

**A COMPARATIVE MULTI-CASE STUDY OF AGRICULTURAL EDUCATION
TEACHERS IN REFERENCE TO THE IMPLEMENTATION OF ACADEMIC
INTEGRATION**

A Dissertation

by

BART EUGENE GILL

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY

May 2011

Major Subject: Agricultural Leadership, Education, and Communications

A Comparative Multi-Case Study of Agricultural Education Teachers in Reference to the
Implementation of Academic Integration
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ABSTRACT

A Comparative Multi-Case Study of Agricultural Education Teachers in Reference to the
Implementation of Academic Integration. (May 2011)

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Many agricultural educators fail to integrate core-subject concepts into their classrooms. Current research addresses the perceptions of agricultural educators regarding core-subject integration, but little research notes the barriers that are identified in these studies or the actions needed by agricultural educators to overcome those barriers. The purpose of this study was to identify the path which progressive agricultural educators who were successful in integrating core-subject concepts, particularly STEM, in their classroom followed. Another purpose of the study was to determine the tools and resources the progressive agricultural educators believe other agricultural educators need in order to follow a similar path. Overall, the participants in the study all followed similar paths to become progressive in academic integration. All participants appeared to be highly self-motivated individuals, seeking out professional development opportunities in order to continuously improve the teaching in their classrooms and increase rigor within their curriculum. Collaboration between agricultural educators and core-subject educators is crucial to increasing rigor in the agricultural education classroom. In light of this, the participants believe longer

professional development workshops are needed for teachers to successfully advance in the area of academic integration along with resource sharing opportunities between other agricultural educators and potentially core-subject teachers. Finally, the participants all possess adequate facilities to conduct academic integration but believe available facilities and budgets affect the success of academic integration, because without proper facilities and supplies it is difficult for teachers to incorporate inquiry based instruction. According to the participants budgets are a constraint for teachers when attempting to advance. If the teacher's budget does not allow for extra purchases, then the teacher should take it upon themselves to seek out additional fiscal support to assist in classroom instruction, by writing grants or asking the local community for support.

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CHAPTER I

INTRODUCTION

The following sections are found in Chapter I: Introduction, Statement of the Problem, Purpose and Objectives, Framework, Assumptions, Limitations, Operational Definitions, and Summary.

According to the National Research Council (1988), “All students need an understanding of basic science concepts” (p.11). Science education literature refers to this idea as scientific literacy. According to DeBoer (2000), the term scientific literacy is a term that was introduced in the 1950s and has been loosely defined since then. After DeBoer (2000) conducted a historical analysis of science education it was determined “...scientific literacy is about the public’s understanding of science” and “that understanding is open-ended and ever-changing” (p. 597). When referring to science literacy in the context of agriculture, the integration of science concepts and principles into agricultural education curricula has a long history. In fact, the importance of science concepts in agriculture was evident long before the idea of scientific literacy was introduced. Passage of The Hatch Act of 1887 that established agricultural experiment stations represents a sampling of the earliest history of science concepts in agriculture. This act focused on the importance of scientific research in agriculture (Brister & Swortzel, 2007). A few years later, in 1917, The Smith-Hughes Act passed establishing agricultural education in public schools to

This dissertation follows the style of *Journal of Agricultural Education*.

assist in advancing the agricultural industry forward by educating our nation's youth about better and more efficient farming practices. In 1963 the Vocational Education Act was passed and somewhat counteracted The Hatch Act, by emphasizing practical skill development to accomplish vocational objectives in agriculture, thus deemphasizing the science objectives (Brister & Swortzel, 2007). While agricultural education was moving toward vocational skill building, the science education profession was struggling to define the goals for science education in the public school system.

Science in the public schools has been a part of the general education curricula since the 19th century, when scientists themselves advocated for science education (DeBoer, 2000). In his 2000 article, DeBoer developed a timeline of science education and tracked the changes within the curricula. DeBoer noted when science was first introduced into the public school system it was included in order to discuss the "...practical importance of science in a world that was becoming dominated by science and technology..." (p. 583). This idea was supported by educational theorists such as John Dewey, who stated "Whatever natural science may be for the specialists, for educational purposes it is knowledge of the conditions of human action" (Dewey, 1916, p. 228). The idea of teaching science "...on the basis of its relevance to contemporary life and its contribution to a shared understanding of the world on the parts of all members of society" (DeBoer, 2000, p. 583) became a concern in the early 1930s. The federal government claimed that the curriculum developers "...had forgotten the fundamental reason why science was being studied, which was to provide a broad understanding of the natural world and the way it affected people's personal and social

lives” (DeBoer, 2000, p. 584). At this time, science education within the public schools became a focal point of educational reform.

Between the 1930s and the 1950s, science education was evaluated and numerous discussions took place. During this time period, the importance of science education was questioned. In the late 1950s, the state of education in the United States was addressed and discussions about “...how the country should respond to the startling rate of scientific and technological change taking place...” were prominent (DeBoer, 2000, p. 586). As a result of those discussions, the new science courses designed “...were academically rigorous” and “very few applications of science or links to daily experiences of students were included” (DeBoer, 2000, p. 587). This refocus of science education “...marked a significant shift in science education in the post-war years” (DeBoer, 2000, p. 588). Educators quickly realized this new model for science education was “...pedagogically unwise...” (p. 588) and “the relationship between science and society...were once again promoted” (p. 588).

According to DeBoer (2000), Hofstein and Yager, in a 1982 article, posited, “...science should be taught in relation to the personal needs of students and in relation to important aspects of contemporary life, such as chemistry in the context of agricultural production” (p. 588). Then after the publishing of the report titled *A Nation at Risk: The Imperative for Educational Reform* in 1983, the science education profession determined that the way to address our nation’s low educational performance “...was to create a more rigorous academic curriculum for all students built around the basic academic subjects of English, mathematics, science, and social studies, as well as

computer science and foreign language” (DeBoer, 2000, p. 589). This philosophy then led into the creation of national science standards, which are still in existence today.

The problem that arose early on, from the implementation of the national science standards, was the reversion back to pedagogical methods of the early 1950s when teachers emphasized “...disciplinary knowledge, separated from its everyday applications” (DeBoer, 2000, p. 587). Norman Lederman 1998 stated, “in many ways the state of science education and science education reform is exactly where it was 100 years ago” (p. 17). Lederman went on to say, “context is necessary for students to understand what the knowledge means” (p. 17) and “unless students can derive meaning for the scientific knowledge they acquire, there is little hope that they can use their knowledge to make informed decisions” (p. 17).

To help ensure career and technical education (CTE) is following along with current educational trends, the Carl D. Perkins Vocational and Applied Technology Education Act of 2006 (a.k.a Perkins IV) was passed. The Carl D. Perkins Act is the most recent legislation providing funds for CTE. The Carl D. Perkins Act “...emphasizes the importance of integration and requires CTE teachers to participate in professional development to prepare them for integrating rigorous academic skills into their technical curricula” (Sturko & Gregson, 2009, p. 1). Throughout the introduction of this chapter, agricultural education will be discussed as part of the CTE pathways and referenced as CTE.

The cyclical pattern has recently began to repeat as curriculum developers have realized, once again, that teaching science out of context has only hindered the progress

of the students' learning. According to Scheurich and Huggins (2008), "...science and math will increasingly be taught in an integrated fashion along with technology, just as it is used in the real world..." (p. viii). In his 2005 article, Daggett posited that "a rigorous and relevant education is a product of effective learning, which takes place when standards, curriculum, instruction, and assessment interrelate and reinforce each other" (p. 1). Daggett's views on education are similar to those of John Dewey (1938), who believed "...that there is an intimate and necessary relation between the process of actual experience and education" (p. 20). Both, John Dewey and William Daggett had a large impact on education in our society, thus providing direction for CTE educators to increase rigor, relevance, and relationships within their classrooms.

