collaboration is voluntary, 2) collaboration requires parity among participants, 3) collaboration is based upon mutual goals, 4) collaboration depends on shared responsibility for participation and decision making, 5) individuals who collaborate share their resources, and 6) individuals who collaborate share accountability for outcomes.

In a study to determine the relationship of collaborative settings to certain social organizational factors in medium-sized secondary schools, Hickey (1994) randomly selected 20 medium-sized schools in Wisconsin from a population of 140. A 31-item questionnaire was used to answer two main questions in the study: 1) to what extent are secondary schools collaborative settings? And, 2) what was the relationship between the schools as collaborative settings and the predefined social organizational conditions of the amount of team teaching, teacher's certainty about the technical culture and their instructional practices, teacher involvement in decision making, and the extent to which teachers share instructional goals?

In a combined quantitative and qualitative measurement, the researcher used the results from the questionnaire to identify collaborative settings and isolated settings. Three teachers were randomly selected from each of the collaborative settings, and three teachers were randomly selected from each of the isolated settings. Follow-up interviews were conducted asking critical questions to further clarify issues. Hickey (1994) found that:

> While "pockets" of collaboration may exist in some departments and among some teachers within a school, the portrayal of secondary schools as being an organization of "cells and bells" perpetuating the norms of isolation between teachers would seem to be accurate. Factors which seem to contribute to this phenomenon included but are not limited to, the organizational structure of the high school, teachers' focus on an academic discipline, the lack of time, and a teacher's willingness to collaborate with colleagues. These barriers to teacher collaboration appeared to exist at the secondary level whether or not the school had formalized departments (p. 56).

Indeed, the questions may not be how long teachers have worked together or how much time they have to collaborate. Rather, it may have more to do with how *willing* they are to work together with their peers, and have they been *taught* how to collaborate by either pre-service or in-service training?

Thompson (1996) selected a purposive sample of the recognized leaders in agriscience integration within the United States. He selected the winners of the AgriScience Teacher of the Year award at the state, regional, and national levels. In a sample of 131 teachers who responded, the question was asked if the respondents had participated in workshops and/or courses that taught them how to integrate science into their curriculum. Approximately 82 percent responded that they had participated in workshops, and of those 82 percent, eighteen percent indicated they had attended 6-15 workshops. Thompson found the recipients of the National FFA AgriScience Teacher of the Year award were veteran teachers with an average age of 42 years and an average teaching experience of 18 years. In addition, Thompson concluded these were experienced teachers who were leaders in educational reform and committed to improving the image and quality of their programs. He also concluded that agriscience teachers perceived the lack of appropriate equipment, adequate funding, and in-service workshops as barriers to integrating science. Furthermore, Thompson recommended that in-service programs be offered to assist teachers in integrating science into the agricultural education curriculum. And finally, agriscience teachers perceived that undergraduates would be better prepared to teach if they received instruction on how to integrate science and if they student taught with a cooperating teacher who integrated science.

Agriscience teachers also believed that teacher preparation programs should provide in-service training for teachers on how to integrate science. However, questions remain as to whether these same teachers were involved in active collaboration with other teachers in their buildings or districts, and to what extent resources and knowledge were exchanged in order to enhance the agricultural curriculum. Curriculum integration can occur in isolation from other teachers if an individual teacher decides it will. Although the AgriScience Teacher of the Year award program has done much to motivate teachers to integrate science into their traditional agriculture curriculum, it is difficult to determine if the winners in this program are actively engaged in collaborative efforts.

Responsiveness of University Teacher Training Programs to Curriculum Changes at the Pre-service Level

"Of the six National Academy of Sciences recommendations for agricultural teacher education, there was little evidence among the limited sample of universities that any substantive changes have occurred." (Shinn, 1993)

It hardly seems justifiable to expect permanent, long-term changes to occur in agricultural education, if the teachers being produced at universities and teacher preparation colleges continue to be stamped out using the same curriculum and methods that have produced agriculture instructors for the past 70 years. What has been the response of agriculture teacher education programs to educational reform? Have universities and teacher preparation colleges across the United States responded to the call for a new product? Have they begun delivering a teacher who is equipped for change, ready to teach agriculture as an applied science, math and business course?

A Louisiana study was conducted to determine the answer to those very questions in a survey of in-service needs of Louisiana state agriculture instructors. The study specifically focused on topic areas in the revised agricultural science curricula for which agriscience teachers needed in-service assistance and on identifying agriscience teachers' self-perceived knowledge and skill levels for the selected topic areas. The sample consisted of 206 agricultural teachers in the state of Louisiana. One of the most important findings was that the population of agriscience teachers in Louisiana was aging. With nearly 22% of the teachers already having completed twenty years of teaching experience, Louisiana agricultural education could begin to experience an increase in retirements in the next ten years (Neason, 1992). This is noted because it indicated that many of the teachers completed their college degrees a number of years ago. The science skills they learned, such as using a microscope, preparing slides, or balancing a scale, may well have been forgotten over time.

The new Louisiana agriscience curriculum contained competencies such as biotechnology skills and concepts. Osborne and Miller (1985) found that teachers who have a high level of ability in certain skill areas are more confident in their ability to demonstrate those skills. They also noted that confident teachers taught the skills more often and used methods involving live specimens and student practice more frequently. Furthermore, they found that teachers who lacked confidence in performing a skill taught about the skill area, but seldom did they actually demonstrate the skill or teach students in an actual hands-on situation.

The most notable results from this study indicated that agriscience teachers in Louisiana felt they had sufficient knowledge and skills for teaching basic soil science and soil and plant fertility. They also rated their knowledge and skills for basic plant science, basic animal science, pest management, and natural resource management as sufficient. In-service programs in these areas were not a high priority. Agriscience teachers rated their levels of knowledge and skills in plant science, biotechnology, applied science skills, and animal science biotechnology as low. The recommendation was that the Louisiana Department of Education should construct in-service programs in these areas as soon as possible. Plant Science and Biotechnology should receive the highest priority for in-service programs. These conclusions and recommendations were helpful for determining the areas of need that university and state staff should focus on for in-service training.

The application of this study's findings to pre-service instruction have strong implications for teacher preparation today. And, while the Neason study looked at only those agriscience teachers in one state, the findings are helpful when compared to similar studies in other states. In Mississippi, Newman and Johnson (1994) surveyed the in-service needs of agricultural teachers teaching pilot agriscience courses. The specific objectives were to: 1) determine the teachers' perceptions of the importance of the various units taught in the courses and their personal level of competence in each unit, 2) determine the need for in-service education in the agriscience units based on the Borich model of assessing needs, and 3) determine the units for which teachers perceived additional instructional materials were needed.

The conclusions of this study indicated that teachers did not rate the need for in-service training exceptionally high. The researchers pointed to a recent workshop on agriscience as the reason for this response. However, teachers perceived themselves to be in need of additional preparation in the areas of computers, biotechnology, mechanical technology, entomology, environmental science, and aquaculture. The three most pressing needs for in-service education were in the areas of biotechnology, computers, and mechanical/physical technology. The researchers recommended that undergraduate curricula be restructured to provide more preparation in these areas. This exhibited a progressive response to the plea of agriscience teachers for more training in agriscience course materials.

In broad terms, the recommendations applicable to teacher education programs are stated in the National Academy of Sciences (1988) report:

> In-service education or special summer programs for teachers should be offered focusing on how to use new instructional material and take advantage of students' interest in agricultural subjects. Successful reform efforts within vocational agriculture programs will rely on strong programmatic leadership at the state and national levels. The major leadership challenges include program evaluation, teacher education, curriculum development, assuring adequate resources at the local level, and creating a more flexible, budgetary framework. A center for curriculum design and staff development involving faculty from colleges of agriculture and education should be established, preferably at the land grant universities in each state (p. 17).

These steps for improving program quality and delivery at the local level all begin at the university and college teacher-training program level. In 1988 when the

National Academy of Sciences produced their findings, six recommendations for teacher education were highlighted: 1) stress applied learning but strengthen science, technology, economics, agribusiness marketing and management, international agriculture, and public policy; 2) improve technology transfer and develop methods to teach the strengthened areas; 3) develop partnerships to deliver in-service programs; 4) establish centers for curriculum design and counselor training; 5) develop linkages with science, business, and educational technology; and 6) establish a network to recruit talented students into the teaching profession.

In an effort to better understand the nature of university faculty and their responses to the change mandated by the NAS report, a survey of eight universities with agricultural education teacher training programs was performed regarding programmatic changes (Camp & Oliver, 1988-91). Sadly, it was discovered that few changes were made within the teacher education curricula that were documented in undergraduate course catalogs. In addition, few changes in the course requirements for certification within agricultural education had been made. When asked to estimate the extent of changes in the nature of certification for agricultural teacher education, the general agreement among respondents was "little to some" change had occurred. When asked to describe the impact of the NAS report upon agricultural teacher education, one professor estimated little impact on agricultural teacher education. "The report has been used as a resource to make minor changes in the form of Agriscience and junior high programs. These changes have not yet impacted agricultural teacher education" (Camp & Oliver, 1988-91).

Summary

In reviewing the literature the following areas were examined: (a) historical considerations, (b) educational reform, (c) the agriscience movement, (d) agricultural teacher perceptions of agriscience, (e) science teacher perceptions of agriscience, (f) administrator and guidance counselor perceptions of agriscience, (g) barriers to collaboration and integration, and (h) university responsiveness in the form of curricular changes at the pre-service level.

Evidence was found in the literature that it was necessary for the delivery of the traditional vocational agriculture curriculum to change. With increased sophistication of entry level skills required in the agricultural industry and changing entrance requirements for universities, agriculture must be taught in a method that students will understand and that will prepare them for a variety of future endeavors, few of which will include production agriculture. Teaching science principles in the context of agriculture as agriscience has been recommended as one of the significant changes that agriculture can make. While agriculture teachers are unsure about many of these new methods for infusing science principles into their curriculum, and readily admit they are not prepared for classes such as biotechnology and entomology, most individuals involved with school reform at the local level support the idea and welcome the change.

Universities and agricultural teacher preparation colleges are present in discussions regarding this reform of agricultural education, but little if anything has been done at the pre-service level to prepare student teachers for the changes that lie ahead in agricultural education at the local level.

In conclusion, the literature provided a basis and theoretical framework for the study of methods for integrating science and agriculture. The literature also played a significant role in determining the nature and focus of the research design used here for evaluating change in agricultural education.

CHAPTER 3
DESIGN AND METHODOLOGY

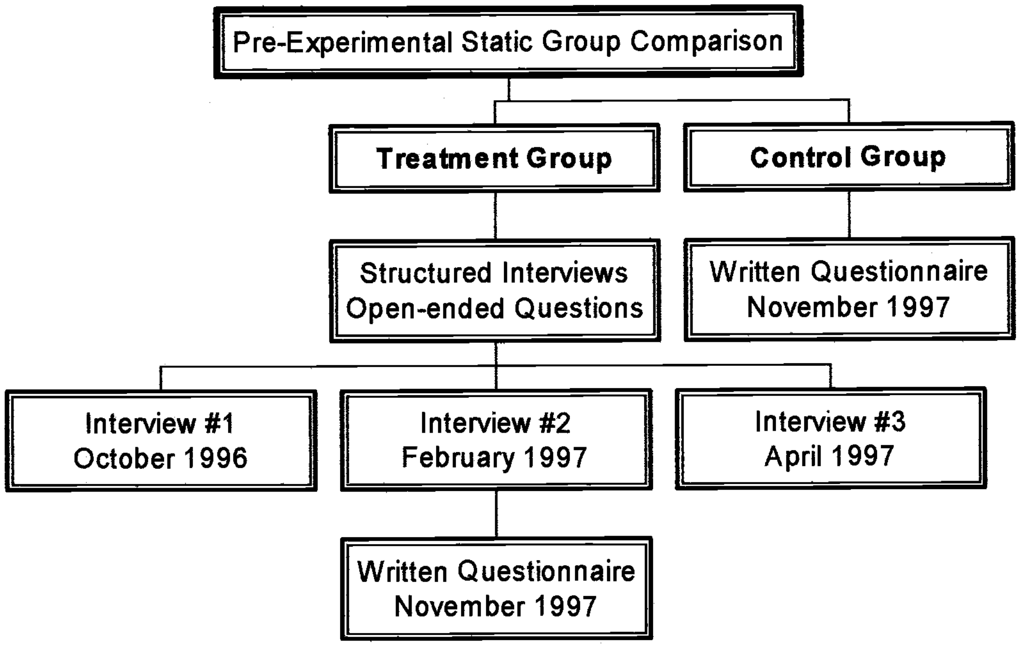
The purpose of this chapter is to detail the design of this study. Included in this chapter is discussion of the rationale for the research design and methods used for collecting data. Additional information discusses the population and sample selection as well as data analysis.

Design of the Study

The design of the study was pre-experimental, static group comparison (see Figure 3.1). According to Gall, Borg and Gall (1996, p.507) "the static-group comparison design has two characteristics: research participants are not randomly assigned to the two treatment groups; and a posttest, but no pretest, is administered to both groups." Furthermore, Gall, Borg and Gall state "the main threat to internal validity in this design is that posttest differences between groups can be attributed to characteristics of the groups as well as to the experimental treatment (p. 507)."

With smaller sample sizes and the inability to randomly assign subjects to either the treatment group or the control group, the static-group comparison became the most likely design to use in this research project.

Figure 3.1
Research Schematic of Agriculture and Science Integration Study



Methodology

The research study used a combination of qualitative analysis and quantitative analysis in order to utilize the strengths of each research methodology. Reichardt and Rallis (1994) state:

> A defensible understanding of reality can withstand scrutiny from different perspectives and methodologies. Indeed, given its complexities and multiple facets, a complete understanding of human nature is likely to require more than one perspective and methodology. The qualitative and quantitative traditions can provide a binocular vision with which to deepen our understandings. That the qualitative and quantitative perspectives remain partly adversarial in their relationship does not preclude cooperation in working together toward their shared goal. In fact, just the opposite is true. By working together, the two traditions can enhance the practice and utilization of research and evaluation (p. 11).