Recently, comprehensive research studies were conducted to test student retention rates of math and science concepts after students were educated through the implementation of newly developed integrated curricula (Burriss, Bednarz, & Frazee, 2008; Parr, Edwards, & Leising, 2006; Stone, Alfred, Pearson, Lewis, & Jensen, 2007; Young, Edwards, & Leising, 2009). These studies produced positive results for CTE student achievement on math and science competency assessments (Burriss et al., 2008; Parr et al., 2006; Stone et al., 2007; Young et al., 2009). According to Plank (2001), students enrolled in CTE programs tend to avoid formalized science and math classes and elect to enroll in more applied science, technology, engineering, and mathematics (STEM) type courses when given the choice. As a result, students who lack interest in traditional science and math courses are at a disadvantage when taking state assessments. This enrollment choice may be related, in some cases, to the students' lack of desire to

pursue a four-year degree. If students lack desire to pursue four-year college degrees, they may overlook the connection between academic courses and CTE thus deeming academic courses irrelevant and frustrating (Plank, 2001). According to Stone (2002), “A new value of vocational education is emerging...” (p. 2).

Fundamental core STEM concepts are embedded in multiple CTE skills and no teacher can successfully teach those CTE skills without utilizing the embedded fundamental core STEM concepts. CTE teachers view integration as a means to improve academic content of CTE courses and prepare students for a changing workplace (Stasz, Kaganoff, & Eden, 1994). According to the Association of Career and Technical Education (ACTE, 2009), “to reinforce the skills needed in the 21st century, students also need to be provided ‘real-world’ experiences” (p. 3). The coupling of STEM concepts with real-world applications, in context, allows students to experience applied examples of S.T.E.M. concepts and gain relevant, hands-on experience. The applied knowledge gained through CTE courses serves to increase conceptual understanding of the STEM concepts and increases student engagement in the learning process (Wonacott, 2002).

According to Fletcher and Zirkle (2009), “...a major objective of CTE is to increase student achievement through the integration of CTE and traditional academic content” (p. 81). According to Daggett (2005), “...career and technical education programs provide the most effective learning opportunities. Not only are students applying skills and knowledge to real-world situations in their CTE program, but also they are drawing on knowledge learned in their core-subjects” (p. 1). The long-term

effects of this practice are not established, but recent studies report that CTE students who receive integrated curriculum in mathematics are more proficient in performing mathematical equations on assessments (Stone et al., 2007). According to the results of the study by Stone et al. (2007), on the TerraNova posttest, "...an average student from the control classroom would answer 45% of the items correctly..." and "...a comparable student from the experimental group would answer about 49% correctly on the posttest, a statistically significant difference of 9%" (p. 9). Because the emphasis in many schools is success on state standardized assessments, CTE programs must provide support in their curricula to increase science and math scores in order for the courses to provide maximum value for students (Balschweid & Thompson, 2002; Balschweid, 2002; Connors & Elliot, 1994; Layfield, Minor, & Waldvogel, 2001; Roberson, Flowers, & Moore, 2001; Thompson & Blaschweid, 1999; Thompson, 2001; Thompson & Shumacher, 1997; Warnick, Thompson, & Gummer, 2004). According to Johnson, Charner, and White (2003), "curriculum integration seems to be a powerful tool for both academic and vocational teachers" (p. 66). Additionally, "curriculum integration allows and requires teachers to move from a more traditional model, in which they are isolated in the classroom, to a more collaborative one, in which they are required to work in teams to plan, deliver, and/or assess the results of instruction" (p. 66).

Research has found CTE courses can be an effective method to help students master science and math concepts (Burriss et al., 2008; Chiasson & Burnett, 2001; Parr et al., 2006; Ricketts, Duncan, & Peak, 2006; Stone et al., 2007; Warnick et al., 2004; Young et al., 2009). According to Parr et al. (2006), "the math-enhanced Agricultural

Power and Technology curriculum and aligned instructional approach...did significantly affect ($p < .05$) student performance on the mathematics placement test..." (p. 89). In the Parr et al. (2006) study, "the control group students achieved a mean score of 13.01..." and "the experimental group had a mean score of 15.56" (p. 88) with a significant difference of $p = .017$. Furthermore, Ricketts et al. (2006) found "...students achieved higher science scores due to their participation in an agriscience course(s) or activity, in comparison to those who did not participate" (p. 53). In their 2006 study, Ricketts et al. found there is a significant relationship between the number of courses in agriscience a student participated in and science scores on the GHSGT; $r(520) = .15$, $p < .01$. Still, despite the efforts of the federal government and the CTE teachers, "U.S. students are underprepared to compete in the increasingly global economy" (ACTE, 2009).

Statement of Problem

When examining the literature related to core-subject integration, three points were identified that have not been addressed extensively. 1) According to Norris and Briers (1989), teachers who respond positively to the concept of integrating core content into their curricula were more likely to integrate core content areas. After reviewing the literature, it is still unclear how CTE teachers' attitudes can be changed to more positively respond to the concept of integration, and thus infuse more core content into their classroom. 2) The second point not extensively addressed is the idea of flexibility in the classroom. According to Johnson et al. (2003), "Flexibility is a key factor contributing to successful integration" and "career and technical education teachers must

become responsible for a curriculum that extends beyond their area or subject matter expertise” (p. 66). Flexibility is defined by Johnson et al. (2003), as the ability to willingly relinquish some of the autonomy found in most traditional classrooms in order to work effectively in partnerships with other teachers. What if teachers are not given the opportunity to be flexible or are not willing to be flexible in their instruction? How will this affect the level of integration? 3) The final point not extensively addressed was the idea of professional development that was focused on core-subject integration. The limited number of professional development opportunities focusing on core-subject integration within the CTE classroom is much smaller than the number of professional development opportunities focusing on CTE content development. According to Myers and Thompson (2008), “professional development is paramount to moving the [agricultural education] profession forward in integrating academics into agricultural education programs” (p. 219).

Many agricultural educators fail to integrate core-subject concepts into their classrooms. Current research addresses the perceptions of agricultural educators regarding core-subject integration (Balschweid & Thompson, 2002; Balschweid, 2002; Connors & Elliot, 1994; Layfield, Minor, & Waldvogel, 2001; Roberson et al., 2001; Thompson & Blaschweid, 1999; Thompson & Balschweid, 2000; Thompson, 2001; Thompson & Shumacher, 1997; Warnick, Thompson, & Gummer, 2004), but little research notes the barriers identified in the perception studies and the action of agricultural educators needed to overcome these barriers.

Purpose and Objectives

The purpose of this study was two-fold: 1) Identify the path that progressive agricultural educators, who were successful in integrating core-subject concepts, particularly STEM, in their classroom followed, and 2) To determine the tools and resources progressive agricultural educators believe other agricultural educators need in order to follow a similar path (see Figure 1.1). The Conceptual Model of the Problem was developed based on the review of the literature which identified barriers (time, funding, attitude, and STEM competence) that hinder the implementation of academic integration. Thus, the following research questions were developed:

1. What path did progressive agricultural educators follow to successfully integrate core-subject concepts into their curriculum?
2. What tools and resources were currently utilized in agricultural education classrooms that were identified as successfully accomplishing core-subject integration?
3. What tools and resources are needed for other agricultural educators to implement core-subject integration within their classroom?