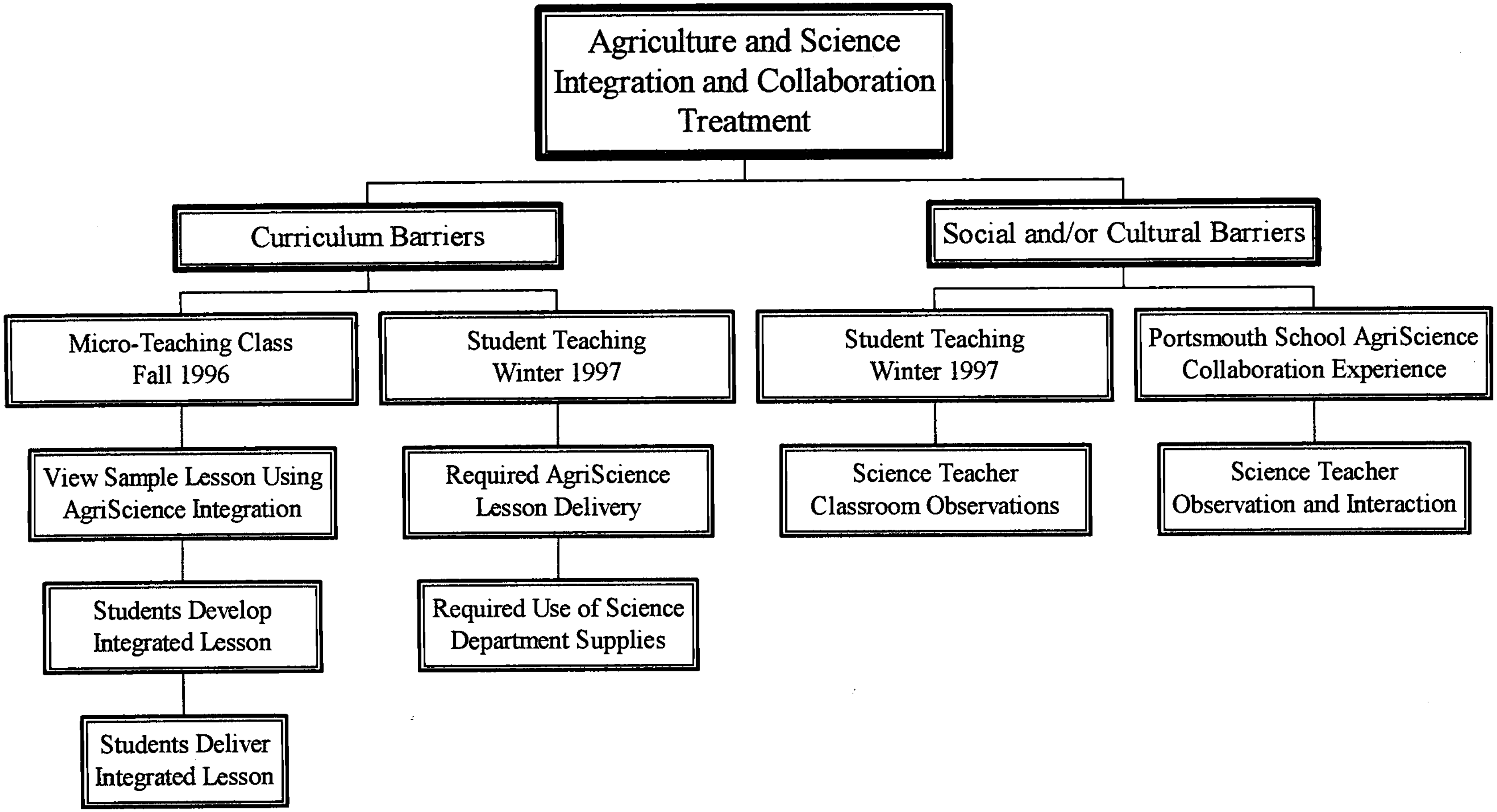
Specifically, the research combined a series of personal interviews with the treatment group in addition to the written questionnaire administered to both the treatment and control groups (see Figure 3.2). The objectives were to examine the levels of integration and collaboration among MAT (Master of Arts in Teaching) students and graduates with their counterparts in science education, and to identify social and cultural barriers that may inhibit collaboration.

The treatment was administered in three phases during the 1996-97 academic year. Observations were timed to occur either during or after each phase of the treatment. During the 1996 fall term students were enrolled in a micro-teaching class. Students viewed sample agriculture lessons that included scientific principles, and were taught methods of integrating scientific principles into their own lessons. Then, the students themselves developed and delivered lessons that contained scientific principles within the agricultural context. Finally, students viewed the lessons of their cohort members that integrated science and had the opportunity to evaluate those lessons for content, delivery and methodology. Interview #1 took place during the 1996 fall term.

During the 1997 winter term, the teacher preparation cohort members were teaching at their student teaching sites. The student teachers were required to deliver a science-based lesson to an AST (Agricultural Science and Technology) class. In addition, they were required to establish contact with a science teacher in their building and observe that teacher in the classroom setting. Finally, the student teachers were required to borrow equipment and/or supplies from the science department for use in the agricultural classroom. Interview #2 occurred during the 1997 winter term.

During the 1997 spring term, members of the 1996-97 teacher preparation cohort were required to attend a one-week job shadowing/team-teaching experience at

Figure 3.2
Schematic of Treatment Used in the Agriculture and Science Integration and Collaboration Research Study



Portsmouth Middle School in downtown Portland, Oregon. The teachers selected for observation and interaction were science/mathematics teachers from the metropolitan middle school. Interview #3 occurred during spring term of 1997 following the Portsmouth Middle school experience.

The final data collection occurred in November/December of 1997 with a mailed questionnaire. The survey was sent to all members of the six agricultural education teacher preparation cohorts from 1991-97 who were currently teaching agricultural education.

Research Questions and Hypotheses

The research questions and null hypotheses used to guide the investigation were stated as follows:

1. What were selected demographics for the participants in the treatment and control groups?

2. What was the need felt by secondary agricultural education MAT student teachers to update their curriculum through integration and collaboration efforts and to include more scientific principles in their agriculture curriculum?

3. What social and cultural barriers existed between agriculture and science teachers at the secondary level as recognized by agricultural education MAT student teachers and graduates?

4. What was the level of collaboration and curriculum integration carried out by selected members of the 1996-97 agricultural education MAT cohort as compared with cohorts from the previous five years?

The following null hypotheses were formulated to test the study's research questions #2, #3, and #4:

Ho_1: There was no significant difference in the need felt by the 1996-97 secondary agricultural education MAT student teachers to update their curriculum through integration and collaboration efforts to include more scientific principles in their agriculture curriculum when compared to cohorts from the previous five years.

Ho_2: There was no significant difference in the perception of social and cultural barriers that exist between agriculture and science teachers at the secondary level as recognized by the 1996-97 agricultural science and technology MAT student teachers when compared to the previous five years' cohorts.

Ho_3: There was no significant difference in the amount of collaboration and curriculum integration conducted by members of the 1996-97 agricultural education MAT cohort when compared with cohorts from the previous five years.

Institutional Review Board (IRB) Statement

Oregon State University complies with regulations of the Department of Health and Human Services for the protection of human subjects involved in research. Therefore, Federal regulations and Oregon State University policy required review and approval of all research studies that involve human subjects before investigators could begin their research. The Oregon State University Research Office and the IRB conducted this review to protect the rights and welfare of human subjects involved in biomedical and behavioral research. In compliance with the aforementioned policy, this study received exempt review status, and was approved on February 7, 1997 (refer to appendix A for letter of approval).

Population

The population for the treatment group, and the qualitative portion of the study, consisted of all graduate students enrolled in the 1996-97 MAT (Master of Arts in Teaching) agricultural education cohort at Oregon State University. Six students made up the 1996-97 MAT cohort. Due to the size of the population, all members of the cohort were included in the study. Table 3.1 provides selected demographic information for the six subjects involved in the initial qualitative study.

Table 3.1
Selected Demographic Information of MAT Students Involved in Qualitative Interviews (N=6)

Demographic Trait	No. of Students
Gender	4 Females 2 Males
Background in High School Agriculture?	3 Yes 3 No
Background in 4-H?	3 Yes 3 No

The subjects representing the control group, and involved in the quantitative analysis of the study, were members of the previous five MAT agricultural education cohorts at Oregon State University. Beginning in 1991-92 with the first cohort and continuing through 1995-96, thirty-three students completed the Agricultural Education MAT program and became eligible for teaching employment. Furthermore, fifteen graduates obtained teaching positions in Oregon teaching secondary agricultural education. Table 3.2 further defines the control population.

Due to the size of the population, all members of the previous cohorts who were currently teaching secondary agricultural education were included in the quantitative analysis of the study.

Table 3.2
Number of Master of Arts in Teaching graduates for the 1991-1997 cohorts currently teaching Agricultural Education (N=19)

Year	Number of students in cohort	Number of graduates teaching Agriculture Science and Technology in Oregon
1991-92	2	1
1992-93	6	2
1993-94	5	3
1994-95	7	4
1995-96	6	5
1996-97	6	4

Data Collection-Personal Interviews

Two separate forms of data were collected during the study, qualitative and quantitative. Qualitative data was collected from the treatment group during a series of three audio taped interviews. The interviews were scheduled at three specific times during the 1996-97 academic year to coincide with the treatment that the subjects were receiving.

Interview #1 took place in October of 1996 during fall term of classes at Oregon State University. The purpose of the interview was to collect baseline data and to chronicle the attitudes and perceptions of the subjects toward the concepts of curriculum integration and collaboration in teaching, as well as their perceptions of social and cultural barriers that exist between science teachers and agriculture teachers. The interview was conducted in the Agricultural Education office of Oregon State University. All interviews were taped using a portable audiocassette tape recorder.

Interview #2 took place in February of 1997 during the subjects' student teaching internship in winter term of classes at Oregon State University. This interview was conducted on-site at the individual placements where each subject was teaching. Interview #2 was designed to collect information regarding actual curriculum integration and collaboration being conducted in the field during their teaching practicum. Furthermore, the interview also sought to highlight additional attitudes concerning their perceptions of barriers to integration and collaboration between science and agriculture teachers as experienced during their teaching internship.

Interview #3 was conducted during spring term of classes at Oregon State University in April of 1997. The purpose of the interview was to collect information following the one-week placement at Portsmouth Middle School in downtown Portland, Oregon. Each subject was assigned to shadow and team-teach with a science and/or mathematics instructor for one week. The purpose was to learn various methods used in teaching academics while looking for opportunities to integrate the sciences and/or math into the agricultural education curriculum and to help the science/math teacher understand how agriculture could be used as a context for teaching their subject. In addition, interview #3 served as the concluding interview summarizing the treatment effect performed during the MAT (Master of Arts in Teaching) academic year. The interview was conducted on-site in the agricultural education office at Oregon State University.

The final collection of data occurred in November of 1997. A mailed survey was sent to all Agricultural Education MAT (Master of Arts in Teaching) graduates from Oregon State University who were actively teaching secondary agricultural education. All cohorts were included in the survey, which collected data from the first cohort in 1991-92 through the 1996-97 cohort.

All of the instruments were developed by the researcher and a panel of experts provided direction for the information included in the interviews and the survey. The committee was comprised of Oregon State University faculty representing two teacher education groups: science and mathematics education, and agricultural education. Copies of proposed questions were sent to committee members, with a request for comments and suggestions.

A total of twenty-five questions from the first interview (appendix B) were formulated to gather demographic information and answers to questions concerning the MAT (Master of Arts in Teaching) students' initial perceptions regarding curriculum integration and collaboration. In addition, information regarding teacher perceptions of the existence of social and cultural barriers between science teachers and agriculture teachers was sought from the members of the agriculture and science education cohorts being examined.

Questions from the second interview (appendix C), conducted three months later, focused on the similarities and differences between the answers given in the first interview and the students' real-life experiences in the classroom during the subject's student teaching experience. The twenty-three questions in the second interview focused on curriculum integration and their experiences and perceptions concerning social and cultural differences between science teachers and agriculture teachers.

Sixteen questions made up the third, and final, interview (appendix D). The subjects were asked once more for their perceptions concerning their experiences involving curriculum integration, collaboration, and barriers between science teachers and agriculture teachers. The interview was conducted following the conclusion of all treatments performed during the subjects' tenure as student teachers.

Data Collection-Survey Instrumentation

The quantitative portion of the study involved a survey mailed to the participants in November of 1997. The purpose for the survey was to compare answers to questions concerning curriculum integration and collaboration between the treatment group and the control group. The questionnaire was developed by faculty members in the Agricultural Education Department at Oregon State University and based upon responses given during the audio taped interviews. Members of the researcher's doctoral committee reviewed the instrument.

The mailed questionnaire (appendix E) consisted of three sections. Section one contained eight statements concerning the integration of science into the agriculture curriculum. Teachers were asked to rate each statement concerning curriculum integration using an ordinal scale regarding the importance they placed upon the statement. A similar scale was used to determine their level of involvement with the contents of the statement. Section two contained twelve statements concerning potential barriers that could exist between science and agriculture teachers. Teachers were asked to respond to each statement using a 5-point Likert-type scale. Three open-ended questions concerning agriculture teacher perceptions of barriers to working with science teachers completed this section. Section three contained items concerning demographic information. The answers for questions in this section consisted of short answer and yes/no responses.

The instrument used in the study was submitted to a panel of experts consisting of practicing agriculture teachers and university professors who reviewed it for content validity. Refinements were made in the draft instrument consistent with panel input to improve content validity. Cronbach's coefficient alpha was used to calculate the reliability of the instrument. Reliability was viewed as the extent to which other researchers would arrive at similar results if they studied the same case using exactly the same procedures as the first researcher (Gall, Borg and Gall, 1996). The instrument was pilot tested in October of 1997 by eight Agricultural Science and Technology teachers currently teaching in Oregon who were not part of the study. The purpose for the field test was to confirm reliability and to obtain additional feedback concerning validity of the instrument from practicing teachers. Reliability for the ordinal and

Likert-type sections of the instrument was calculated and the results listed in Table 3.3. Only minor changes were made to the instrument for clarity based upon the results and recommendations of the pilot test group. Furthermore, a post hoc test of reliability was run using Cronbach's coefficient alpha to confirm the original reliability scores.

Table 3.3
Instrument Reliability Using Cronbach's Coefficient Alpha for Pilot and Post Hoc Tests

Instrument Section	Reliability (Cronbach's alpha)	
	pilot test	post hoc
I Importance	0.8551	0.8675
II Involvement	0.8772	0.9035
III Barriers	0.8687	0.7861

The quantitative questionnaire served as the comparison for the treatment and control groups involved in the pre-experimental, static group comparison model.

Data Collection

The survey instrument and cover letter (appendix F) were mailed to fifteen teachers in the control group and four teachers in the treatment group for a total of nineteen teachers. Two of the original six members of the treatment group did not enter the teaching profession as a secondary agricultural education instructor and therefore were eliminated from the survey portion of the research. Enclosed with each survey was a stamped, self-addressed, return envelope. After two weeks, follow-up telephone calls were made to those instructors who had not mailed in their questionnaires.

Additional surveys were sent to two teachers who had indicated they misplaced or discarded the original survey. Within four weeks from the original date of mailing, all subjects had returned the survey for a 100 percent response rate.

Data Analysis

Data were entered into a computer in the Agricultural Education office of Oregon State University and analyzed using procedures from the SPSS® for Windows™ Release 6.1 computer package.

Specifically, each research question and null hypothesis was analyzed in the following manner: Data related to research questions one, two and three were analyzed using descriptive statistics. Frequency counts, percentages, means and standard deviations were calculated for the null hypotheses and demographic variables. No predictive statistics were used for this study since the survey groups involved were the population.

Summary

Chapter three presented the basic design of the study. This chapter also articulated the methodology and population involved in the research. The various methods involved in data collection were also discussed, as well as the methods used to analyze the data. Chapter four presents the findings of this research study.

CHAPTER 4
FINDINGS

This study yielded two types of data. The first was in-depth, verbal responses which revealed the ongoing thought processes of the subjects undergoing treatment to become successful agricultural education teachers. The qualitative data revealed their perceptions of the importance, opportunities, and barriers present in collaborating with science teachers and their perceived ability to integrate science principles into the agriculture curriculum.

Secondly, the study produced data that revealed relationships and trends between the treatment and control groups. The quantitative results included frequency tables and means that compared the treatment and control groups in their desire to integrate science into their curriculum and their experiences with barriers that could prevent collaboration between disciplines.

Qualitative Findings

Responses to Integration Questions from Interview #1

The first of three treatment group interviews was conducted between October 16th and November 1st, 1996, prior to the beginning of the subjects' student teaching experience. The purpose for the initial interview was to determine benchmark levels for the subjects' perceptions concerning the integration of scientific principles into the agriculture curriculum, and the nature of the relationship between science and agriculture teachers as perceived by the agricultural education cohort teachers. When asked what percentage of the agriculture curriculum should contain science, the average response of the treatment group was seventy-four percent. The high response was one hundred percent and the low response was fifty percent. Table 4.1 illustrates the comparison of the responses from interview one with the same question when asked during interview two that occurred during the subjects' student teaching experience.