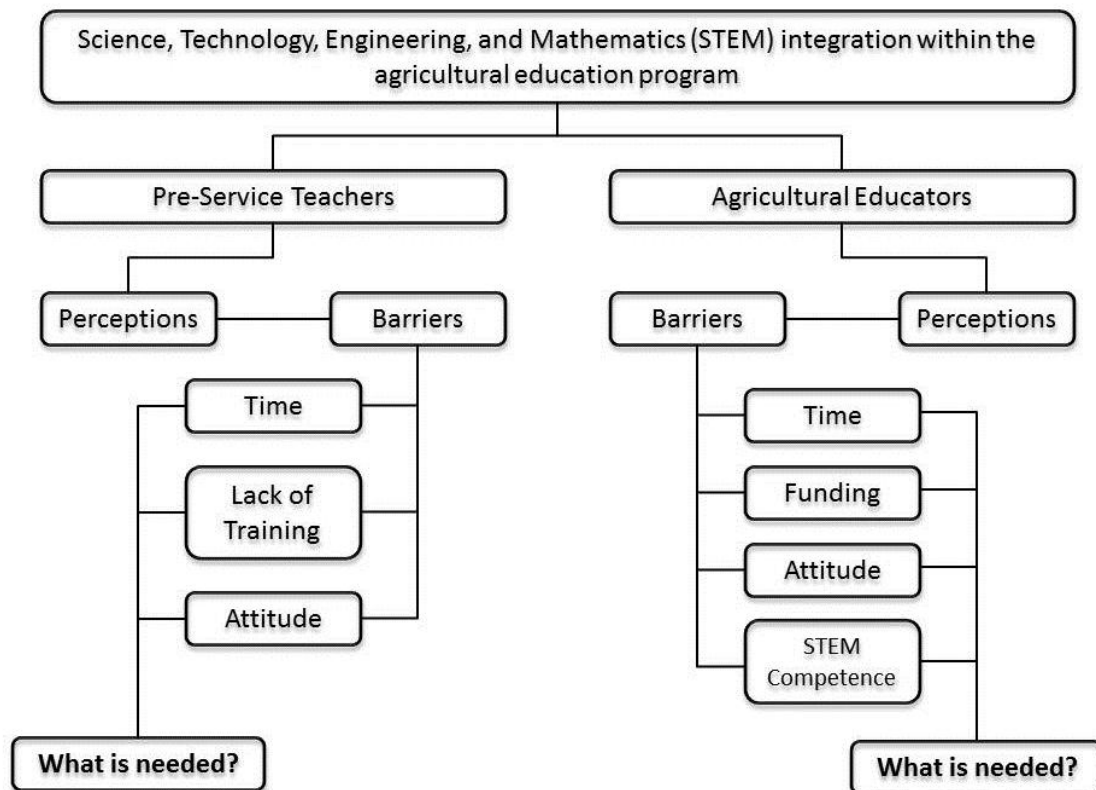


Figure 1.1. Conceptual Model of the Problem

Framework

Constructivism served as the grand theoretical framework (Camp, 2001) for this study. According to Camp (2001), “grand theories are used to explain major categories of phenomena” (p. 3). The educational philosophy of constructivism “...refers to engaging students in constructing their own knowledge” (Loepp, 1999). According to Fosnot and Perry (2005), the foci of constructivism are cognitive development and deep understanding. In a constructivist classroom, students are taught to not view “...learning as a linear process...” rather understand that learning is “...to be complex and

fundamentally nonlinear in nature” (p. 11). When teachers apply constructivism to education,

...learning is not the result of development; learning is development. It requires invention and self-organization on the part of the learner. Thus, teachers need to allow learners to raise their own questions, generate their own hypotheses and models as possibilities, test them out for viability, and defend and discuss them in communities of discourse and practice.

(Fosnot & Perry, 2005, pp. 33-34)

Along with constructivism, Rogers’ model of the innovation-decision process (Rogers, 2003) served as a middle-range theory (Camp, 2001). Camp (2001) stated “middle-range theories fall somewhere between the working hypotheses of everyday life and grand theories” (p. 3). Rogers’ model consists of five stages: knowledge, persuasion, decision, implementation, and confirmation.

1. **Knowledge** occurs when an individual (or other decision-making unit) is exposed to an innovation’s existence and gains an understanding of how it functions.
2. **Persuasion** occurs when an individual (or other decision-making unit) forms a favorable or an unfavorable attitude towards the innovation.
3. **Decision** takes place when an individual (or other decision making unit) engages in activities that lead to a choice to adopt or reject the innovation.
4. **Implementation** occurs when an individual (or other decision making unit) puts the new idea into use.

5. **Confirmation** takes place when an individual seeks reinforcement of an innovation-decision already made, but he or she may reverse this previous decision if exposed to conflicting messages about the innovation. (Rogers, 2003, p. 169)

In addition to Rogers' model of innovation-decision process, the theory of planned behavior, as proposed by Ajzen (1991), (see Figure 1.2) also served as a middle-range theory. When comparing the model of innovation-decision process to the theory of planned behavior it is noted that the theory of planned behavior possesses a strong tie to the decision stage of the model of innovation-decision process. More specifically, the decision stage (model of innovation-decision process) and the intention component (theory of planned behavior) coincide in their purpose. According to the theory of planned behavior a persons' attitude toward a behavior and their perceived behavioral control, affect their intention to, and implementation of, that particular behavior. This definition is very similar to the decision stage which states "an individual (or other decision making unit) engages in activities that lead to a choice to adopt or reject the innovation" (Rogers, 2003, p. 169).

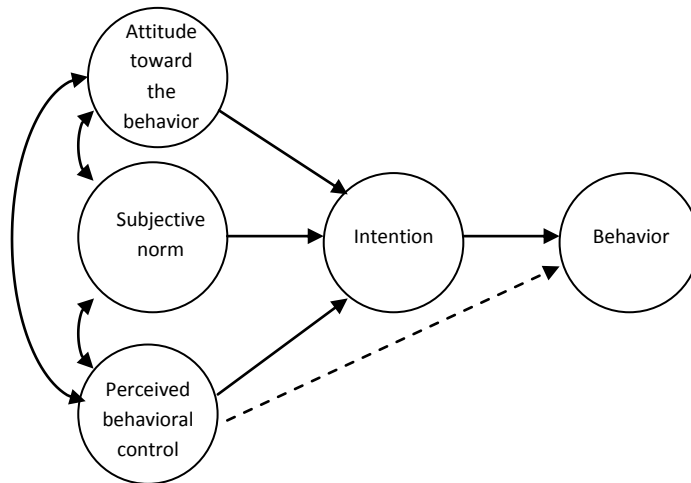


Figure 1.2. Theory of Planned Behavior (Ajzen, 1991, p. 182)

To accompany the model of innovation-decision process and the theory of planned behavior, the integration ladder (see Figure 1.3), as proposed by Harden (2000) served as a substantive theory for this study. Camp (2001) stated, “substantive theories offer explanations in a restricted setting and are limited in scope, often being expressed as propositions or hypotheses” (p. 3). For this particular study, the integration ladder was used to summarize the findings of each case study to help determine whether the goals of the teachers were accomplished. The integration ladder

...has 11 steps from subject based to integrated teaching and learning. The ladder builds on previous descriptions of models of integrated curricula, notably the work of Jacobs, Fogarty, and Drake. In the first four steps on the ladder, the emphasis is on the subjects or disciplines. Moving up the ladder, the following six steps emphasize integration across several

disciplines. In the final step, the student takes more responsibility for the integration and is given the tools to do so. (Harden, 2000, p. 551)

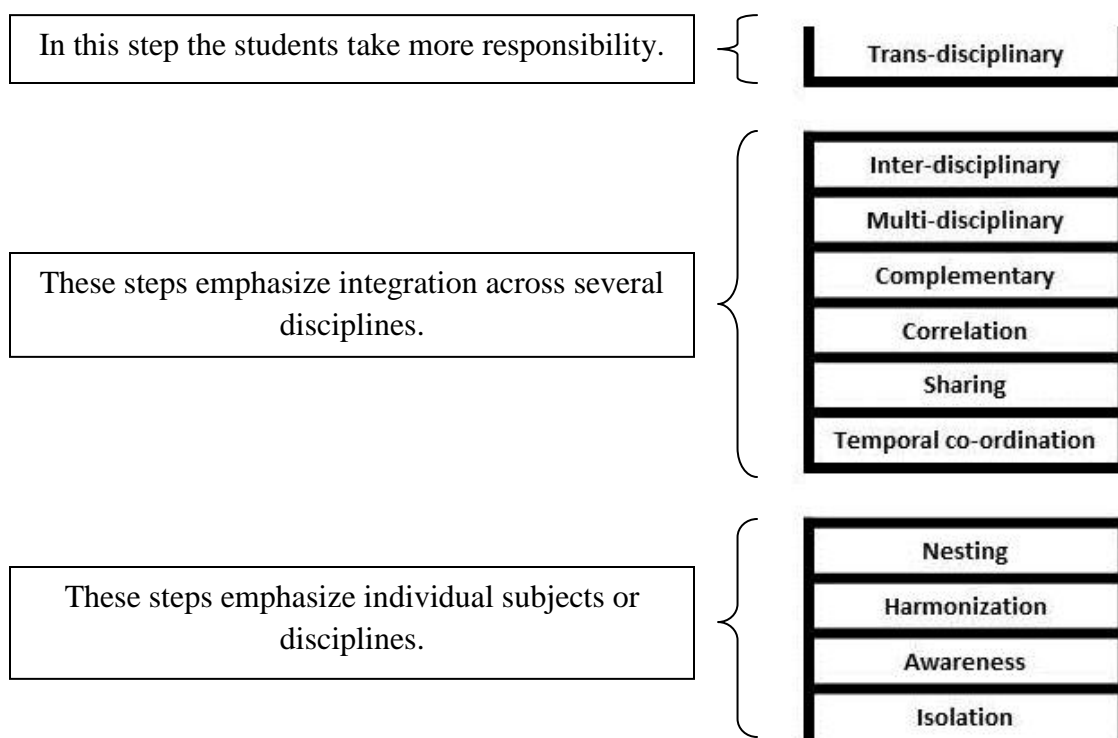


Figure 1.3. The 11 Steps of the Integration Ladder (Harden 2000, p. 552)