Table 4.1
Responses By Agricultural Education Student Interns to the Question 'What Percent of the Agriculture Curriculum Should Contain Science?' (N=6)

Subject	Interview #1 (%)	Interview #2 (%)
F1	100	20
F2	70	50
F3	75	75
F4	50	50
M1	75	75
M2	Missing	Missing

When asked if they would be willing to alter their curriculum in order to allow the students in their Agricultural Education program to receive science credit, two subjects responded:

> *Yes. Science is a large part of natural resources or agriculture. It's all based on that, so if I ever needed to add a little bit of scientific activities into the program, then I would be willing to do that because they'd still get valuable information. (F3)*

> *Yeah, I'd like to do that. If I could get the kids science credit, that would be wonderful. I wouldn't want to do it just so the kids could skip*

science class. I don't feel like I could give them enough of a science base. Because while you were teaching them application, there would be some things that they might not get. (F2)

Furthermore, the subjects in the treatment group were asked their perceptions of the place that the teaching of science has in the agriculture classroom:

I think a very big part. Because to me science principles are fascinating. And a good teacher can make his or her students fascinated also. And if you don't have a basic understanding you're not going to know what you're doing in the greenhouse or why you're doing it. (M1)

I think when you teach science the kids have to understand the principles. A lot of agriculture teachers give the application but never give the principles. Like welding, they teach the steps to light the torch, but they never tell about oxygen, the gas. You've got the application but you don't have the principles in there. I think it's essential for kids to make the connection between the two. (F4)

<u>Responses to Social/Cultural Differences Questions from Interview #1</u>

The subjects were asked a series of questions regarding their perceptions of science teachers and the similarities and differences they perceived between science teachers and agriculture teachers. When asked for their perceptions of a science teacher, the subjects responded:

They are very serious about the science in the world. They are into the big picture of science. I think they are dead serious about science. And they expect the kids to be that way too. Sometimes students just can't grasp science theories and principles, and so it can be a struggle to reach students. (F1)

They're always really intelligent people who maybe are intelligent to the point of not being able to apply the information they know to real life, but the kids actually find it interesting. It's one of those classes *where you come in, sit down and listen to a lecture, and close your books and go home. (F3)*

My perception of science teachers is that they're fun people and they've really got to love to teach because they have to work hard to get kids into the stuff. Because the science teachers that I've known are a little crazy, a little wacko, which I think is a great characteristic for a high school teacher to have. And they are a lot more wacko than the English and writing teachers I've known. (M1)

The subjects were asked for their perception of the similarities found in agriculture and science teachers:

The ag teacher is "let's get out and get our hands on something. Let's get in the garden". The science teacher liked to lecture. He had a desire to see kids get science. He was more interested in people. He was more technology capable with the machines he had in lab. The ag teacher, it took him longer to get up to speed with the equipment and to get him to use some of those things. He preferred [to be] out in the field, he was more common sense, construction, building, that type of thing. (F1)

I think a lot of people don't think of ag teachers as being as smart as science teachers, when in fact they are teaching about the same type of stuff with different experience. Different models. They teach about dissection of animals. In science class they teach about [the] reproductive tract, the digestive tract. And you can do the same thing in ag class. If you go that far into animal science, you do the same thing. And so the similarities, I guess there's a lot more similarities than people believe. I think they teach a lot about the same stuff. (M1)

When asked to respond to perceived differences between science teachers and agriculture teachers, the subjects answered:

It seems like science teachers and those type people are more introverts, and I would say the ag/forestry/natural resources teachers are extraverts. They like to go out with people and do things, and science people are more [likely to] read out of their science journal, sit down and work out the problem on the page and see what the answer is. (F3)

> *Well, obviously you walk into the biology teacher's room, and he's got the lab sinks and the goggles and the chemicals around and things like that. He or she is teaching about basic functions of life. The ag teacher, on the other hand, is usually removed from the school. So you walk out there and you see posters of cows and plows, sheep, some safety things as far as welding. So I guess the difference I see is more ag teachers are application based. Science teachers probably do a little bit more lecturing and telling students "read this chapter so you can understand what we're talking about." (M1)*

When asked if the subjects would feel confident enough to approach a science teacher in their school if they needed help, four subjects responded with "yes", while a fifth gave the following explanation:

> *I think it would depend on where I was actually teaching, and the type of situation and how the school itself, and the teachers, viewed agriculture and forestry. If it was just a place where they sent all the boneheads who needed something to do versus actually teaching something, and if they respected the program as an actual learning based program, then I would probably feel more comfortable. And it would also depend on what type of program they had. If they were really open to people or if they just said 'you stay at your end of the building and we'll stay at ours.' (F3)*

Also, the subjects were asked if they would feel comfortable approaching the science department, in general, for assistance. All subjects in the treatment group responded positively, indicating they would feel comfortable in approaching someone in the science department for assistance in integrating science into the agriculture curriculum.

Subjects in the treatment group were asked if they perceived any drawbacks to integrating science into the agriculture curriculum or collaborating with science teachers:

> *It requires time and resources. It takes time on my part to be sure of what I'm saying to the kids. I think the time is a big factor... and 'turfism'. (F1)*

> *I would be concerned with making sure those people who were teaching it did know what they were talking about. I feel comfortable teaching the basic stuff. There's a lot of stuff I would have to read up on, and I would have to be more prepared for each lesson. (F2)*

> *If you're going to be teaching science principles you have to understand the fundamentals and how they relate to agriculture. You might be a fantastic agriculture teacher, but you basically have to know your science. I don't think you could be a great agriculture teacher and slide by in science and get science credit for your program. (F4)*

Responses to Integration Questions from Interview #2

The second interview of the treatment group was conducted between February 18th and February 27th, 1997. The researcher traveled to the school where each subject was student teaching in their Agricultural Science and Technology program. The intention of the interview was to focus on the integration of scientific principles into the lessons they were using during the student teaching program and to determine if perceptions had changed concerning the social and cultural barriers between science and agriculture teachers since the previous interview. It was intended that by interviewing each subject in the classroom setting they would recall important information more readily than if the interviews were conducted on the campus of Oregon State University.

The subjects were asked to revisit the question from the initial interview concerning what percentage of the curriculum should contain science (see figure 4.1).

Two of five indicated they were overly optimistic in their initial assessment of the amount of science that could be integrated in the agricultural education classroom:

> *I guess in actual practice I've learned that you cannot spend one hundred percent of your time on anything. I'm learning. I have done a lot of science, I've been working on the scientific method for the last two weeks and I think the students have learned a lot. The only thing is that hands-on experiments take time. So there is a lot of things that I realize you just have to plow straight through and give them other information. So, if I'm going to be truthful I'm going to say science has got to be about twenty percent if you're going to include everything else. (F1)*

> *I guess what I find that I want to do and what I'm able to do is not the same thing. I think that it's really important to have science in your classroom, like I said before. Now that I've been here I think maybe I was shooting a little high. I think it should be at least fifty percent. (F2)*

Three students indicated their original estimate for the amount of science that should be integrated was accurate. One subject in the treatment group indicated that, although the original estimate was accurate, he was not able to integrate the desired amount of science into the agriculture curriculum during the student teaching experience:

> *I feel strongly about that (seventy-five percent of the agricultural curriculum should contain science). One thing that I've learned is that it just takes so much effort. Why reinvent the wheel? I've heard that a lot. To set up experiments takes so much more effort than to set up a half-hour lecture. It really does. And I don't know if it's because I'm a student and I have all this stuff to do. I just feel that I don't have a lot of time to do a lot of that. I think it should. I think science should be integrated seventy-five percent like I said before. But did I do that? No, not at all. Not even close. (M1)*

The subjects were asked to indicate what, if any, contacts they had made with science teachers at their student teaching sites. One of the subjects taught at an area center that did not include any science teachers on site and therefore did not have the opportunity to collaborate with a science teacher. Of the remaining four, three did not make any attempt to contact a science teacher in their school, and one worked with the science teachers during a day which was devoted to teacher collaboration. When asked to explain one subject answered:

> *Honestly? I talked with them last term, and anything that I've needed for my experiments I've either brought from my home or gotten out of the shop. So I've never gone over and asked them. (F2)*

Table 4.2 indicates the response of the subjects in the treatment group when asked if they had borrowed any materials, supplies, or equipment from the science department while they were student teaching. One subject indicated borrowing equipment even though there was no formal contact made.

Table 4.2
Level and Type of Materials, Supplies, or Equipment Sharing Among Agricultural Education Student Teachers and Science Faculty at Student Teaching Sites (N=6)

Respondent	Did you borrow materials, supplies, or equipment while student teaching?	List of materials, supplies or equipment borrowed
F1	Yes	Scales, glassware, soil testing equipment
F2	No	
F3	Yes	Thermometers
F4	No	
M1	No	
M2	Missing	Missing

The last question in the integration section of the interview asked the subjects in the treatment group to identify the most difficult element regarding the incorporation of science into the agriculture curriculum. Responses included:

> *The difficulty is time. (F1)*
>
> *For me the hardest thing has been coming up with the ideas. Coming up with an activity that they find fun and that I also find teaches them. I don't really have the resources available to me right now. (F2)*
>
> *It's not 'my' classroom. I think this is the biggest thing. When you come in to teach in somebody's program you just can't come in and say "this is what I want to do." You have to go with the direction that your mentor teacher wants to go. (F4)*
>
> *This room is set up for floral arranging. You can't do many experiments in this room. The greenhouse is where I've had most of my classes. It is totally not conducive for having class in there. It's very hard when your classroom's in the greenhouse. (M1)*

Responses to Social/Cultural Differences Questions from Interview #2

The second set of questions contained in interviews one and two included inquiry into the subjects' perceptions of the similarities and differences between science teachers and agriculture teachers, both before the teacher preparation cohort members taught and after they were in the field. Tables 4.3 and 4.4 illustrate the perceptions of the subjects in the treatment group regarding how they were received by the science faculty in their respective student teaching sites.

Table 4.3
Perceptions of Agricultural Education Student Teachers Concerning How Science Faculty Perceived Their Efforts To Integrate Science Into The Agriculture Curriculum (N=5)

Subject	**Do you feel the science teachers at your school were receptive to your efforts to integrate science into your curriculum?**
F1	I don't think of them as individuals now, but as a group I don't think they give a hoot what we're doing down here. They don't really think that we're teaching science.
F2	I think definitely they would be willing to help.
F3	Yes. They've come over and asked questions and wanted to see what we're doing and will stop in the hallways to answer questions.
F4	I know that both of the science teachers are very open and very receptive and would be and are willing to help out if the situation arises. Very willing.
M1	N/A

Table 4.4
Perceptions of Agricultural Education Student Teachers Concerning Science Faculty Perceptions of Them As Qualified To Teach Students Science (N=5)

Subject	**Do you feel confident that the science teachers at your school respect you as a teacher qualified to teach students science?**
F1	I don't know that. I couldn't say.
F2	They might take it as 'why are you taking our jobs away from us?' I would be hesitant if someone were trying to take my classes and teach them agriculture.
F3	I think they would if I wasn't a student teacher.
F4	Yes. The teachers here do.

Table 4.4 (Continued)

Subject	**Do you feel confident that the science teachers at your school respect you as a teacher qualified to teach students science?**
M1	N/A

The subjects in the treatment group were asked if it were important for them to "like" the science teacher in their respective schools. Every respondent indicated that it was important:

> *If I was going to be borrowing a lot of stuff from them and getting ideas from them? Definitely. I think that it's very important. (F2)*
>
> *I think that it's absolutely essential. Because if you can't work with them, and for instance you want to have science credit in your classroom, they'll never allow it. (F3)*
>
> *I think it's imperative. You have to get along with them. (F4)*
>
> *It's hard. I know since this is confidential I can say this: if I had to work with at least one of the people here specifically, I don't think I could do it. I really don't. Just because of the differences. I don't know if that's me because I guess my answer is yes, I think it's so important to have a good relationship with the person you want to work with. (M1)*

In addition to the need to "like" the science teachers they taught with, the members of the treatment group were asked if they perceived it was important to share a common teaching philosophy and/or a common teaching style in order to effectively collaborate on curriculum projects and to team teach courses together. Tables 4.5 and 4.6 illustrate the responses given to questions concerning the need for common teaching styles and philosophies.

The student teachers were asked for their perceptions of what the 'academic' teachers thought of the Agricultural Education program in their schools (academic teachers was defined as those teaching math, science, language, and writing). Most of the responses mentioned the relationship of their mentor teacher with the faculty. However, the purpose of the question was to determine if other faculty respected the

Table 4.5
Perceptions of Agricultural Education Student Teachers Regarding The Importance of a Common Teaching Philosophy Between Science and Agriculture Teachers (N=5)

Subject	**How important is a common teaching philosophy between science and agriculture teachers?**
F1	Not important.
F2	I think it's very important.
F3	I think it could go either way.
F4	Oh it's so important.
M1	Not important.

Table 4.6
Perceptions of Agricultural Education Student Teachers Regarding The Importance of a Common Teaching Style Between Science and Agriculture Teachers (N=5)

Subject	**How important is a common teaching style between science and agriculture teachers?**
F1	No. They don't even have to have that.
F2	I don't think that's as important.
F3	I don't think that's all that important.

Table 4.6 (Continued)

Subject	**How important is a common teaching style between science and agriculture teachers?**
F4	I don't think it's that important.
M1	Teaching styles is not as important.

academic rigor of the agricultural education program. Student responses included:

I'm glad this is confidential so it won't be repeated. In talking with the principal, he was very honest with me. I have never heard such a negative response toward an agriscience program ever! He said that the other faculty meet in the lounge, and he feels that [the agricultural] faculty is stand-offish. The agricultural faculty doesn't mingle with the other faculty. And I can see that. He's right. (F1)

Most of the teachers seem supportive of it. No one ever has made negative comments about it. I know that the counselors tend to push kids into it that are not necessarily interested in academics. (F3)

I know that some of them turn their nose up at agriculture classes. (F4)

Furthermore, the student teachers were asked for their perceptions of how the counselors in their respective schools viewed the agricultural education program. Once again, it appeared the perceptions of the counselors were more influenced by their relationship with, or opinion of, the mentor teachers. Comments regarding the perceptions of counselors included:

I don't know if they were as honest with me, or as nice. They nod their heads and they say yes, but still I don't think they send a lot of people down here. (F1)

They send a lot of kids out here who don't want to study natural resources. Not that they don't like it. It's just that their goal is not to do well in school. Of all the kids that come out here, probably only half are interested in natural resources. And then there's the other half that come out here just because they heard it was an easy class

> *and their counselor sent them out here because they got kicked out of another class. It seems like no matter what happens, you can't get rid of them. No matter how many times you want to kick them out of your class, there's nowhere for them to go. (F3)*

> *Great. Great. My mentor teacher works very closely with the counselor and she refers students to his class if she thinks they are even remotely interested. She'll talk to my mentor teacher one on one and say "this student wants to do this and this and this. Is it possible to fit this student in anywhere?" I know her students have gone through his program and so she has a very good idea of what goes on in his class. Anybody who deals with my mentor teacher, they know exactly what goes on in there. (F4)*

Finally, the subjects in the treatment group were asked for their perceptions of the site administrator's level of financial support for the purchase of science equipment for their Agricultural Science and Technology Department. Table 4.7 illustrates the responses given to the question.

Table 4.7
Perceptions of Student Teachers Regarding the Level of Financial Support By Site Administrators for the Purchase of Science Equipment For The Agricultural Science and Technology Department (N=5)

Subject	**Does the local school administration support funding for the purchase of science equipment for the agricultural science and technology program?**
F1	The administration doesn't support this program.
F2	The administration is supportive, but support has come through outside grants.
F3	If they had the money they would.
F4	This year no. They would like to see sharing of resources with the science department.
M1	Yes.

Responses to Integration Questions from Interview #3

The third and final interview of the subjects in the treatment group took place between June 3rd and June 6th, 1997. The purpose of the last interview was to obtain data concerning the subjects' perceptions of the integration of science into the agriculture curriculum and their perceptions regarding collaborative efforts between science and agriculture teachers after the subjects had concluded the final portion of the treatment. The student teachers were interviewed on the campus of Oregon State University following their involvement at Portsmouth Middle School in Portland, Oregon. The subjects in the treatment group were assigned the task of shadowing and team-teaching with a science/mathematics teacher at Portsmouth Middle School for one week of classes. The opportunity to teach classes varied with each individual. However, all subjects had the opportunity to work with science teachers on issues of curriculum integration and to observe the textbooks and materials used in the science classrooms.

The final interview focused on issues involving the integration of scientific principles into the agriculture curriculum and the collaboration efforts of science and agriculture teachers together. Eight questions dealt specifically with integration and nine questions concerned collaboration. A total of seventeen questions were included in interview #3.

Student teachers were asked how confident they were of their abilities to integrate scientific principles into their agriculture curriculum and their confidence in collaboration with science teachers. Table 4.8 details the immediate response of the subjects when asked the question. Additional responses included:

> *I see no reason why I shouldn't be able to go to the science teacher wherever I am and get ideas from them or tell them what I'm working on and maybe at some time, if we have the same kids, we can work in each other's classroom. (F2)*

> *I think it will be really easy to do. It will depend on what kind of classes you have. Working with a science teacher, I think, is essential. (F4)*

Table 4.8
Confidence Levels of Student Teachers Concerning Their Ability to Integrate Scientific Principles Into the Agricultural Science and Technology Curriculum and Their Ability to Collaborate With Science Teachers (N=5)

Subject	**Do you feel confident that you can integrate scientific principles into your curriculum or collaborate with the science teacher at your new school?**
F1	Yes. Definitely.
F2	Yeah, I do. Definitely.
F3	It would depend on where I go and what I'm teaching.
F4	Yes. Definitely.
M1	Yeah. I feel confident that I can collaborate. I'm confident I will do my best to integrate science.

The subjects in the treatment group were asked for their perceptions concerning the most difficult part of integrating science into the agriculture curriculum. This question was designed to determine how the student teachers felt about the concept of integrating science into the agriculture curriculum after they had participated in the treatment. Responses varied but included:

The students don't believe that that's what they're there for. (F1)

I think the hardest thing will be knowing the concepts. For instance, if I did something that I know is science related but I don't know the name of it, or the fundamental principle behind it, not being a science teacher I would have to go and look that up. (F2)

Finding creative ways to keep the students interested, to where they don't think they're taking a biology class. So they want to learn about genetics and they're not turned off by it. But they still get the take home message from it. (F3)

The extra time finding the scientific information and aligning it with what your curriculum already has. Making it relate. Just being able to tie it in like it's really a natural phenomenon, which it is, but when you're looking at teaching an agriculture class it's really hard to remember to put the science into it. I think we've been conditioned so long to 'just teaching agriculture' that the science has been forgotten. (F4)

The things that I'm going to have to research or get help with from another teacher. That will take time. Also, setting up experiments and the time needed for gathering materials. (M1)

The subjects were asked to describe the process they would use to integrate science into their agriculture curriculum. Additionally, they were asked how long they would be willing to seek assistance from a science teacher who was not responding to their efforts to integrate science into the agriculture curriculum. Table 4.9 details the responses given concerning the subjects' persistence in working with an unwilling science teacher.

When discussing methods of integration and how they will incorporate science into the agriculture curriculum when they arrive at their new school, all of the subjects indicated they would approach the science department. Comments concerning this

Table 4.9
Length of Time Student Teachers Would Be Willing To Work With Uncooperative Science Teachers Before Giving Up (N=5)

Subject	**How long would you be willing to work with a science teacher who is not responding to your efforts to integrate, before you gave up?**
F1	One semester
F2	Half of a year
F3	One or two months
F4	A couple of weeks
M1	A couple of weeks

area included:

Basically, I will look through the courses that are being taught and the objectives of each one of the courses and try to relate something to each unit and maybe even each lesson in science. And, then if I don't have the means exactly to come up with activities relating to that, but I know that it's somewhere in there, go ahead and talk to a science teacher or another teacher that's there to maybe find out when to teach it. (F3)

Probably one of the easiest ways would be to start by going to the science teacher and just chatting with them. See if he/she is interested in trying to align the curriculum. Maybe the first year or the second year take his or her curriculum from the science department and pick through it and cut and paste so maybe you're teaching the same exact, or very similar, areas and just do different experiments. (F4)

Responses to Social/Cultural Differences questions from Interview #3

The final section of questions from interview #3 dealt with the perceptions each subject had concerning their relationship with science teachers and their ability to work with them. These answers came as a result of the exposure each student had with science teachers at their student teaching site and the week-long job shadowing/team-teaching experience they participated in at Portsmouth Middle School in Portland, Oregon. Students were asked what made them want to spend time with a science teacher. Responses included:

> *You have somebody else to bounce ideas off of. Somebody there can help you decide what is going to work and what isn't from their experience. (F1)*
>
> *I think the thing that would make me most want to work with them is probably their interest in students and their desire to do what they do. You know they enjoy teaching and they enjoy kids so it would be that. (F2)*
>
> *Their enthusiasm and their desire to really have a variety of activities. (F3)*
>
> *I think it comes down to the personality thing again. I would be willing to work most with someone who was real motivated, couldn't wait until students got there. Willing to try new things out. Someone who's really involved. (M1)*

Immediately following the question asking the student teachers to explain what would make them want to spend time with a science teacher, each subject was asked to elaborate on what would make them not want to spend time working with a science teacher. All five of the subjects responded that a science teacher that was not approachable or willing to help would be a factor in deciding not to work with them on collaborative projects or not to seek assistance from a particular science teacher when working on curriculum activities which integrated scientific principles into the agriculture curriculum. In addition, three of the five student teachers mentioned incongruent personalities as being a reason they would not choose to work with a science teacher in their school. The responses included:

> *I would not want to work with them if I felt that personally they were not an approachable person. It's personality for one thing. (F1)*
>
> *Probably if they weren't open to my suggestions. If it were a one way relationship then I wouldn't pursue it. (F2)*
>
> *You know, it just depends on their personality. And I wouldn't want to relate with them very much if they didn't want to share their stuff with me. That would probably turn me off if they weren't going to help me out. I'm pretty open, but if they don't want to help me, I'm not going to be too eager to spend my weekends with them. (F4)*
>
> *Someone who, if I approached them, didn't seem very interested. Personality is such a big thing for me. (M1)*

Interview #3 occurred after the conclusion of the treatment phase of the study. Therefore, the student teachers were asked if, as a result of working with science teachers during the year, their desire to continue collaborative efforts with science teachers at the school they would be teaching at upon graduation, had increased or decreased? Table 4.10 illustrates the brief narrative response given by each subject.

Table 4.10
Responses of Student Teachers to the Question Concerning the Effects of The Treatment Upon Their Desire To Work With Science Teachers (N=5)

Subject	**Has working with science teachers this past year increased or decreased your desire to integrate and collaborate with science teachers?**
F1	It's not really a plus or a minus either way.
F2	It's definitely increased.
F3	I think it's increased it.
F4	Increased. Definitely.
M1	Increased. I'm excited about trying it.

Further comments included:

I wish I could help you out but I really feel like most of what I've done is prep for becoming a new teacher and I haven't really looked at integration on my own part. I mean it's interesting, and it's great, but that first year is looming and I've got a lot of work to do, so I'm not considering it at this time. (F1)

I see so many opportunities for me to use the science, especially all of the hands-on stuff. I probably did ten different science labs when I was at my host school, and it was awesome because it allowed me to gain another interest approach. I think it was really cool. I definitely plan to keep on doing it. (F2)

It's going to be a lot more work. In that first year of teaching I'll be just trying to get the basics out without stumbling too much, you know. And if I'm trying to do FFA and SAE it might be one of the last things on my list, unfortunately, when it should be one of the first things. (M1)

The final question of interview #3 asked for the student teachers to predict how much time they would need before they would be able to successfully integrate scientific principles into their agriculture curriculum and be able to collaborate with science teachers. The researcher was careful not to suggest a certain timetable to avoid deliberately leading the subjects in their response. Table 4.11 illustrates the brief version of their responses.

Table 4.11
Predictions of Agricultural Education Student Teachers Concerning the Timetable for Integrating Scientific Principles Into the Agriculture Curriculum and for Collaborating With Other Teachers Once They Begin Teaching (N=5)

Subject	**When would you predict that you would be willing to integrate and start thinking about ways to collaborate with other teachers?**
F1	Three to five years.

Table 4.11 (Continued)

Subject	**When would you predict that you would be willing to integrate and start thinking about ways to collaborate with other teachers?**
F2	Probably three to four years.
F3	At least the second, if not the third year.
F4	Three years.
M1	At least a year.

More elaborate comments included:

It's going to take three to five years to feel comfortable with what I'm doing so that I can feel comfortable enough to step out of my envelope and work with other teachers. I'll continue anything that the department has going, but beyond that I wouldn't want to start anything brand new. (F1)

I don't know if you could ever integrate everything. You could be working on it for years. I don't really think that it's a final place you reach. I just think it's a never-ending pursuit. But I think after about three years you should have a basic size element in every curriculum area you want to implement it in. (F2)

I think it would be a good three years before it was at least a, I don't want to say strong element, but a very visible element. And then, long term, I'd say five to six years before it was a strong element. I don't want to say 'yeah, I'm going to do it in the first year.' Wrong! I don't think that's feasible. (F4)

Factors that come into play are: The subject you're teaching, facilities, budget, how willing the science teachers are to collaborate. I would say at least a year. If I just do not have the resources, I don't see myself throwing that much time in that direction when I'm just trying to get through the year. Maybe I'm just freaking out too much about how stressful the first year's going to be, but if the things aren't there then I'm not going to put too much effort in. (M1)

Quantitative Findings

Following the conclusion of the interviews of the student teachers involved in the treatment group the final questionnaire was produced (appendix E). The instrument was mailed to members of the treatment group who were currently teaching agricultural education (N=4), and to members of the control group (N=15). The control group represented the graduates of the Agricultural Education Program at Oregon State University since 1992, who were teaching Agricultural Science and Technology.

Research Question #1: Demographic Characteristics of Respondents

The questionnaire was mailed on November 10th, 1997, and all responses were returned by December 16th, 1997. The average respondent reported just under three years of total teaching experience with an average age of 28.7 years. Ninety-five percent (18) had attended a workshop on agriscience. Of the agriculture teachers surveyed, 78.9% (15) responded that they had borrowed materials, supplies, and/or equipment from the science department in their school.

Three out of the fifteen agriculture teachers included in the control group taught outside the state of Oregon. All three teachers not employed in Oregon taught in Washington State. In addition, three out of the four agriculture teachers included in the treatment group taught outside of Oregon. Two of the subjects taught in Washington State, while one taught in California. Table 4.12 contains a summary of selected demographic characteristics reported by the respondents.

Table 4.12
Descriptive Statistics for Selected Demographic Characteristics of Treatment and Control Groups (N=19)

	Treatment			Control		
Characteristic	N	Mean	SD	n	Mean	SD
Age	4	27.5	2.6	15	29.1	4.8
Years of Teaching Experience	4	1.0	0.0	15	3.0	1.2
Number of Students in your school	4	1500	424.2	14	783	448.0
Number of Faculty in your school	4	93.2	58.7	12	47.8	42.1

	Treatment			Control		
Characteristic	N	Yes	No	n	Yes	No
Does your school give science credit for Agricultural Science and Technology courses?	4	3	1	15	8	7
Have you ever attended any workshops on agriscience?	4	4	0	15	14	1
Do you currently have a science endorsement?	4	0	4	15	1	14
If you do not have a science endorsement, do you plan to get one?	4	1	1	15	9	3
Do you share a common prep period with any of the science teachers in your school?	4	2	-	15	9	5

Research Question 2: Importance of Agriscience Integration

Question numbers one through eight of the questionnaire dealt with the need felt by secondary agricultural education teachers for incorporating scientific principles into the Agricultural Education Program through collaboration and integration efforts. The eight questions addressed the following null hypothesis:

Ho_1: There was no significant difference in the need felt by the 1996-97 secondary Agricultural Education teacher preparation cohort group to update their curriculum through integration and collaboration efforts to include more scientific principles in their agricultural education curriculum when compared to cohorts from the previous five years.

In order to test null hypothesis Ho_1 between groups, a t-test for independent means was used. According to Gall, Borg, and Gall (1996, p. 772), the t-test for independent means is "a procedure for determining whether the observed difference between the mean scores of two groups on [a particular variable] is statistically significant. The procedure is used when there is no relationship between the two sets of scores."

A statistical comparison for the tests between the control and treatment groups was set a-priori using a two-tailed t-test at alpha 0.05. This was done for each question in the section regarding perceived barriers of collaboration and integration and the section concerning the respondent's perceived level of importance for curriculum integration. To control for the equality of variance between the control and treatment groups, Levene's test for equality of variance was used. When the p-value for Levene's test was <0.05, the two-tailed significance was calculated on unequal variance between the two groups (Ramsey & Schafer, 1997, p.99).

The results of the analysis are presented in Table 4.13. For questions one

Table 4.13
Comparison of the 1996-97 Cohort and Previous Cohort Groups Concerning the Perceived Need Felt By Each Cohort Group to Integrate Scientific Principles Into the AST Curriculum (N=19)

Statement	Group	No. of Cases	Mean	SD	p-value
AST (Agricultural Science and Technology) teachers should integrate scientific principles into their lessons	**Control**	15	4.67	0.62	0.68
	Treatment	4	4.50	1.00	
AST teachers should work with science teachers in their respective schools to assist in integrating scientific principles into the AST curriculum	**Control**	15	4.20	0.86	0.91
	Treatment	4	4.25	0.50	
Science teachers should assist AST instructors to incorporate scientific principles into the AST curriculum	**Control**	15	3.80	1.01	0.89
	Treatment	4	3.75	0.50	
Science teachers should be aware of the efforts to integrate science into AST programs within their building	**Control**	15	4.53	0.64	0.54
	Treatment	4	4.75	0.50	
AST teachers should share the resources of their programs with teachers in the science department	**Control**	15	4.20	0.94	0.41
	Treatment	4	3.75	0.96	
Science teachers should share the resources of their departments with the AST instructor	**Control**	15	4.27	0.96	0.62
	Treatment	4	4.00	0.82	
My AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately	**Control**	15	3.33	1.05	0.89
	Treatment	4	3.25	0.96	
AST teachers should attend workshops on incorporating scientific principles into their curriculum	**Control**	15	4.27	0.88	0.006*
	Treatment	4	5.00	0.00	

Note. *$p < 0.05$ two-tailed.

through eight, a five-point ordinal scale was used to assess the importance respondents placed on each statement. The choices for selection of importance were 1=Unimportant, 2=Below Average, 3=Average, 4= Above Average, and 5=Utmost. Of the eight statements listed, only statement number eight "AST teachers should attend workshops on incorporating scientific principles into their curriculum" was statistically significant. Accordingly, the null hypothesis (Ho_1) failed to be rejected. The raw mean scores on the eight statements were the lowest, 3.33 and 3.25 for the control and treatment groups respectively, for the statement "my AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately". Two questions which received the highest marks were "science teachers should be aware of the efforts to integrate science into AST programs within their building" (4.53 for the control group, 4.75 for the treatment group), and "AST instructors should attend workshops on incorporating scientific principles into their curriculum" (4.27 for the control group, 5.00 for the treatment group).