For this study the researcher developed a pathway, based on literature about programmatic needs of agricultural educators, which agricultural educators follow to become progressive in the area of academic integration. The literature outlines multiple barriers that inhibit agricultural educators from implementing academic integration into their classroom. According to previous research, barriers that hinder the implementation of core-subject integration within classrooms are time, lack of funding, lack of faculty support, lack of equipment and supply, planning, lack of instructional materials, and

curriculum development (Balschweid & Thompson, 2002; Roberson et al., 2001; Thompson & Balschweid, 1999; Thompson & Shumacher, 1997; Warnick et al., 2004). The researcher believes a teacher's educational background, the school district/agricultural education program, resources available to the teacher (i.e. facilities, supplies, equipment, and budget), and professional development attended by the teacher all contribute to the academic integration in the classroom (see Figure 1.4).

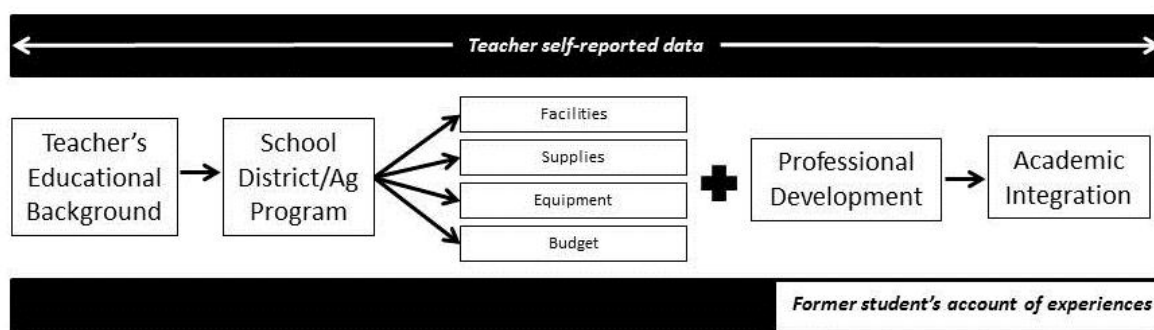


Figure 1.4. Agricultural Educators Pathway to Academic Integration

Assumptions

Based on the knowledge gained from previous teaching experience and previous agriculture classroom observations, the researcher assumed the resources utilized and the path followed to become progressive in core-subject integration would be similar among the participants. The researcher assumed progressive teachers are provided adequate resources needed to be successful in academic integration, are self-motivated to attend professional development workshops pertaining to core-subject integration, seek out

potential grant funding opportunities, and possess strong support from their school administrators.

Limitations of the Study

1. The results of the study only pertain to the individuals that participated in the study.
2. The researcher relied on a third party to initially identify potential participants based upon researcher identified characteristics: 1) the teacher regularly implements academic integration in the classroom and 2) the teacher serves as a leader in their respective home state in terms of academic integration.
3. Observations of the participants teaching in the classroom did not take place, therefore the information provided in this document is teacher self-reported data or student recalled data.

Operational Definitions

Academic/Core-subject Integration: A curriculum approach that purposefully draws together knowledge, perspectives, and methods of inquiry from more than one discipline to develop a more powerful understanding of a central idea, issue, person, or event. The purpose is not to eliminate the individual disciplines but to use them in combination.

(Parker, 2005, pp. 452-453)

Agricultural Education: “Prepares students for successful careers and a lifetime of informed choices in the global agriculture, food, fiber, and natural resources industries”

(NRC, 1988, p.2).

Agriscience: “Instruction in agriculture emphasizing the principles, concepts, and laws of science and their mathematical relationships supporting, describing and explaining agriculture” (Lee, 2000, p.2).

Career and Technical Education (CTE): Career and technical education prepares both youth and adults for a wide range of careers. These careers may require varying levels of education – from high school and postsecondary certificates to two- and four-year college degrees. Career and technical education is offered in middle schools, high schools, community and technical colleges and other postsecondary institutions.

(<http://www.acteonline.org/about.aspx>)

Core-subjects: Core-subjects can include, but are not limited to: Science, Technology, Engineering, Mathematics, Language Arts, and History/Social Studies.

Inquiry Based Learning: A multifaceted activity that involves making observations; posing questions, examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in the light of experimental evidence; using tools to gather, analyze and interpret data; proposing answers, explanations, and results. (NRCNA, 2009)

Progressive Agricultural Education Programs: Progressive agricultural education programs meet the following criteria: offer core credit for agricultural courses; use inquiry based learning; collaborate with core-subject teachers; and participate in the FFA Agriscience Fair.

Supervised Agricultural Experience Program (SAE): The actual planned application of concepts and principles learned in agricultural education. Students are supervised by

agricultural teachers in cooperation with parents/guardians, employers, and other adults who assist them in the development and achievement of their educational goals. The purpose is to help students develop skills and abilities leading toward a career. (Barrick, et al., 1992, p. 1)

Traditional Agricultural Education Programs: Agricultural education programs that place a heavy emphasis on production based agriculture and vocational skill building.

National Association of Agricultural Educators (NAAE): The NAAE is a federation of state agricultural educators associations with more than 7,650 members. Currently NAAE is focusing on three areas - advocacy for agricultural education, professional development for agricultural educators, and recruitment and retention of current ag educators. (<http://www.naae.org/about/memberservices/>)

Non-Traditional Agricultural Education Programs: Agricultural education programs that emphasize science based instruction, more, and vocational skill building, less.

Summary

Many people view agricultural education courses as strictly vocational courses despite the fact that “agriculture now so thoroughly combines basic and applied aspects of the traditional STEM disciplines” (NRCNA, 2009, p.4). Although the vocational aspects of the courses continue to be important, current trends have begun to revert back to the inclusion and emphasis of STEM concepts in CTE courses. According to the Texas Education Agency (TEA) (2007), “CTE no longer focuses solely on preparing students to enter the world of work immediately after high school graduation. CTE

subject areas include business, trade and industrial, health occupations, agricultural sciences, family and consumer sciences, marketing, and technology education” (p. 1).

Secondary students in the United States currently lag behind their peers in other countries in terms of science and math literacy and lack the skills necessary for today’s high-skill workplaces or to meet college entrance requirements (Stone et al., 2007).

According to the United States Department of Education (USDE) and the National Center for Educational Statistics (NCES) (2009), 15 year old United States students were out performed, in terms of average scores based on the Organization for Economic Cooperation and Development (OECD) mathematics literacy assessment by their peers in 23 other countries. Additionally, United States’ students were also outperformed in the sciences, in terms of average scores based on the OECD science literacy assessment, by peers in 16 other countries (USDE, 2009). Failing to show the applicability of core-subject content in real-life scenarios can increase the gap between the students in the United States and the students in other countries. Some agricultural educators are doing just that, failing to teach the students about the core-subject skills necessary to accomplish the agricultural concepts being taught.

Because agricultural educators are failing to make the connection between core-subject content and agricultural education content, it is important to examine the barriers hindering their progress in the integration process. Research should be done to discover the resources current agricultural educators need to become progressive in the area of core-subject integration. According to Dormody (1993b), “whether or not science credit is pursued, agricultural competencies should be clearly cross-referenced with science

competencies to show how agriscience courses reinforce science competencies” (p. 69). By providing teachers with the proper resources the barriers will be reduced and the teachers’ attitudes towards core-subject integration will become more favorable. Therefore, “state supervisors and teacher educators in agricultural education should consider addressing [integration], during preservice and inservice education” and “the teachers should be encouraged to expand their concept of agriscience to include the physical sciences...” (Dormody, 1993b, p. 69).