Both groups rated six of the eight (75%) statements 4.00 or higher on the five-point ordinal scale, indicating they felt the statements were "above average" in importance for their Agricultural Science and Technology program. Two questions (25%) received scores between 3.00 and 4.00 indicating the statements were between "above average" and "average" in importance to the respondent's AST program. The two statements which received the lowest mean scores were "science teachers should assist AST teachers to incorporate scientific principles into the AST curriculum" (3.80 for the control group, 3.75 for the treatment group), and "my AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately" (3.33 for the control group, 3.25 for the treatment group).

Research Question 3: Perceptions of Social and Cultural Barriers Inhibiting Collaboration Between Science and Agricultural Science and Technology Teachers

The survey included fifteen questions which asked the respondents to rate their perceptions of the existence of social and/or cultural barriers which inhibited their ability to collaborate with the science teacher(s) in their school and limited their ability to integrate science into their agriculture curriculum. Twelve of the questions asked respondents to make selections using a five-point Likert-type scale to indicate their perceptions of each statement. Respondents' choices were 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree, and N/A=not applicable. Three open-ended questions regarding barriers to integration and collaboration with science teachers concluded this portion of the survey. The fifteen questions in the barriers section addressed the following null hypothesis:

Ho_2: There was no significant difference in the perception of social and cultural barriers that exist between agriculture and science teachers at the secondary level as recognized by the 1996-97 Agricultural Education teacher preparation cohort when compared to the previous five years' cohorts.

In order to test Ho_2, the t-test for independent means was used. A statistical comparison for the tests between the control and treatment groups was set a-priori using a two-tailed t-test at alpha 0.05. Furthermore, Levene's test for equality of variance was used to control for unequal variance, at p-value <0.05 level of significance.

The results of the analysis are presented in Table 4.14. Of the twelve statements listed, only "a difference in years of teaching experience is a barrier in working with the science teacher(s) in my school" was statistically significant between the treatment and

Table 4.14
Comparison of the 1996-97 Teacher Preparation Cohort Graduates and Graduates of Previous Cohorts Concerning Their Perceptions of Social and Cultural Barriers to Working With Science Teachers in Their Schools (N=19)

Barrier Statement	Group	No. of Cases	Mean	SD	p-value
Time is a barrier in working with the science teacher(s) at my school	**Control**	14	4.14	1.10	0.88
	Treatment	4	4.25	1.50	
The physical separation in the location of our departments is a barrier in working with the science teachers(s) at my school	**Control**	13	3.23	1.24	0.74
	Treatment	4	3.50	1.92	
A lack of understanding about agricultural science among the science teacher(s) is a barrier in working with the teacher(s) at my school	**Control**	14	3.79	1.05	0.95
	Treatment	4	3.75	0.50	
A lack of common interests (I have nothing in common with...) is a barrier in working with science teacher(s) at my school	**Control**	13	2.38	1.19	0.63
	Treatment	4	2.75	1.71	
A lack of communication is a barrier in working with science teacher(s) at my school	**Control**	14	3.00	1.41	0.54
	Treatment	4	3.50	1.29	
The science teacher(s) **not** viewing agriculture as an applied science is a barrier in working with the science teacher(s) at my school	**Control**	14	3.00	1.24	0.26
	Treatment	4	3.75	0.50	

Table 4.14 (Continued)

Barrier Statement	Group	No. of Cases	Mean	SD	p-value
The science teacher(s) **not** viewing my AST program as science based is a barrier in working with the science teacher(s) at my school	**Control**	14	3.21	1.19	0.96
	Treatment	4	3.25	0.50	
A fundamental difference in the way we view the world and food production in general is a barrier in working with the science teacher(s) at my school	**Control**	13	2.62	1.12	0.35
	Treatment	4	3.25	1.26	
The politics within the hierarchy of my school is a barrier in working with the science teacher(s) at my school	**Control**	14	2.64	1.40	0.62
	Treatment	4	2.25	1.26	
A difference in personalities is a barrier in working with the science teacher(s) at my school	**Control**	14	2.14	1.17	0.60
	Treatment	4	2.50	1.29	
A difference in teaching philosophies is a barrier in working with the science teacher(s) at my school	**Control**	13	2.15	1.14	0.61
	Treatment	4	2.50	1.29	
A difference in years of teaching experience is a barrier in working with the science teacher(s) in my school	**Control**	14	2.07	0.73	0.039 *
	Treatment	4	3.25	1.50	

Note. *p < 0.05 two-tailed.

control groups with a p-value of 0.039 on a two-tailed t-test of independent means. Here, the null hypothesis (Ho_2) failed to be rejected. Only one of the questions received mean scores over 4.00 for both groups. The statement "time is a barrier in working with the science teacher(s) at my school" received a mean score of 4.14 and 4.25 from the control and treatment groups respectively. Five of the twelve statements (42%) were rated between 3.00 and 4.00 by both groups indicating the respondents leaned toward agreement from neutral to the barrier statement. The statement "a difference in years of teaching experience is a barrier in working with the science teacher(s) in my school" received the lowest rating (2.07) from the control group. The treatment group rated the statement "the politics within the hierarchy of my school is a barrier in working with the science teacher(s) at my school" as the lowest (2.25) of the twelve statements. Scores of 2.00 to 3.00 indicated that respondents leaned toward disagreement from neutral regarding the statement was a barrier for them in collaborating with the science teacher(s) in their building, with four questions falling into this category for 33% of the statements.

Three open-ended questions asked respondents to provide information in detail regarding barriers that prohibit them from collaborating with the science teacher(s) in their building. Table 4.15 provides responses to the open-ended questions. When

Table 4.15
Responses of the 1996-97 Teacher Preparation Cohort Group and Previous Cohort Graduates to Open Ended Questions Concerning Barriers to Collaboration With Science Teachers and the Integration of Science Principles into the AST Curriculum (N=19)

What do you feel is the greatest barrier to working with the science teacher(s) at your school?	Group
1. Time needed to work together (2).	Control
2. The difference in structures of our programs. Science is more structured with textbook assignments and anatomy colorbooks.	
3. Time and the science teacher's lack of respect for the value of the AST program.	

Table 4.15 (Continued)

What do you feel is the greatest barrier to working with the science teachers at your school?	Group
4. Some teachers feel that AST teachers aren't qualified to teach science.	Control
5. They (science teachers) are not willing to cooperate or integrate.	
6. Time and personal beliefs.	
7. The state of the AST program when I accepted this position. It was primarily shop classes.	
8. The past history of how science teachers viewed my AST program before I arrived.	
9. Distance. We have a great distance between the departments.	
10. Time – Scheduling conflicts.	
11. Reluctance of science to accept agriculture as a science-based subject.	
1. Time (3).	Treatment
2. Science teachers are a rather strange lot personality wise.	
3. There is some bad blood between the two departments.	

Please list any other differences that you perceive as barriers that prevent you, or could prevent you, from working with the science teachers at your school.	Group
1. We compete for students in the upper level (11-12) courses. Lack of technical knowledge by instructors, and science teacher's perceptions of AST teachers as non-academic.	Control
2. AST programs reduce the number and quality of students in the regular science program that has a negative impact upon their budgets, etc.	
3. Lack of understanding that we can feed from each other and that I can apply their theory.	
4. The issue of lab science credit.	

Table 4.15 (Continued)

Please list any other differences that you perceive as barriers that prevent you, or could prevent you, from working with the science teachers at your school.	Group
5. I could probably be educating them more on what we/I do in the area of science.	Control
6. Limited equipment-unwillingness to share due to time and the number of students who need the equipment.	
7. Age-the science teachers are almost twice my age and use an "old" style of teaching-lecture format.	
1. My AST program draws students away from the science department because AST grants science credit.	Treatment
2. The science teachers are preoccupied with their own agenda. We work within our department just as well without them.	

What barriers exist that keep you from obtaining a science endorsement?	Group
1. Passing the exam and the exams are always scheduled during State FFA Convention or my County fair.	Control
2. Time (6).	
3. I don't have the necessary credits for endorsement in Washington state (2).	
4. Money (3).	
5. No desire to be miss-assigned if my AST numbers are low.	
6. Taking the test.	
1. Time (3)	Treatment
2. Money	

asked "what do you feel is the greatest barrier to working with the science teacher(s) at your school?" three out of four respondents in the treatment group mentioned the time required. Five of the fifteen teachers in the control group responded to the same question by writing that time was the greatest barrier inhibiting them from collaborating with the science teacher in their school.

Respondents were asked to list any other differences they perceived as barriers that prevented them, or could prevent them, from working with the science teachers in their schools. The responses to this question were broader in range. Two out of the eight responses (25%) from the control group indicated that competition for the same students caused a barrier between the science teacher and the agriculture teacher when trying to collaborate and integrate scientific principles into the agriculture curriculum. One of the three responses to this question from the treatment group also stated competition for students as their answer.

When respondents in the control group were asked for barriers that existed that kept them from obtaining a science endorsement, six responses were given. All six included the time necessary to study and take the test as a barrier. Three of the four teachers in the treatment group also marked time as a barrier for obtaining their science endorsement. The money necessary to take the test for obtaining a science endorsement was listed as the second most commonly occurring response. Three out of six in the control group and one out of four in the treatment group listed money as a barrier to gaining their science endorsement.

Research Question 4: Involvement in AgriScience Integration

Question numbers one through eight of the questionnaire asked for the respondents to rate their involvement in the statements listed concerning the concept of incorporating scientific principles into the Agricultural Science and Technology Program through collaboration and integration efforts. The eight questions addressed the following null hypothesis:

Ho_3: There was no significant difference in the amount of collaboration and curriculum integration conducted by members of the 1996-97 agricultural education teacher preparation cohort when compared with cohorts from the previous five years.

In order to test null hypothesis Ho_3 between groups, a t-test for independent means was again used. The statistical comparison for the tests between the control and treatment groups was set a-priori using a two-tailed t-test at alpha 0.05.

The results of the analysis were presented in Table 4.16. For questions one through eight, a five-point ordinal scale was used to monitor the degree of involvement of the respondents with regard to each collaboration and integration statement. The choices for selection of involvement were 1=Never, 2=Seldom, 3=Sometimes, 4= Much of the time, and 5=Always. Of the eight statements in the questionnaire concerning teacher involvement in the collaboration and integration of scientific principles into the AST curriculum, none was found to be statistically significant. Thus, the null hypothesis (Ho_3) failed to be rejected. Teachers in the control group rated the statement "AST teachers should integrate scientific principles into their lessons" higher than the other statements with a 4.00 indicating they were involved in it "much of the time". Meanwhile, the teachers in the treatment group rated their involvement with the statement "science teachers should be aware of the efforts to integrate science into the AST programs within their building" higher than the other statements giving it a rating of 4.00. The lowest rated statement by both the treatment and control groups was "my

AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately". This statement received a score of 1.75 from the treatment group and 2.13 from the control group indicating they were seldom involved with the activity. The scores for the teacher involvement section of the questionnaire were generally lower than the scores in the section asking teachers to rate the level of importance they placed upon the statements. Comparisons can be made since the respondents were asked to rate the same statements in both sections. Four of the eight statements (50%) received scores lower than 3.00 indicating teachers were

Table 4.16
Comparison of Cohorts Concerning Their Involvement in Collaboration and Integration of Scientific Principles Into the AST Curriculum (N=19)

Statement	Group	No. of Cases	Mean	SD	p-value
AST (Agricultural Science and Technology) teachers should integrate scientific principles into their lessons	**Control**	15	4.00	0.65	0.24
	Treatment	4	3.50	1.00	
AST teachers should work with science teachers in their respective schools to assist in integrating scientific principles into the AST curriculum	**Control**	15	2.87	1.30	0.87
	Treatment	4	2.75	0.96	
Science teachers should assist AST instructors to incorporate scientific principles into the AST curriculum	**Control**	15	2.40	1.35	0.84
	Treatment	4	2.25	0.96	
Science teachers should be aware of the efforts to integrate science into AST programs within their building	**Control**	15	3.20	1.21	0.23
	Treatment	4	4.00	0.82	

Table 4.16 (Continued)

Statement	Group	No. of Cases	Mean	SD	p-value
AST teachers should share the resources of their programs with teachers in the science department	**Control**	15	3.27	1.28	0.46
	Treatment	4	2.75	0.96	
Science teachers should share the resources of their departments with the AST instructor	**Control**	15	3.07	1.16	0.92
	Treatment	4	3.00	1.16	
My AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately	**Control**	15	2.13	0.99	0.50
	Treatment	4	1.75	0.96	
AST teachers should attend workshops on incorporating scientific principles into their curriculum	**Control**	15	3.47	0.83	0.95
	Treatment	4	3.50	1.29	

Note. *$p < 0.05$ two-tailed.

less than "sometimes" involved in various integration concepts. Similarly, four of the eight statements (50%) received scores over 3.00 indicating teachers were more than "sometimes" involved in various other integration concepts.

Three additional questions asked for respondents to indicate the level of resource sharing they had experienced with the science teacher(s) in their school. Table 4.17 indicates the responses given concerning the sharing of resources in the collaboration and integration process. When asked if the agriculture teacher had been involved in team-teaching a class with a science teacher, only one respondent from the control group indicated they had, while none of the teachers in the treatment group had participated in that activity. Eighty-seven percent of the respondents in the control

Table 4.17
Comparison of the Frequencies and Percentages of Actual Agriculture and Science Teacher Interaction and Resource Sharing Between the Cohorts (N=19)

Statement	Group	Response	
		Frequency	Percent
Have you ever team-taught a class with a science teacher from your school?	Control	Yes-1	0.07
		No-14	0.93
	Treatment	Yes-0	0.00
		No-4	1.00
Have you borrowed materials/supplies/equipment from the science department in your school?	Control	Yes-13	0.87
		No-2	0.13
	Treatment	Yes-2	0.50
		No-2	0.50

group indicated they had borrowed resources from the science department in their school, compared to fifty percent of the respondents in the treatment group.

Table 4.18 gives a detailed description of the types of materials, supplies, and equipment agriculture teachers borrowed from the science department in their buildings. Of the thirteen respondents in the control group who indicated they borrowed materials from the science department, nine of those respondents borrowed microscopes and/or microscope slides. This represented the most frequently borrowed equipment among the control group respondents. Dissecting supplies and lab equipment and/or glassware were borrowed by four of the agriculture teachers in the control group, which represented the second most frequently borrowed equipment listed. Three teachers indicated they had borrowed chemicals, two agriculture teachers listed measuring instruments, and two of the thirteen replied that they had borrowed thermometers.