According to Myers and Thompson (2008), “as a profession, agricultural educators need to create a ‘buy-in’ from the profession to integrate science, math, and reading into the curriculum” (p. 219). Based on the theory of constructivism, the model of innovation-decision process, and the theory of planned behavior, the teachers will be more willing take control of the core-subject integration idea if they begin to feel more comfortable with the implementation of core-subject integration. Once the willingness to integrate is established, then the agricultural educators can begin to develop a system that will work in their classroom to provide more opportunities for their students to learn science and math through the application of agricultural concepts.

CHAPTER II

LITERATURE REVIEW

Introduction

“Agriculture now so thoroughly combines basic and applied aspects of the traditional STEM disciplines” (NRCNA, 2009, p.4), thus making agricultural education a logical vehicle to teach today’s youth. According to the United States Department of Education (USDE) and the National Center for Educational Statistics (NCES) (2009), youth in the United States lag behind youth in other countries in their science and math abilities, therefore career and technical education (CTE), now more than ever, is called upon to integrate core-subjects in their classrooms. Integrating core-subjects into the CTE courses can be done through the application of inquiry based learning, core-subject and CTE teacher collaboration, student participation in science fairs, utilization of integrated curriculum, and professional development activities focused on core-subject integration.

Chapter II begins with the overall demographical composition of students who are enrolled in CTE and depicts select demographics of the agriculture, food, and natural resources cluster group contained within CTE. Following the two demographical sections, Chapter II explores literature in reference to educational standards and standardized assessments, requirements for highly qualified teachers, inquiry based learning, teacher collaboration, core-subject integration, benefits of core-subject integration for the student and the teacher, current integration initiatives, and ends with

the current perceptions of core-subject integration within the agricultural education classroom. The information gleaned from the literature review served as a basis for determining the operational criteria utilized to select the participants of this study and develop the research questions that guided the study.

CTE Demographics

According to the United States Department of Education Office of Vocational and Adult Education, more than 15 million students were enrolled in CTE programs in the 2006-2007 academic year (see Figure 2.1), which is the highest enrollment since the 1999-2000 academic school year.

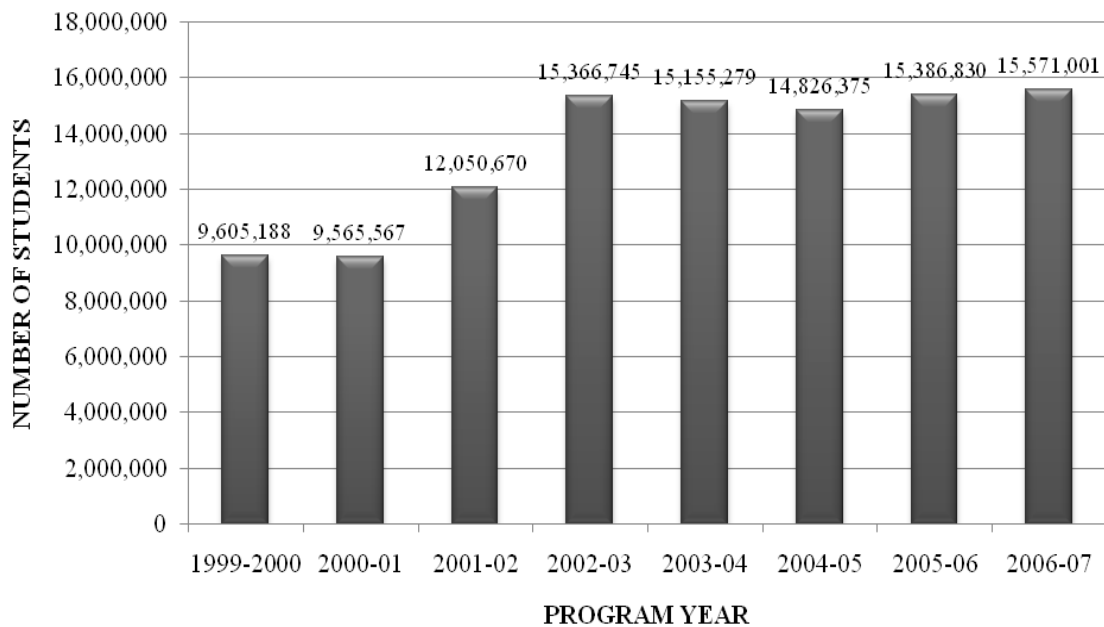


Figure 2.1 Student Enrollment in Career and Technical Education Programs, PY 1999-2007

Source: U. S. Department of Education, Office of Vocational and Adult Education, Consolidated Annual Performance, Accountability, and Financial Status Report for the State Basic Grant and Tech Prep Grant Programs under the Carl D. Perkins Vocational and Technical Education Act of 1998, FY 2006-07 (OMB Number 1830-0503).

Over half (63.7%, over 9.9 million students) of the students enrolled in CTE were enrolled in a secondary CTE program (see Table 2.1). Of the students enrolled in a secondary CTE program, 89.7% (over 8.9 million secondary students) were categorized as special populations. Special populations as defined in the Carl D. Perkins III Act include: *displaced homemaker, economically disadvantaged, individuals with limited English proficiency, individuals with a disability, individuals with other barriers to educational achievement, individuals preparing for a nontraditional training and employment, and single parents* (see Table 2.1).

Table 2.1

Student Enrollment in Career and Technical Education Programs by Disaggregated Categories of Select Student Characteristics, PY 2006-07

Select Student Characteristics	Disaggregated Category	Secondary	Postsecondary
Total Enrollment		9,924,658	5,646,289
<i>Gender</i>	Male	5,316,643	2,507,155
	Female	4,605,893	3,106,035
	Unknown*	2,122	33,099
<i>Race/Ethnicity</i>	Black	1,714,667	715,087
	Hispanic	1,889,627	912,152
	White	5,633,629	2,976,133
	Asian/Pacific Islander	439,408	387,609
	American Indian	118,335	71,867
<i>Special Populations</i>	Individuals With Disabilities	1,046,473	262,578
	Economically Disadvantaged	3,484,630	1,643,219
	Limited English Proficient	520,020	243,926
	Displaced Homemaker	6,416	74,236
	Other Educational Barriers	1,393,679	756,231
	Single Parent	56,761	267,151
	Nontraditional Students	2,399,053	1,067,829

* Unknown denotes instances where the state could not identify the gender of the student.

Source: U. S. Department of Education, Office of Vocational and Adult Education, Consolidated Annual Performance, Accountability, and Financial Status Report for the State Basic Grant and Tech Prep Grant Programs under the Carl D. Perkins Vocational and Technical Education Act of 1998, FY 2006–07 (OMB Number 1830-0503).

According to the National Center for Educational Statistics in 2005, 92.3% of all high school graduates across the nation earned at least one credit in a CTE course. These students accounted for over 2.4 million graduates. Additionally, 38.8% (over one million graduates) of the nation's high school graduates were considered two credit occupational concentrators and 21.3% (over 575,000 graduates) were considered three credit occupational concentrators. According to ACTE (2010), "High quality career and technical education can help more students persist in and complete high school, preparing them for a postsecondary education and training that will be critical to future economic successes."

CTE consists of 16 career clusters, which support ongoing efforts to move from vocational education to career and technical education (<http://dpi.wi.gov/cte/careerclustershome.html>): *Agriculture, Food, and Natural Resources; Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Government and Public Administration; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections and Security; Manufacturing; Marketing, Sales, and Service; Science Technology, Engineering, and Mathematics; and Transportation, Distribution, and Logistics*. Career clusters blend rigorous academic and technical training, provide career development, offer options for students to experience all aspects of a business or industry, and facilitate/assist students and educators with ongoing transitions. Career clusters serve as a framework for CTE in the 21st century, providing students with contemporary and high

quality programs that assist students in understanding the process of knowledge and skill transfer with verification of their ability to properly perform the skill.

Agricultural Education Demographics

According to the National Center for Educational Statistics in 2005, 11.5% of all high school graduates earned some sort of credit within the agriculture, food, and natural resources career cluster. This constitutes for over 310,000 high school graduates. Furthermore, 4.7% (over 126,000 graduates) of the high school graduates were classified as two credit concentrators and 2.9% (over 78,000 graduates) were classified as three credit concentrators. With over 11% of our nation's youth enrolling in agriculture, food, and natural resources, this career cluster possesses the opportunity to make a large impact on our nation's population by developing problem solving skills through the implementation of inquiry based learning in a real life context.

Educational Standards and Standardized Assessment

In 2001 the No Child Left Behind (NCLB) Act was passed and was based on four pillars: 1) stronger accountability for results, 2) more freedom for states and communities, 3) proven education methods, and 4) more choices for parents (www.ed.gov). According to the United States Department of Education (USDE), the NCLB benefits children, empowers parents, and supports and strengthens schools. Within the NCLB act, high quality state standards and assessment systems serve as a cornerstone. According to the USDE, "by setting standards, measuring progress, and holding states accountable for their students' achievement, states can ensure that no child lacks the basic skills needed to succeed in our increasingly competitive, global

economy” (www.ed.gov). As of January 2009, “39 states have implemented high-quality standards and assessment systems that have received the status of Full Approval or Full Approval with Recommendations” (www.ed.gov). The remaining states still have work to do on their systems to gain Full Approval.

Even though not all 50 states have Full Approval, the NCLB has resulted in “continued growth and gains by America’s schoolchildren, particularly among younger and minority students” (www.ed.gov). According to the USDE, as of 2007, “48 states and the District of Columbia either improved academically or held steady in all categories” (www.ed.gov).

Overall it appears NCLB has made a positive impact on the American education system. According to Kymes (2004), “the intent of NCLB was closely tied to a desire to produce an adequate workforce of skilled laborers. This is certainly a core value which drives CTE program planners” (p. 5). Not all assessments have indicated that NCLB has positively impacted all aspects of the American education system, because “for the designers of NCLB, student success resides solely in academic realms” (p. 5). According to Abrams, Pedulla, and Madaus (2003), “in general, teachers in high-stakes states reported significant decreases in time spent on instruction in the fine arts, industrial/vocational education, field trips, class trips, enrichment assemblies, and class enrichment activities” (p. 6). Furthermore, the National Assessment of Vocational Education (USDE, 2004) found a national decline in the amount of vocational credits earned by secondary education students.

Phelps (2002) reinforces the fact that “career and technical education is not immune to the provisions of NCLB” (p. 1). In fact, Phelps (2002) believes the heavy focus on academics outlined by the NCLB “...will result in a reduction of secondary CTE programs” (p. 6). According to Phelps (2002), “we are already seeing increased academic courses for graduation, therefore reducing the time available to students to take career technical courses” (p. 6). In response to the effects NCLB has had on CTE,

many CTE researchers call for integration of CTE and academic programs of study for all students focusing on career clusters instead of particular occupations. Stated differently, the current major focus of CTE is to require all students to participate in a combination of CTE and academic courses and to focus on broad career clusters instead of specialized jobs in CTE courses.

(Fletcher, 2006, p. 165)

The Association of Career and Technical Education (ACTE, 2009) believes “if well implemented, [CTE] programs offer remarkable results in both academic and technical skill outcomes and address many of the major educational concerns that exist today” (p. 1). According to ACTE (2009), “while there are many factors that contribute to low student achievement, one critical element is a lack of education relevance, both to students’ individual lives, and to the complex diverse workplace that has emerged from the knowledge revolution” (p. 2).

Highly Qualified Teachers

According to Fletcher (2006), one of the many challenges that CTE faces, in regards to meeting the requirements of NCLB, is “...ensuring all CTE teachers are

highly qualified” (p. 167). To be considered a highly qualified teacher, CTE teachers must have earned a bachelor’s degree and a teaching certification, and are required to have passed an assessment in the particular subject area in which they intend to teach (Fletcher, 2006). In a study done by Pavelock, Woolery, Ullrich, and Kelley (2009), science specialists and CTE specialists agree with the federal requirements. Pavelock et al. (2009) reported that “over 90% of the respondents felt a bachelor’s degree from a four-year university was a necessity as a teacher credential” (p. 9). Whereas, “just over one-fourth (25.5%) of the respondents perceived that teachers having majored in any field of science was necessary, but just over one-half (56.9%) of the respondents noted that a teacher should have a major in the specific field of science in which they would be teaching” (p. 9) for teachers to offer science credit for their courses. According to *National Assessment for Vocational Education* (USDE, 2004),

Current vocational teachers are less likely than academic teachers to have bachelor’s degrees and many do not feel they have received sufficient professional development on the key strategy of integration. Moreover, prospective high school vocational teachers (in vocational teacher training programs) score lower on basic reading and writing tests than do those preparing to be elementary school teachers and lower on math tests than other secondary teachers. (p. 10)

Beyond the federal requirements for highly qualified teachers within CTE, each state is given the opportunity to add to the federal guidelines for highly qualified teachers in CTE, particularly in regards to offering core-subject credit towards

graduation. Some states require their teachers to be certified in the core-subject area, in which credits are awarded through enrollment in a particular CTE course, and other states do not. Some of the states, which do not require certification in the core-subject areas, require their teachers to enroll in additional coursework or enroll in specific courses while completing their teacher preparation program. For instance, Texas agricultural educators are required to have taught classes that relate to the course subject offered for core credit or have taken additional post-secondary courses that relate to the agricultural class offered for credit towards graduation in order for them to offer science or math credit for agricultural education courses. Teacher education graduates "...need to have competence in both the content they plan to teach and supporting content" (Conroy & Trumbull, 2000, p. 308). Conroy and Trumbull (2000) stated "it is important for teachers to possess subject matter to 'teach with' as it is for them to know the subject(s) they will teach" (p. 308).

According to Ewing and Foster (2010), the "...classroom/laboratory instruction was deemed most important by high school administrators when looking at the entire agricultural education model" (p. 10) in Pennsylvania. In a study done by Roberts and Dyer (2004), eight of the top 20 characteristics of effective agricultural teachers are classified as instructional related, two were classified as program planning/management, two were located in the professionalism/personal growth category, one was classified in the marketing category, and the remaining seven characteristics were located in the personal qualities, SAE, or FFA categories. Roberts and Dyer (2004) reported the

characteristics of effective agricultural teachers with 100% agreement from the participants were:

1. Cares for students
2. Effectively plans for instruction
3. Effectively evaluates student achievement
4. Is honest, moral, and ethical
5. Has a sound knowledge of FFA, actively advises the FFA chapter, and effectively prepares students for CDEs and other FFA activities
6. Communicates well with others
7. Effectively manages, maintains, and improves laboratories (p. 7)

Standard 1a, outlined in Professional Standards for the Accreditation of Teacher Preparation Institutions written by the National Council for Accreditation of Teacher Education (NCATE, 2008), states their target for content knowledge for teacher candidates is that “teacher candidates have in-depth knowledge of the content that they plan to teach as described in professional, state, and institutional standards” (p. 16) and they “...demonstrate their knowledge through inquiry, critical analysis, and synthesis of the subject” (p. 16). According to NCATE (2008), teacher candidates should “...present the content to students in challenging, clear, and compelling ways, using real-world contexts” (p. 17) and “...foster active inquiry, collaboration, and supportive interaction in the classroom” (p. 22).

Inquiry Based Instruction

Inquiry is a multifaceted activity that involves making observations; posing questions, examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in the light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and results. Inquiry requires identification of assumptions, use of critical and logical thinking and consideration of alternative explanations. (National Research Council, 1996, p. 23)

According to Parr and Edwards (2004), "...Inquiry-centered, inquiry-oriented, or inquiry-based learning, as it is practiced in secondary science education (e.g., the "Learning Cycle"), is deeply rooted in a constructivist or hand-on/minds-on approach to learning" (p. 106). "The single best way to grow a better brain is through challenging problem solving" (Loepp, 1999). The National Science Education Standards state that, "Inquiry into authentic questions generated from student experiences is the central strategy for teaching science" (National Research Council, 1996, p. 31).

In the process of inquiry, students are encouraged to construct their own conceptual frameworks when presented with a problem in a real-life context (Roth, 1992). According to Roth (1992), "new analytical, conceptual, or practical tools are embedded in the context of students' self-determined inquiry" (p. 308). The inquiry based learning approach assumes "that students need to find solutions to real problems by asking and refining questions; designing and conducting investigations; gathering and

analyzing information and data; making interpretations, creating explanations, and drawing conclusions; and reporting findings” (Marx et al., 2004, p. 1064).

Agricultural educators use strategies from project based learning through building real-life scenarios in their classroom. According to Capraro and Slough (2008), project based learning has “a well-defined outcome and ill-defined task” (p. 5) through “...the use of a project that often results in the emergence of various learning outcomes in addition to the ones anticipated” (p. 5). The projects utilized are centered on real-life scenarios and are similar to those found in the agricultural education classroom.