Two agriculture teachers in the treatment group indicated they had borrowed supplies from the science department. Both teachers indicated they had borrowed measuring

Table 4.18
Comparison of the Type of Materials/Supplies/Equipment Shared By Agriculture and Science Teachers Between the 1996-97 Cohort and Previous Cohort Groups (N=19)

Statement	Group
If you answered yes to the above question, what materials/supplies/equipment have you borrowed from the science department in your school?	
1. Microscopes and/or slides (9)	Control
2. Dissecting supplies (4)	
3. Lab equipment and/or glassware (4)	
4. Chemicals (3)	
5. Measuring instruments (2)	
6. Thermometers (2)	
7. Distilled water	
8. Books	
9. Videos	
1. Measuring instruments (2)	Treatment
2. Chemicals	
3. Microscopes and/or slides	
4. Thermometers	

devices. Chemicals, microscopes and/or slides and thermometers were also listed as equipment borrowed by members of the treatment group.

Summary

This study produced two types of data: quantitative and qualitative. Interviews of the treatment group were conducted to determine initial perceptions towards elements of collaboration with science teachers and the integration of scientific principles into the agriculture curriculum. Responses from the interviews were then analyzed to construct the survey instrument that was used to collect the quantitative data.

Comparisons were made between the 1996-97 Agricultural Education teacher preparation cohort (treatment group) and the previous five year's teacher preparation cohorts (the control group). Subjects in the two groups were asked their perceptions on the importance of, and their involvement in, specific statements concerning collaboration efforts with science teachers and their integration of scientific principles into the agriculture curriculum. In addition, the subjects were asked for their perceptions of barriers that existed between science teachers and agriculture teachers.

CHAPTER 5
SUMMARY OF FINDINGS, DISCUSSION, AND CONCLUSIONS; RECOMMENDATIONS; AND PROBLEMS FOR FUTURE RESEARCH

Introduction

Two types of results were gathered during this study: qualitative and quantitative. The qualitative data yielded findings from interviews conducted only with the treatment group. Although the results from the interview series were used to guide the development of the questionnaire used in the quantitative portion of this study, the responses to the interviews also yielded useful data pertinent to this study.

The conclusions of this study were based on the responses of the agricultural education teacher preparation cohorts from 1991-96 currently teaching secondary agricultural education (control group), and members of the 1996-97 cohort currently teaching secondary agricultural education (treatment group). Although other teacher training programs emphasize the integration of science into the agriculture curriculum, caution must be exercised when generalizing the results beyond the population.

Summary, Discussion, and Conclusions of Qualitative Findings

When the respondents in the treatment group were initially asked to estimate their perception of how much science should be integrated into the agriculture curriculum, the mean response for percentage of science they would include was 74%.

When asked the same question three months later, after they had been involved in student teaching at their assigned school, the mean response was 54%. Reasons given for the decrease in the perceived amount of science integrated into the agriculture curriculum included the amount of time needed by the AST teachers to incorporate science and the desire to be sure they could teach the scientific principles accurately. The drop in favoring integration appears to reflect the reality of the time commitment required to become a good teacher. Integration was perceived as important, but becoming a good teacher had to come first. It can be concluded that the treatment of discussions promoting the integration of science and the collaboration with science teachers in the methods class and in teaching a micro-teaching lesson involving science had the desired effect of positively impacting the treatment group's attitudes. As the reality of the workload of the teaching assignment set in through student teaching, the ideals were tempered somewhat but not dismissed.

When asked during their student teaching experience if they had borrowed materials, supplies, or equipment from the science department at their student teaching site, two of five (40%) responded that they had. Measuring equipment, glassware, thermometers, and soil testing equipment were the items respondents indicated borrowing while they were student teaching. One of the treatments was to require teaching a science lesson during student teaching. With only 40% saying they borrowed equipment from the science department, that indicates the other 60% were able to find the needed science equipment in the agricultural education department. Therefore, some current agriculture teachers are working toward science integration and could be an asset to student teachers who need to see this effort being made.

Respondents in the treatment group were asked for their perceptions concerning how receptive they thought the science teachers at their school were regarding their attempts to infuse science into the agriculture curriculum. Three out of the four (75%) respondents indicated a favorable impression of the science teacher in response to their efforts to integrate scientific principles into the agriculture curriculum. When asked how important a common teaching philosophy was to the success of collaboration efforts between agriculture and science teachers, two out of five (40%) responded that it was not important, two of the five (40%) indicated it was very important and one (20%) was undecided. If the science lesson had not been required as part of the treatment group, one wonders if they would have discovered this information. It can be concluded that science teachers are generally open to helping agriculture teachers integrate science through collaboration.

When asked how important a common teaching style was to the success of collaboration efforts between agriculture and science teachers, all five (100%) responded that it was not important to the success of the collaboration effort. It can be concluded that personality appears more important to collaboration than teaching style. In addition, the treatment group was asked for their perceptions of the administration at their student teaching site concerning the financial support for the purchase of science equipment for the agricultural education program. Four out of five (80%) responded that, although the administration supported the effort, there was no money provided for the purchase of science equipment. It was also noticed that administrators are perceived by the agriculture teacher as being supportive of collaboration, which is consistent with the educational reform philosophy of Oregon.

The treatment group was asked if they felt confident in their ability to integrate scientific principles into their agriculture curriculum and to collaborate with the science teacher when they arrived at the school where they were hired. Four out of five (80%) responded with words such as "definitely" and "confident" that they could accomplish this task. Finally, the subjects in the treatment group were asked how long they felt it would take before they would be willing to integrate science and to think about ways to collaborate with science teachers at the schools where they were hired. Three out of five (60%) responded it would be at least three years. One (20%) subject responded with "at least the second, if not the third year." The treatment activities had the desired effect: the student teachers had a positive attitude toward science integration into the agriculture curriculum and felt positive about, and confident in, their ability to collaborate with science teachers. It should be realized that collaboration will likely start after year two or three, rather than at year one.

Summary, Discussion, and Conclusions of Quantitative Findings

Research question one sought to determine selected demographic variables of the control and treatment groups. The average age and years of teaching experience were expectedly different for both groups with the mean age of the teachers in the treatment group 27.5 years, and the mean age of the teachers in the control group 29.1 years. The subjects in the treatment group were all in their first year of teaching, while the mean length of teaching experience for the control group was 3.0 years.

A difference in the number of years of teaching experience between the agriculture teacher and the science teacher was a statistically significant barrier when comparing the control and treatment groups. This indicates that younger, first-year agricultural education teachers may be reluctant to approach the science teachers in their school and may be intimidated by what they perceive as veteran science teachers who are much more knowledgeable about science than they are, and therefore conclude that the science teachers may be unwilling to collaborate with the agriculture teacher. It might also be concluded that new graduates might perceive they were viewed as the "experts" in their field, and might be more reluctant to seek assistance from the science teacher realizing they run the risk of giving the impression they don't know all that they should. As a result, the evidence suggests that new graduates need to realize they are just beginning as teachers and they will need assistance during their first years of teaching. Teacher preparation faculty should focus on emphasizing this issue to students preparing to become Agricultural Science and Technology teachers encouraging them to ask questions of colleagues within their school buildings. A final point to consider is the time concern expressed by the 1996-97 cohort. They did mention that they would not have time to collaborate until their second or third year. Since these data were collected during their first year, it may be simply a case of not enough time having transpired for them to have performed collaboration by the time they responded to the survey instrument.

Seventy-five percent (three out of four) of the treatment group taught at schools that awarded science credit for agricultural education courses, compared to fifty-three percent (eight out of fifteen) of the respondents in the control group. When asked if they had attended a workshop on agriscience fourteen out of the fifteen (93%) subjects in the control group indicated that they had, while all four (100%) members of the treatment group answered with "yes" as their response. It appears that the additional measures taken with the treatment group move the attitude scale one notch closer to putting beliefs into action.

Only one teacher (7%) in the control group had obtained a science teaching endorsement, while no teachers in the treatment group indicated possessing a science endorsement. Finally, when asked if they planned on obtaining a science endorsement, nine out of the remaining fourteen teachers (64%) in the control group indicated they were planning to obtain an endorsement for teaching science in their state. This compared to only one out of the four (25%) respondents in the treatment group who expressed an interest in acquiring the science teaching endorsement. It may be that new teachers realize possessing certification in science is not what makes them successful in integrating science into their agriculture curriculum, but rather it's participation in in-service workshops and collaboration with their local science teacher that will give their students the strong, science based agricultural education they need.

Research question two analyzed the need felt by the 1996-97 agricultural education teacher preparation cohort members to update their curriculum through integration and collaboration efforts and to include more scientific principles in their agriculture curriculum as compared to teacher preparation cohorts from 1991-96. The respondents rated the importance of each of the items using a five-point ordinal scale where 1=Unimportant, 2= Below Average, 3=Average, 4=Above Average, and 5=Utmost.

The raw mean scores of the control group for the eight items ranged from a high mean score of 4.67 for the item "AST (Agricultural Science and Technology) teachers should integrate scientific principles into their lessons" to a low mean of 3.33 for the item, "my AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately." The respondents in the control group rated six (75%) of the items 4.00 or higher while all eight (100%) of the items received a rating of 3.00 or higher.

The raw mean scores of the treatment group for the eight items ranged from a high mean score of 5.00 for the item "AST teachers should attend workshops on incorporating scientific principles into their curriculum" to a low mean score of 3.25 for the item, "my AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately."

A review of the high mean scores for the importance that both groups placed upon integrating scientific principles into the agriculture curriculum indicated they felt strongly that agriculture teachers should integrate scientific principles into their lessons. In addition, both groups felt it important that science teachers be aware of the efforts to integrate science into the agricultural education programs within their building. The respondents in the treatment group rated five (62%) of the items 4.00 or higher while all eight (100%) of the items received mean ratings of 3.00 or higher. Respondents of both the treatment and control groups rated the same statement concerning science teachers' involvement in reviewing the agriculture curriculum with the lowest mean score. Agricultural education teachers placed average importance on science teachers reviewing the agriculture teacher's curriculum to ensure scientific principles were being taught accurately, not that it was perceived as unimportant, but rather, given time constraints, others were more important. Therefore, agriculture teachers were seldom involved in that activity. It might be assumed, therefore, that with little expertise in writing science principles and lessons, the agriculture teachers may have felt intimidated to expose their work to an expert, or again, the time issue may be arising and the teachers simply had little time to do this level of checking.

Finally, recent graduates of Oregon State University's Agricultural Education Teacher Preparation Program perceived that the integration of scientific principles into the agriculture curriculum was important. Seventy-five percent of the items received mean scores greater than 4.00 for the control group, and 62% of the items received a mean score greater than 4.00 for the treatment group. Both treatment and control groups agreed conceptually to the importance of integration of curriculum and collaboration with science teachers.

Of the eight statements used to test Hypothesis Ho_1, seven were statistically insignificant while only one statement "AST teachers should attend workshops on incorporating scientific principles into their curriculum" was statistically significant between the treatment and control groups. Therefore, the null hypothesis failed to be rejected. Since the inception of the cohort model in 1991, Oregon State University agricultural education teacher training faculty have verbally emphasized the integration of science into the agriculture curriculum. However, it was not until the 1996-97 teacher preparation cohort that the practice of integrating science into the agricultural education curriculum was made mandatory with specific training in integration techniques and methods of collaboration. As a result, every member of the 1996-97 teacher preparation cohort indicated they had attended a workshop on agriscience. It may be concluded that exposure to science methodology and teaching practice increased the desire to incorporate more science. Finally, the positive attitudes toward integration by the treatment group indicate the treatments used had a positive impact on teacher preparation graduates at Oregon State University. And, from a theoretical perspective, it is the change in attitude among teacher preparation graduates that is the most important. If the Agricultural Education Teacher Preparation Program at Oregon State University can affect a shift in attitude among its graduates toward the concept of integration, a change in the way those graduates approach integration and collaboration will occur and they will pursue it whole-heartedly.

Research question three determined the perception of social and/or cultural barriers between agriculture and science teachers at the secondary level as recognized by the 1996-97 agricultural education teacher preparation graduates and compared with recent agricultural education teacher preparation graduates from previous years. The respondents rated their beliefs about statements concerning barriers to collaborating with science teachers using a five-point Likert-type scale where N/A=Not applicable, 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree.

The raw mean scores of the control group for the twelve Likert-type items ranged from a high mean score of 4.14 for the item "time is a barrier in working with the science teacher(s) at my school" to a low mean of 2.07 for the item, "a difference in years of teaching experience is a barrier in working with the science teacher(s) in my school." The respondents in the control group rated one (8%) of the items 4.00 or higher, while six (50%) of the items received mean ratings of 3.00 or higher. Six (50%) of the items received a mean score of less than 3.00.

The raw mean scores of the treatment group for the twelve Likert-type items ranged from a high mean score of 4.25 for the item "time is a barrier in working with the science teacher(s) at my school" to a low mean of 2.25 for the item, "the politics within the hierarchy of my school is a barrier in working with the science teacher(s) at my school." The respondents in the treatment group rated one (8%) of the items 4.00 or higher while eight (67%) of the items received mean ratings of 3.00 or higher. Four (33%) of the items received a mean score of less than 3.00.

Two open-ended questions sought to determine additional information concerning the perception of social and/or cultural barriers between agriculture teachers and science teachers. When asked for the greatest barrier in working with science teachers at their respective schools, five (33%) respondents of the control group indicated some element of time was the problem, while three (75%) respondents of the treatment group felt time was the greatest barrier. Additional comments from the control group indicated a lack of respect among the science teacher's for the value of the agricultural education program and the agriculture teacher's qualifications to teach science, historical perceptions held by science teachers about the agricultural education program before the current teacher arrived, and the reluctance of science teachers to accept agriculture as a science-based subject, as barriers to collaborating with the science teacher(s) in their school.

In response to the same open-ended question, subjects in the treatment group indicated a difference in personalities and the existence of unresolved past differences as the greatest barriers in preventing collaboration between science and agriculture teachers.

Agriculture teachers in both groups felt that the past history of the agricultural education program influenced the perceptions of the science teachers in their building towards the agricultural education program and the attempts of the agriculture teacher to integrate scientific principles into the curriculum. This is in agreement with the conclusions of Osborne and Dyer (1995) that efforts are needed to build a more positive image of agricultural education programs. Since many agricultural education programs face poor images due to past history, agriculture teachers could improve the reputation of the program by allowing science teachers to assist them in developing segments of the agriculture curriculum to capitalize on opportunities to repair severed ties and establish new reputations.

When asked for additional barriers to collaboration, respondents from both groups indicated competition for the same students was a barrier perceived by agriculture teachers. The need for the same equipment at the same time the science teacher was using it was also a barrier inhibiting agriculture teachers from borrowing materials, equipment and supplies from the science department. Clearly, if communication between the science and agriculture teachers were increased concerning the coordination and timing of curricula taught within the year, the necessary supplies, materials, and equipment could be available when each of the teachers involved was ready to use them.

Of the twelve statements used to test Hypothesis Ho_2, no statistically significant difference in the perception of barriers was found in eleven statements, while only one statement "a difference in years of teaching experience is a barrier in working with the science teacher(s) in my school", was statistically significant between the treatment and control groups. As a result, the null hypothesis failed to be rejected. Respondents in both the treatment and control groups rated time as the greatest barrier to integrating science into the agriculture curriculum and to collaborating with the science teacher on methods of integration. This was the only barrier to receive a mean score greater than 4.00. There is evidence that agriculture teachers need more preparation time for integrating science concepts into their curriculum and for collaborating with the science teacher in their school. This concurs with the findings of Thompson (1996).