Traditionally, when mathematics or science courses are taught in secondary schools, they are taught almost exclusively through abstract thought. That is students are taught formulas or laws, and then the students are tested on those formulas or laws. The real-world connections or the importance of those formulas or laws are rarely taught, and even included. The real-world connections are generally just mentioned in the textbook or by the teacher and are rarely at the center of teaching and learning. (Capraro & Slough, 2008, p. vii)

Davison, Miller, and Metheny (1995) posit a thought that mirrors Capraro and Slough: “We believe that the most potent approach to integration is to focus, not on science and mathematics content, but on scientific processes” (p. 229). According to Balschweid and Thompson (2002), “the call for increased integration of academic and applied concepts can be heard from both academic and vocational sources” (p. 1). For teachers to successfully implement integrative strategies into their classrooms “...they

need feedback and support from their professional colleagues as they work through the process” (Sturko & Gregson, 2009).

Teacher Collaboration

“Collaboration with other academic teachers through cross-curricular projects will help students better understand the academics, as well as technical concepts and principles” (Myers & Thompson, 2008, p. 219). According to a study done by Roberson, Flowers, and Moore (2001), some agricultural teachers spend little time participating in shared planning and teaching with core-subject teachers, coordinating with core-subject teachers to teach higher level thinking skills at the same time, connecting one main topic or theme to all topics, and reorganizing curriculum and coordinating with core-subject teachers so that similar topics are taught concurrently. “It is not uncommon for agriculture teachers to spend many years teaching in the same school and yet have little to no idea what...” (Whent, 1994, p. 11) other teachers are doing in their classrooms. According to Loepp (1999), teachers need to become members of learning communities to effectively teach an integrated curriculum. Dormody (1993b) stated “whether or not science credit is pursued, agriculture teachers should work closely with science departments when developing, implementing, and evaluating agriscience courses” (p. 69).

Whent (1994) summarized four major barriers to collaboration: “1) an initial lack of understanding of what the other teacher teaches and the resources available; 2) the physical distance between the agriculture department and the science department; 3) difficulty in finding time to work together due to preparation periods being scheduled at

different times; and 4) a general lack of administrative support for integration” (pp. 14-15). Dormody (1993a) stated agricultural education departments who share program resources with the science department have a positive attitude towards science and participate in professional development workshops alongside the science educators. Furthermore, Dormody (1993a) reported agricultural educators “...who feel they can use some help...” (p. 58) benefit greatly from collaboration with science teachers.

Curriculum Integration

Curriculum integration involves every facet of education (<http://www.ascd.org/Default.aspx>). According to the Association for Supervision and Curriculum Development (ASCD) (<http://www.ascd.org/Default.aspx>), teachers who implement integrated curriculum in their classrooms are pleased with the results. The ASCD (<http://www.ascd.org/Default.aspx>) stated integrated curriculum is necessary because the world we live in has never been divided into different disciplines. Czerniak, Weber, Sandemann, and Ahern (1999) made a similar statement: “In the real world, people’s lives are not separated into separate subjects; therefore it seems logical that subject areas should not be separated in schools” (p. 1).

Davison et al. (1995) stated the key purpose behind integrating subjects such as mathematics and science “is to develop relevancy and applicability of the discipline to the existing student experiences” (p. 226). The problem with core-subject integration is the word integration is interpreted differently by different educators (Davison et al., 1995; Hinde, 2005; Johnson, Charner, & White, 2003; Kysilka, 1998; Pang & Good, 2000). Parker (2005) defines integration as:

...a curriculum approach that purposefully draws together knowledge, perspectives, and methods of inquiry from more than one discipline to develop a more powerful understanding of a central idea, issue, person, or event. The purpose is not to eliminate the individual disciplines but to use them in combination. (pp. 452-453)

The ASCD (<http://www.ascd.org/Default.aspx>) has a similar definition, suggesting integrated curriculum “...is about making meaningful connections between topics or skills that are usually addressed in different subject areas” (p. 2). Beane (1996) defined integration with four characteristics:

- a) curriculum that is organized around problems and issues that are of personal and social significance in the real world
- b) use of pertinent knowledge in the context of topic without regard for subject lines
- c) knowledge that is used to study a current problem rather than for a test or grade level outcome
- d) emphasis placed on projects and activities with real application of knowledge and problem solving

Integration within Core-subjects

When addressing curriculum integration within core-subject areas, “traditionally, school curriculum has been largely based on the concept that instruction should be separated into distinct subjects for ease of understanding and then reassembled when complex applications are required” (Wicklein & Schell, 1995, p. 59). According to

Wicklein and Schell (1995), “the curricular concept of integrating or connecting school subject areas has gained significant attention in the recent years...” (p. 59). West, Vasquez-Mireles, and Coker (2006) stated “both mathematics and science education are highly influenced by standards developed by professional organizations” and “the science program should be coordinated with the mathematics program to enhance student use and understanding of mathematics in the study of science and to improve student understanding of mathematics” (p.11). According to Loepp (1999), “having the opportunity to utilize knowledge and skills from several disciplines does offer increased opportunities for making the curriculum relevant” (p. 21).

Integration within CTE and Agricultural Education

According to a study done by Stasz, Kaganoff, and Eden , (1994), core-subject integration within CTE has been present in educational research since the mid-1980s. Many of the pieces written were theoretical, speculative, or advocative with little research done that tested how core-subject integration affects student learning (Johnson et al., 2003; Myers, Washburn, & Dyer, 2004; Stasz et al., 1994). Although the vocational aspects of the CTE courses continue to be important, current educational reform has placed a large emphasis on the integration of science, technology, engineering, and mathematics (STEM) concepts (Plank, 2001) throughout CTE pathways. Core-subject integration has been supported and continues to be supported by the teaching profession and business and industry (Roberson et al., 2001). According to the American Association for the Advancement of Sciences (AAAS), the integration of vocational and core-subject concepts are critical in order to meet the students’

educational needs and allow for connections to be made that are meaningful and relevant. “CTE programs can be a great help to language arts, math, and science teachers by reinforcing the skills and concepts that students learn in those subjects” (Daggett, 2005, p. 5). Dormody states “the agricultural mechanics laboratory (e.g., hydraulics), land laboratory (e.g., soil properties), and greenhouse (e.g., climate factors) are motivational settings for teaching physical science principles” (1993b, p. 69), because of the opportunities present for the utilization of real-world applications. According to Roth (1992), “both the National Council of Teachers of Mathematics (NCTM) and the AAAS documents highlight the importance of integrating real-world problems with school subject matter...” (p. 307).

Anderson, Williams, and Hillison (2008) reported in Virginia, “there were only three courses that were taught by at least two agricultural education teachers that had a mean percentage of integration over 30%, all three courses were agribusiness courses” (p. 88). Furthermore, “...the typical agricultural education teacher...only integrated mathematics into 23% of their lessons” (Anderson et al., 2008, p. 88).

Models of Integration

There are numerous designs for curriculum integration presented/reviewed in the literature. Davison et al. (1995) introduced five different types of integration methods: 1) Discipline Specific Integration, which “...involves an activity that includes two or more different branches...” (p.227) of two different subjects. “This type of integration requires a problem where students reach an informed decision based upon data analysis from all the disciplines and their use of critical thinking and problem solving skills” (p.

227).; 2) Content Specific Integration, which "...involves choosing an existing curriculum objective from..." (p. 227) each subject.; 3) Process Integration, which uses "...real-life activities in the classroom" (p. 228).; 4) Methodological Integration, which is "...developed under the constructivist theory using scientific discovery and inquiry teaching techniques and building on prior knowledge..." (p. 229); and 5) Thematic Integration, which "...begins with a theme which then becomes the medium with which all the disciplines interact" (p. 229). Hinde (2005) summarized four different designs of integration: 1) "Immersed and Networked Models, in which students direct the integration process" (p. 106); 2) Correlation and Sequenced Model, in which "...teachers arrange concepts so that similar learning activities relate to one another" (p. 106); 3) Open and True Color Design, in which "...students and teachers select the subject matter in the context of problems that the class determines should be addressed"(p. 106); and 4) Broad Fields Design, in which "...the focus is on the unity or synthesis across subject areas" (p.106).