Barriers receiving high marks between 3.00 and 4.00 included science teachers' "misunderstanding of the nature of the agricultural science and technology program", and "the physical separation of the science and agriculture departments." It appears that since both groups indicated physical distance was a barrier to working with the science teacher in their building, agricultural education graduates have not made a priority of spending time in activities that directly involve them with members of the science department. Routine activities such as faculty meetings and lunches in the faculty lounge could offer exposure to science teachers and other faculty that would help make up for the separation caused by distance.

Research question four sought to identify the level of collaboration and curriculum integration actually carried out by 1996-97 agricultural education teacher preparation cohort graduates as compared to graduates of previous teacher preparation cohorts. Again, the respondents rated their involvement in each of the items using a five-point ordinal scale where 1=Never, 2= Seldom, 3=Sometimes, 4=Much of the time, and 5=Always.

The raw mean scores of the control group for the eight items concerning their involvement with certain integration activities ranged from a high mean score of 4.00 for the item "AST (Agricultural Science and Technology) teachers should integrate scientific principles into their lessons" to a low mean of 2.13 for the item, "my AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately." The respondents rated one (12%) of the items 4.00 or higher while five (62%) received mean ratings of 3.00 or higher. Three (38%) of the items received a mean score less than 3.00.

The raw mean scores of the treatment group for the eight items concerning their involvement in the same integration activities described above ranged from a high mean score of 4.00 for the item "science teachers should be aware of the efforts to integrate science into AST programs within their own building" to a low mean of 1.75 for the item, "my AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately." The respondents rated one (12%) of the items 4.00 or higher while four (50%) received mean ratings of 3.00 or higher. Four (50%) of the items received a mean score less than 3.00 while one (12%) item was rated with a mean score below 2.00. Respondents of both the treatment and control groups rated the same statement concerning science teacher's involvement in reviewing the agriculture curriculum with the lowest mean score. While it might be assumed that the treatment group had not had time for such an activity, the control group had no such excuse, hence for whatever reason they were not willing to open their curriculum to review by science staff.

Two open-ended questions sought to determine additional information concerning the involvement of members of the treatment and control groups with the science teacher(s) at their schools. When asked if they had ever team-taught a class with a science teacher at their school, only one (7%) member of the control group answered positively compared with no (0%) respondents in the treatment group. Additionally, when asked if they had borrowed materials, supplies, or equipment from the science department in their school, thirteen (87%) respondents in the control group answered 'yes', while two (50%) of the four respondents in the treatment group stated that they borrowed equipment from the science department. When asked to identify the materials, supplies, and equipment that were borrowed nine (69%) of the thirteen who had responded positively indicated they had borrowed microscopes and/or microscope slides from the science department. This represented the greatest number of responses from the control group. Furthermore, four (31%) respondents indicated they had borrowed dissecting supplies and four (31%) indicated they had borrowed lab equipment and/or glassware. While two (100%) respondents of the treatment group listed measuring instruments as the most frequently borrowed equipment from the science department in their school. Also listed by the treatment group with one (50%) response each was chemicals, microscopes and/or microscope slides, and thermometers. Again it appears likely that, with only three months of teaching experience in their new schools, the 1996-97 graduates had not had sufficient time to make contacts and be comfortable with team-teaching or borrowing of equipment.

Teacher preparation cohort members who received pre-service instruction on integrating science into the agriculture curriculum and in methods of collaboration with science teachers were confident of their ability to accomplish these tasks after becoming licensed teachers. However, at the conclusion of their student teaching experience, all student teachers expressed concern that it would take at least one year, and most likely three years, before they could implement many of the integration and collaboration practices. Therefore, it may be concluded that given the schedule of teachers and the expectations placed upon them, integration will take time to emerge as a priority.

Of the eight statements used to test Hypothesis Ho_3, none was statistically significant. Therefore, the null hypothesis failed to be rejected.

Recommendations

1. It is recommended that the Agricultural Education Department at Oregon State University do follow-up integration and collaboration in-service workshops with these graduates after they have completed two to three years of teaching experience to enhance science integration and science teacher collaboration efforts. In-service before this time may not generate the greatest amount of change because the agriculture teachers are still adjusting to other aspects of their jobs.

2. Administrators should investigate scheduling agriculture and science teachers with the same preparation time whenever possible to enhance collaboration and potential sharing of equipment.

3. Increased emphasis should be placed on pre-service instruction about collaboration. This could include allowing pre-service science teachers to review the curriculum of pre-service agriculture teachers for scientific accuracy. Efforts should focus on reducing the time it takes for teacher preparation graduates to incorporate scientific principles into their agriculture curriculum and validation for accuracy.

4. Priority should be placed on communication strategies for teacher preparation graduates in agricultural education to educate the faculty at their school, especially the science teachers, on the mission and focus of the local Agricultural Education Program.

5. Additional funding from local, state, and federal sources should be provided for the integration of science into the agriculture curriculum and for the purchase of additional equipment and resources to be shared between the science and agricultural education departments.

6. Science and agricultural education departments should coordinate the timing of curricula offered during the academic year so they can share resources without conflict.

7. Current treatments of integration and collaboration with science teachers throughout all phases of the Agricultural Education Teacher Preparation Program at Oregon State University should be continued and enhanced to maintain the positive demeanor towards integration of science into the agriculture curriculum.

8. Agricultural education teacher preparation graduates should be encouraged to participate in activities at their building sites which would foster relationships with members of the science department and general faculty to increase the opportunities for collaborative endeavors and for overall marketing of the secondary agricultural education program.

9. Since secondary agricultural education teachers have extended summer contracts, district administrators should offer science teachers extended contract days for the purpose of allowing collaborative efforts between the agriculture and science teacher to take place without the time constraints and distractions that occur during the academic year.

10. The Agricultural Education Department at Oregon State University should survey agriculture teachers who host student teachers to determine their level of science integration. Secondary agricultural education departments with high levels of science integration activity should receive preference in student teacher placements. Allowing student teachers exposure to programs that model effective integration and collaboration

with science departments would encourage further development of this practice among agricultural education teacher preparation graduates.

11. The Agricultural Education Department at Oregon State University should consider offering a joint in-service workshop for agriculture teachers and their district's science teachers for increasing integration and collaboration.

12. The Agricultural Education Department at Oregon State University should consider requiring an integration activity as part of the standard licensure requirements for AST teachers in Oregon.

Problems for Future Research

1. This study should be replicated at the regional or national level to determine if similar approaches to science integration and collaboration with science teachers at other agricultural education teacher training institutions have similar results and to determine the effectiveness of a pre-service approach.

2. A study should be conducted utilizing pre-service agriculture and science student teacher teams to determine the influence this approach would have on the social and/ or cultural differences between the two groups.

3. Future research should be designed to investigate the possibility of pre-service agricultural education teacher preparation students being offered opportunities to collaborate with pre-service science education teacher preparation students to increase the likelihood of establishing positive relationships between the two groups and for building bridges that could enhance future relationships at the schools hiring graduates from these two programs.

4. A follow-up survey of 1996-97 cohort graduates should be conducted after they have completed two to three years of teaching to determine if the attitudes they expressed become reality when the time constraints of the beginning teachers have been removed.

5. Follow-up studies should be conducted to determine the relationship between collaboration, integration, and its impact upon student learning between agriculture and science education students. Specifically, what effect does collaboration have upon the

successful integration of science into the agriculture curriculum and how does the technique of collaboration compare with other methods used to integrate disciplines?

BIBLIOGRAPHY

American Association for the Advancement of Science (1993). Project 2061-Science for all Americans. Washington, DC: Author

Caine, R. N. & Caine, G. (1994). Making connections: Teaching and the human brain. Menlo Park, CA: Addison-Wesley Publishing.

Camp, W. G. & Esheverria, R. A. (1989). A national study of the supply and demand for teachers of agricultural education in 1988. Blacksburg: Virginia Polytechnic Institute and State University.

Camp, W. G. & Oliver, J. D. (1990). A national study of the supply and demand for teachers of agricultural education in 1989. Blacksburg: Virginia Polytechnic Institute and State University.

Connors, J., & Elliot, J. (1994). Teacher Perceptions of Agriscience and natural resources curriculum. Journal of Agricultural Education, 35 (4), 15-19.

Dewey, J. (1920). Reconstruction in philosophy. New York, NY: Henry Holt.

Dewey, J. (1938). Experience and education. New York, NY: Macmillan.

Dormody, T. J. (in press). Exploring resource sharing between secondary school teachers of agriculture and science departments nationally. Journal of Agriculture Education.

Emery, P. & Linder, M. (1993). Integrating Agriculture into the Science Curriculum. The Agricultural Education Magazine, 65 (7), 17-18.

Enderlin, K. J. & Osborne, E. W. (1992). Student achievement, attitudes, and thinking skill attainment in an integrated science/agriculture course. Proceedings of the Nineteenth Annual National Agricultural Education Research Meeting. St. Louis, MO.

Enderlin, K J., Petrea, R. E., & Osborne, E. W., (1993). Student and teacher attitude toward and performance in an integrated science/agriculture course. Proceedings of the 47th Annual Central Region Research Conference in Agricultural Education. St. Louis, MO.

Friend, M. & Cook, L., (1992). Interactions: Collaboration skills for school professionals. White Plains, NY: Longman Publishers USA.

Gall, M. D., Borg, W. R. & Gall, J. P. (1996). Educational research: An introduction (6th ed.). White Plains, NY: Longman Publishers USA.

Hickey, J. G. (1994). The relationship of collaborative settings to social organizational factors in medium-sized Wisconsin secondary schools. Unpublished doctoral dissertation, University of Wisconsin-Madison.

Hurd, P. D., (1984). Reforming science education: The search for a new vision. Washington, DC: Council for basic education.

Hurd, P. D., (1991). Why we must transform science education. Educational Leadership, 49 (2), 33-35.

Johnson, D. M., & Newman, M. E. (1993). Perceptions of administrators, guidance counselors, and science teachers concerning pilot agriscience courses. Journal of Agricultural Education, 34 (2), 46-54.

Johnson, D. M. (1995). Arkansas agricultural teachers' opinions concerning science credit for agriculture. Proceedings of the 22nd Annual National Agriculture Education Research Meeting. Denver, CO.

Kirby, B. M. (1990). Attitudes, knowledge, and implementation of agricultural science by North Carolina agricultural education teachers. Proceedings of the 17th Annual National Agricultural Education Research Meeting. Cincinnati, OH.

Krueger, D. E. & Wamhoff, C. H. (1995). Michigan agriscience and natural resources teachers' perceptions of the impact of the agriscience and natural resource curriculum on local agriscience programs. Proceedings of the 49th Annual Central Research Conference in Agriculture Education. St. Louis, MO.

Little, J. W. (1982). Norms of collegiality and experimentation: Workplace conditions of school success. American Educational Research Journal, 19(3), 325-340.

McClure, A. F., Chrisman, J. R., & Mock, P. (1985). Education for work. New Jersey: Associated University Presses.

National Academy of Sciences, Committee on Agricultural Education in the Secondary Schools. (1988). Understanding agriculture: New directions for education. Washington, DC: National Academy Press.

National Commission on Excellence in Education (1983). A nation at risk: The imperative for educational reform. David P. Gardner (Chair). Washington, DC: United States Department of Education.

Neason, A. B. (1992). Analysis of agriscience teacher in-service needs. Proceedings of the 19th Annual National Agricultural Education Research Meeting. St. Louis, MO.

Newman, M.E. & Johnson, D. M. (1993). Perceptions of Mississippi secondary agricultural teachers concerning pilot agriscience courses. Journal of Agricultural Education, 34 (3), 49-58.

Newman, M. E. & Johnson, D. M. (1994). In-service education needs of teachers of pilot agriscience courses in Mississippi. The Journal of Agricultural Education, 35 (1), 54-60.

Oliver, J. D. (1991). A national study of the supply and demand for teachers of agricultural education in 1990. Blacksburg: Virginia Polytechnic Institute and State University.

Oliver, J. D. & Camp, W. G. (1992). A national study of the supply and demand for teachers of agricultural education in 1991. Blacksburg: Virginia Polytechnic Institute and State University.

Osborne, E. W., & Dyer, J. E. (1994). The influence of science applications in agricultural courses on attitudes of Illinois guidance counselors at model student teaching centers. Proceedings of the 48th Annual Central Region Research Conference in Agricultural Education. St. Louis, MO.

Osborne, E. W. & Dyer, J. E. (1995). Attitudes of Illinois high school science teachers toward the agricultural industry and educational programs in agriculture. Proceedings of the 22nd Annual National Agricultural Education Research Meeting. Denver, CO.

Osborne, E. W. & Miller, L. E. (1985). Livestock skills performance levels reported by agricultural production teachers in Ohio. The Journal of American Association of Teacher Educators in Agriculture, 26 (3), 28-36.

Parnell, D. (1986). The neglected majority. Washington DC: The Community College Press.

Phipps, L. (1965). Handbook on Agriculture Education in Public Schools. The Interstate Printers and Publishers.

Prosser, C., & Allen, C. (1925). Vocational education in a democracy. New York, NY: The Century Company.

Ramsey, F. L., & Schafer, D. W. (1997). The statistical sleuth: a course in methods of data analysis. Belmont, CA: Wadsworth Publishing Co.

Random House Dictionary (2^{nd} ed.). (1980). New York, NY: Random House.

Reichardt, C. S. & Rallis, S. F. (1994). The qualitative-quantitative debate: New perspectives. San Francisco, CA: Jossey-Bass Publishers.

Roegge, C. A. & Russell, E. B. (1990). Teaching applied biology in secondary agriculture: Effects on student achievement and attitudes. Journal of Agricultural Education, 31 (1), 27-31.

Shinn, G. C. (1993). A reflection of change in teacher education. The Agricultural Education Magazine, 65 (7), 10-13.

Smith, S. C. & Scott, J. J. (1990). The collaborative school: A work environment for effective instruction. Eugene, OR: ERIC Clearinghouse on Educational Management. (ERIC Document Reproduction Service No. EA 021 574).

Terry, R. (1993). Projecting an agriscience image. The Agricultural Education Magazine, 66 (4), 9-14.

The strategic plan for agricultural education. (1990). Alexandria, VA: National FFA Center.

Thompson, G. W. (1996). Characteristics and implications of integrating science in secondary agricultural education programs. Unpublished doctoral dissertation, University of Missouri-Columbia.

Vaughn, P. (1993). Teaching agriscience: A few cautions. The Agricultural Education Magazine, 66 (4), 4.

Whent, L. S., & Leising, J. (1988). A descriptive study of the basic core curriculum for agricultural students in California. Proceedings of the 66th Annual Western Region Agricultural Education Research Seminar. Fort Collins, CO.

APPENDICES

Appendix A.
Human Subjects Approval

OFFICE
OF
DEAN OF RESEARCH

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February 7, 1997

Principal Investigator:

The following project has been approved for exemption under the guidelines of Oregon State University's Committee for the Protection of Human Subjects and the U.S. Department of Health and Human Services:

Principal Investigator(s): R. L. Cole

Student's Name (if any): Mark A. Balschweid

Department: Agriculture Education & Gen. Ag.

Source of Funding:

Project Title: Agriculture and Science Integration: A Pre-service Prescription for Contextual Learning

Comments:

This approval is valid for one year from the date of this letter. A copy of this information will be provided to the Committee for the Protection of Human Subjects. If questions arise, you may be contacted further.

Sincerely,

Mary E. Nunn
Sponsored Programs Officer

cc: CPHS Chair

Appendix B.
Treatment Interview#1 Questions

Interview #1 Questions

Demographic Information

1. You are in preparation to be an Ag Science and Technology instructor is this correct?

2. What specific plans do you have as they relate to this degree and teacher certification?

3. Did you go through a high school Agriculture Science and Technology program? How many years? What type of program? Briefly describe.

4. Were you involved in 4-H?

5. Please describe your background in agriculture. Include experiences, jobs, coursework, previous degrees, etc.

Degree in college:

6. Please describe your background in science.

Integration Questions

1. Please give a brief overview of your perceptions of what the job of an Agriculture teacher entails.

2. What percent of the Agriculture curriculum would you say should contain math? Science? Speech?

3. Do you want the agriculture students in your program to receive dual credit for math? Science? Communication (speech or writing)?

4. As an Agriculture teacher, do you feel that it's your job to teach math, science and/or writing skills? Explain how you do that.

5. Is it a math, science and/or writing teacher's job to teach agriculture? Explain how.

6. Would you be willing to *alter* your curriculum in order to allow the students in your program to receive math credit? Science credit? Explain how much.

7. What place does the teaching of science principles have in the agriculture classroom? Explain.

Social/Cultural Differences

1. Please describe your perceptions of who a science teacher is, based on your interactions and observations of science teachers.

2. What kinds of things do, you believe, science instructors teach? Be specific.

3. In your opinion, how are Ag teachers and Science teachers similar? Explain.

4. How are Ag teachers and science teachers different? Explain.

5. If you were trying to establish science credit for the students in your program, would you feel comfortable approaching the *science department* in your school for assistance?

6. Would you feel comfortable approaching an *individual science educator* for help?

7. What would keep you from approaching a science teacher for assistance?

8. Do you feel that science teachers would be helpful and welcome your efforts in teaching science? Explain.

9. Hypothetical situation: You are working on a lesson about photosynthesis and you are not quite sure of the function of guard cells in the plant's leaf. Would you feel comfortable asking a science teacher for an explanation? Would you feel comfortable asking a science teacher if you could borrow supplies from his/her storeroom?

10. Hypothetical situation: A science teacher approaches you with an idea about team teaching a unit on water quality and it effects on our environment. What is your reaction?

11. Do you see any drawbacks to including science principles into your agriculture curriculum?

12. Any comments that you would like to make regarding this interview?

Appendix C.
Treatment Interview #2 Questions

Interview #2 Questions

Integration Questions

1. You stated in your first interview 4 months ago, that you felt __% of the agriculture curriculum should contain Science. Have you implemented that percentage into your daily lessons? If yes, how and in what form? If no, why not?

2. Do you still feel that this percentage is accurate in the amount of science that should be taught in the agriculture classroom? If yes, why? What causes you to think that? If no, how much and in what form?

3. What units have you taught since you have been out student teaching winter quarter?

4. Have you incorporated any science principles into these units? If so, describe. If not, how could you integrate science principles?

5. What contacts have you made with faculty in the science department? Please describe those contacts. What did you discuss?

6. If you have made contact(s), how did they go? If you haven't, why?

7. Have you borrowed any materials or supplies from the science department since you've been student teaching? If yes, what did you borrow?

8. If you have, what procedures did you use to get them? If you haven't, why?

9. What has been the most difficult thing about integrating science concepts into the Agriculture Science and Technology classroom?

Social/Cultural Differences Questions

1. What is your opinion of the science teacher(s) at your school?

2. Do you feel the science teacher(s) at your school are receptive to your efforts to integrate science into your curriculum? Why? Why not?

3. Do you feel confident that the science teacher(s) at your school respect you as a teacher qualified to teach students science? Why? Why not?

4. How important is it that you 'get along with' or 'like' the science teacher(s) at your school if you desire to integrate your curricula? Isn't what's best for the student all that really matters?

5. Without trying to influence your comments, how important do you think a common 'philosophy' is to teachers trying to integrate their curricula? A common teaching style?

6. In your opinion, what is the perception of the 'academic' teachers towards the Agriculture Science and Technology program at your school?

7. In your opinion, what is the perception of the counselors in the counseling center towards the Agriculture Science and Technology program at your school and its academic rigor?

8. In your opinion, what is the overall perception of the students in your school towards the Agriculture Science and Technology program?

9. What chances do students perceive they have of going on to college if they take high school Agriculture?

10. How do you feel you are perceived by students?

11. Did you ask science teachers about getting High School graduation credit for an Agriculture course like "Biotechnology Applications in Agriculture"? If not, why? If yes, what were their responses?

12. Did the administration support funding for science equipment in the AST program?

13. Were you asked if you had a science license?

14. Have you been asked to participate in teacher socials after school or in the evenings?

Appendix D.
Treatment Interview #3 Questions

Interview #3 Questions

Integration Questions

1. Have the activities you have been involved in this past year concerning working with science teachers been helpful in preparing you to integrate science into your curriculum? How?

2. Do you feel confident that you can integrate scientific principles into your curriculum or collaborate with the science teacher at your new school?

3. During your week at Portsmouth, did you find any of the material being presented to students similar to material that could be/is presented in an AST curriculum? If so, what? And in what context would it be taught in the AST program?

4. What would you say is the hardest aspect of integrating scientific *principles* into your AST curriculum?

5. How will you go about integrating scientific principles into your curriculum when you arrive at your new school? Be specific.

6. How will you go about collaborating with other teachers when you arrive at your new school?

7. Did the experience at Portsmouth help/hinder your ideas/skills/knowledge/ability to work with science teachers on integrating science and AST curricula.

Social/Cultural Differences questions

1. You have had the opportunity to work with other teachers during the experience at Portsmouth Middle School, what is your (professional/personal) opinion of the science teachers(s) in the science program there?

2. Is that different than the science teacher you worked with in the high school of your internship?

3. Were the science teachers at Portsmouth eager/willing/open to discussing issues of integration of curricula?

4. Speaking strictly about the *person* of the science teacher (and not about their curriculum, their department resources, etc.) what makes you want to work with them or spend time with them on a curriculum integration project?

5. What would make you *not* want to spend time with a science teacher you work with at the school you will be teaching at?

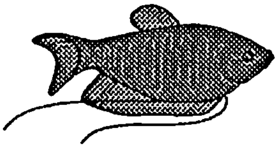
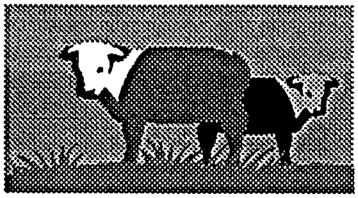
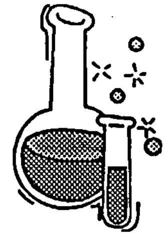
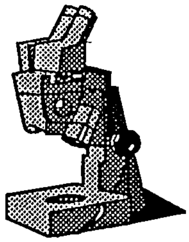
6. As a result of working closely with another teacher for the week you were at Portsmouth, what areas do you see as possibilities for integrating science into your curriculum?

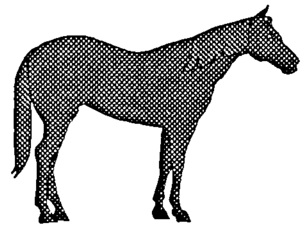
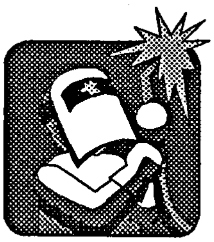
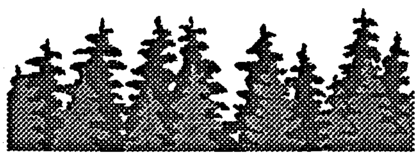
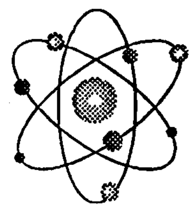
7. Has exposure to science teachers in your student teaching site and Portsmouth Middle School improved your perceptions about science teachers? Explain your answer.

8. Has working with science teachers this last year increased or decreased your desire to integrate and collaborate with science teachers? Explain.

9. When would you predict that you would be willing to integrate and start thinking about ways to collaborate with other teachers?

Appendix E.
Written Survey

Integrating Science into Agriculture

The purpose of this survey is to determine if agriculture and science integration and collaboration is taking place in your program. Your participation is important and will contribute to the future direction of the Agricultural Education Teacher Preparation Program at Oregon State University.

Key words and phrases:

Agricultural Science and Technology – the name for secondary agricultural education programs in Oregon as approved by the Oregon Vocational Agriculture Teachers Association in 1991. (Formerly known as Vocational Agriculture).

Integration – combining parts together to make a whole.

Curriculum integration – combining several subject areas into one unit. e.g. agriculture and science and report writing combined into an agriscience student project.

Collaboration – teachers working together in an educational setting.

Section I:

A. Read each AST (Agricultural Science and Technology) program statement.

B. Rate the importance of each statement by circling the number of the statement under the heading "Importance" which most nearly reflects the importance you place on the statement.

C. Rate your involvement in each concept in the statement by circling the number of the statement under the heading "Involvement" which most nearly reflects your involvement in the concept.

D. Please note that high numbers represent high importance or use and low numbers represent low importance or use.

Example Response

Importance		Involvement
1 --Unimportant, 2 --Below Average, 3 --Average, 4 --Above Average, 5 --Utmost		1 --Never, 2 --Seldom, 3 --Sometimes, 4 --Much of the time, 5 --Always
1 2 3 4 (5)	Respond to surveys.	1 2 3 4 (5)

Curriculum integration

Importance: –Unimportant –Below Average –Average –Above Average –Utmost		Involvement: –Never –Seldom –Sometimes –Much of the time –Always
1 2 3 4 5	AST (Agricultural Science and Technology) instructors should integrate scientific principles into their lessons.	1 2 3 4 5
1 2 3 4 5	AST instructors should work with science teachers in their respective schools to assist in integrating scientific principles into the AST curriculum.	1 2 3 4 5
1 2 3 4 5	Science instructors should assist AST instructors to incorporate scientific principles into the AST curriculum.	1 2 3 4 5
1 2 3 4 5	Science instructors should be aware of the efforts to integrate science into AST Programs within their building.	1 2 3 4 5
1 2 3 4 5	AST instructors should share the resources of their programs with teachers in the science department.	1 2 3 4 5
1 2 3 4 5	Science teachers should share the resources of their departments with the AST instructor.	1 2 3 4 5
1 2 3 4 5	My AST curriculum should be reviewed by the science teacher(s) to ensure scientific principles are being taught accurately.	1 2 3 4 5
1 2 3 4 5	AST instructors should attend workshops on incorporating scientific principles into their curriculum.	1 2 3 4 5

Section II: Included in this section is a list of statements concerning barriers that may exist between AST instructors and science teachers. As you read each statement, please respond to each item by sharing your beliefs about the item using the 1 to 5 scale listed below.

5=Strongly Agree **4**=Agree **3**=Neutral **2**=Disagree **1**=Strongly Disagree **N/A**=Not Applicable

1. _____Time is a barrier in working with the science teacher(s) at my school.

2. _____The physical separation in the location of our departments is a barrier in working with the science teacher(s) at my school.

3. _____A lack of understanding about agricultural science among the science teacher(s) is a barrier in working with the teacher(s) at my school.

4. _____A lack of common interests (I have nothing in common with.....) is a barrier in working with science teacher(s) at my school.

5. _____A lack of communication is a barrier in working with science teacher(s) at my school.

6. _____The science teacher(s) **not** viewing agriculture as an applied science is a barrier in working with the science teacher(s) at my school.

7. _____The science teacher(s) **not** viewing my AST Program as science based is a barrier in working with the science teacher(s) at my school.

8. _____A fundamental difference in the way we view the world and food production in general is a barrier in working with the science teacher(s) at my school.

9. _____The politics within the hierarchy of my school is a barrier in working with the science teacher(s) at my school.

10. ____A difference in personalities is a barrier in working with the science teacher(s) at my school.

11. ____A difference in teaching philosophies is a barrier in working with the science teacher(s) in my school.

12. ____A difference in years of teaching experience is a barrier in working with the science teacher(s) in my school.

13. What do you feel is the greatest barrier to working with the science teacher(s) at your school?

____
____
____

14. Please list any other differences that you perceive as barriers that prevent you, or could prevent you, from working with the science teachers at your school:

____
____
____

15. What barriers exist that keep you from obtaining a science endorsement? (Do not answer if you currently hold a science endorsement)

____
____
____

Section III: To aid in interpreting the results of this study, additional information is requested. This information will remain confidential, and will not be used to identify you in the final report.

1. Age ____

2. Years of teaching experience (including current year) ____

3. Years teaching at current school (include this year) _____

4. Does your school give science credit for AST (Agriculture Science and Technology) courses? **YES** **NO**

If yes, please explain the method your school uses for awarding science credit to students in your AST program (e.g. two years of AST credit = one year of physical science)

____
____
____

5. Have you ever attended any workshops on agriscience? **YES** **NO**

6. Do you currently have a science endorsement? **YES** **NO**

7. If you do not have a science endorsement do you plan to obtain one? **YES** **NO**

8. Number of students in your school _____

9. Number of faculty in your school _____

10. Number of science teachers in your school _____

11. Do you share a common preparation period with any of the science teachers? _____

12. Have you ever team-taught a class with a science teacher from your school? **YES** **NO**

13. Have you borrowed materials/supplies/equipment from the science department in your school? **YES** **NO**

If yes, what materials/supplies/equipment have you borrowed from the science department in your school:

____

____

____

This concludes the questionnaire. Thank-you for taking the time to participate in this study. **Please return this form by November 24, 1997** in the stamped, self-addressed envelope to 112 Strand Agriculture Hall, Corvallis, Oregon 97331.

Thank You!

Appendix F.
Cover Letter to Participants

November 10, 1997

Ag Teacher Name
School
Address

Dear

We request your participation in a study being conducted by Agricultural Education faculty at Oregon State University. The study is designed to answer two important questions:

a. What level of integration and collaboration is being performed concerning the inclusion of scientific principles in Oregon AST (Agriculture Science and Technology) programs?

b. What barriers exist that prohibit the inclusion of scientific principles into the AST (Agriculture Science and Technology) curriculum through integration and collaboration techniques?

Answers to these questions will help guide the future direction of both pre-service and in-service instruction in agricultural education. Therefore, your response to this questionnaire is vital to the success of this study. Please take a few minutes to complete the survey and mail it back to us in the self-addressed, stamped envelope that is provided.

Please return the completed questionnaire by November 24, 1997.

Your responses will be kept in the strictest confidence. Data will be analyzed on a group basis to ensure confidentiality. The code number on the bottom of the questionnaire will be used only for data collection purposes.

Thank-you in advance for your prompt, honest response. Your input is essential for the improvement of agricultural education in Oregon. If you have any questions please call our office at 541-737-5658.

Sincerely,

Mark A. Balschweid
Instructor
Oregon State University

Dr. Greg Thompson
Assistant Professor
Oregon State University

Appendix G.
Panel of Experts Used for Instrument Development and Consultation

Dr. R. L. Cole, Professor and Head
Agricultural Education and General Agriculture Department
Oregon State University
Corvallis, Oregon

Dr. Greg Thompson, Assistant Professor
Agricultural Education and General Agriculture Department
Oregon State University
Corvallis, Oregon

Dr. Joanne Engel, Associate Professor
School of Education
Oregon State University
Corvallis, Oregon

Dr. Norman Lederman, Associate Professor
Department of Science and Mathematics Education
Oregon State University
Corvallis, Oregon

Dr. Robert Birkenholz, Associate Professor
Agricultural Education
University of Missouri-Columbia
Columbia, Missouri

Dr. Wayne Fanno, Assistant Professor
Agricultural Education and General Agriculture Department
Oregon State University
Corvallis, Oregon