The models/designs identified in the literature can be classified into one of two approaches to integration as presented by Parker (2005): fusion or infusion. The fusion design "...merges related subjects into a new subject. Two or more subject areas are merged in such a way that they form a new unified idea" (Hinde, 2005, p. 106). The infusion design brings two or more subjects "...together to form a meaningful curriculum" (p. 106) where "aspects of one subject area are inserted or infused into a second to help the learner gain a deeper understanding of the second. Therefore, one subject area is the helper of another" (p. 106) and "one or more objectives from various

subject areas are achieved as a result of the infusion of one topic into another” (Hinde, 2005, p. 106).

To better understand and evaluate the integration process in the classroom, Ronald Harden (2000) developed an 11 step continuum, which is based off the work of Jacobs, Fogarty, and Drake. The 11 step continuum is referred to as The Integration Ladder. According to Harden (2000), “as one moves up the ladder, there is less emphasis on the role of disciplines, an increasing requirement for a central curriculum, organizational structure and a requirement for greater participation by staff in curriculum discussion and planning” (p. 551).

The first step on the integration ladder is Isolation. In the Isolation step (Harden, 2000),

departments or subject specialists organize their teaching without consideration of other subjects or disciplines. Each discipline looks, from the perspective of their own discipline, at the curriculum content in terms of areas to be covered, depth of coverage, sequence, and timing. No attention is paid to the other or related subjects, which contribute to the curriculum. The slots in the timetable are labeled with the name of the subject, which is taught by specialists in the discipline. Each subject is seen as an entity in itself. The objectives are seen as mastery of the subject and these are tested in a subject-based assessment of the student's knowledge and understanding of the subject. The relationships between subjects are not explicitly covered and related topics from two disciplines are not intentionally correlated. (pp. 551-552)

The second step on the integration ladder is Awareness. The Awareness step is (Harden, 2000)

similar to isolation, the teaching is subject-based. Some mechanisms are in place, however, whereby the teacher in one subject is made aware of what is covered in the other subjects in the curriculum. This can be achieved through appropriate documentation about the aims and objectives of each course and the content and topics covered in lectures and other teaching sessions. Lecture notes or handouts may be circulated to other course teachers as well as to students. Given this information, the teacher can take account of what colleagues cover in other parts of the course when planning his or her teaching, avoiding unnecessary duplication or redundancy and cross-referring, where appropriate, to other parts of the course. At this step, however, there is no explicit attempt to help the student to take an integrated view of the subject. (p. 552)

The third step on the integration ladder is Harmonization (Harden, 2000).

In harmonization, teachers responsible for different parts of the same course, consult each other and communicate about their courses. The consultation process takes place through informal discussions between teachers and through formal curriculum planning committee meetings. The consultation may involve individual teachers or groups of teachers. The process of consultation may be overseen by a member of staff who has some overall responsibility for the curriculum or has, as his or her remit, the facilitation or organization of discussion between teachers from different subjects. This consultation process

encourages teachers to adapt their programs so that each course makes an appropriate contribution to the curriculum and the overall curriculum objectives are more likely to be achieved. (p. 552)

The fourth step on the Integration Ladder is Nesting (Harden, 2000).

Nesting occurs when a teacher targets, within a subject-based course, skills relating to other subjects. Content drawn from different subjects in the curriculum may be used to enrich the teaching of one subject. The term 'infusion' has also been applied to this stage of integration where teachers 'analyze the separate subject's goals and identify ways in which these generic skills can be refined into existing subjects.' (p. 552-553)

The fifth step on the Integration Ladder is Temporal Co-ordination (Harden, 2000).

In temporal co-ordination, each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines. The timetable is adjusted so that topics within the subjects or disciplines which are related are scheduled at the same time. Similar topics are taught on the same day or week while remaining part of a subject-based teaching program. Students study the concepts of the different subjects separately, and are left themselves to uncover the relationships. This approach has been described also as 'parallel' or 'concurrent' teaching. (p. 553)

The sixth step on the Integration Ladder is Sharing. In the Sharing step (Harden, 2000),

two disciplines may agree to plan and jointly implement a teaching program. The shared planning and teaching takes place in two disciplines in which overlapping concepts or ideas emerge as organizing elements. The two disciplines which come together to offer such a program are usually complementary subjects and the joint course produced emphasizes shared concepts, skills and attitudes. The focus of the course is usually in these shared elements. (p. 553)

The seventh step on the Integration Ladder is Correlation (Harden, 2000). In the 'correlation' step of integration, the emphasis remains on disciplines or subjects with subject-based courses taking up most of the curriculum time. Within this framework, an integrated teaching session or course is introduced in addition to the subject-based teaching. This session brings together areas of interest common to each of the subjects. (p. 554)

The eighth step on the Integration Ladder is Complementary (Harden, 2000). The 'complementary' approach has both subject-based and integrated teaching. The integrated sessions now represent a major feature of the curriculum. These sessions are recognized to be, in terms of time, allocated resources and assessment as important, if not more important, than the subject-based teaching. The focus for the teaching may be a theme or topic to which the disciplines can contribute. (p. 554)

The ninth step on the Integration Ladder is Multi-disciplinary (Harden, 2000).

A multi-disciplinary approach brings together a number of subject areas in a single course with themes, problems, topics or issues as the focus for the students learning. The themes selected as the focus in an integrated course may function in different ways. The themes can delineate an area in which practical decisions have to be made and which serve as a focal point of interdisciplinary thinking. Problems and the tasks to be undertaken by the professional may also be used as a focus for integrated teaching. (p. 554)

The tenth step on the Integration Ladder is Inter-disciplinary (Harden, 2000).

In inter-disciplinary integration there is a further shift of emphasis to themes as a focus for the learning of and to the commonalties across the disciplines or subjects as they relate to the theme. Inter-disciplinary is defined as a study of a phenomenon that involves the use of two or more academic disciplines simultaneously. Inter-disciplinary teaching implies a higher level of integration, with the content of all or most subjects combined into a new course with a new menu. In the inter-disciplinary course there may be no reference to individual disciplines or subjects, and subjects are not identified as such in the timetable. (p. 555)

The final step on the Integration Ladder is Trans-disciplinary (Harden, 2000).

In trans-disciplinary, as in inter-disciplinary integration, the curriculum transcends the individual disciplines. The focus with trans-disciplinary integration for learning, however, is not a theme or topic selected for this

purpose, but the field of knowledge as exemplified in the real world. The teacher provides a structure or framework of learning opportunities, but the integration is done in the mind of the student, based on hi-fidelity situations in the real world of clinical care. (p. 555)

The Integration Ladder is designed to present a "...taxonomy which defines 11 steps between the two extremes of subject-based and integrated teaching" (Harden, 2000, p. 556). Providing a list of options for the teachers encourages them to explore the integration options and to determine which level will best fit their curriculum to better serve their students (Harden, 2000).

Benefits of Core-subject Integration

According to the results of previous research, "Agricultural teachers perceive that teachers and students benefit from vocational and academic integration" (Roberson et al., 2001, p. 12).

Student Benefits

"Career and technical education produces gains in academic achievement and earnings and represents a significant contribution to the education of America's youth and adults in preparation of a skilled workforce" (ACTE, 2010). Students benefit from core-subject integration because they become better prepared for the workforce, develop problem solving skills, receive meaningful instruction, gain more appreciation for agriculture, develop thinking skills, get reinforcement of basic skills, and gain more appreciation for academics (Roberson et al., 2001). The ACTE (2010) reports the following benefits associated with students enrolling in CTE:

- 1) CTE students achieve academic success
- 2) CTE students experience increases in earnings and improved employment outcomes
- 3) CTE reduces dropout and absentee rates
- 4) CTE students achieve postsecondary success

According to Venille, Wallace, Rennie, and Malone (1998), through integrated curriculum, students could identify common threads between different subjects, thus allowing for a stronger transfer of knowledge and skills between subjects. Furthermore, Hargreaves and Moore (2000) posited that integration increases the rigor and relevance of the classroom instruction by relating the content taught back to the students' lives (Brister & Swortzel, 2007). Daggett (2005) stated, "the student's ability to apply high-rigor knowledge in a relevant, real-world setting needs to be the true finish line..." (p. 1). Although there is little evidence linking an increase in academic performance to core-subject integration, there are other benefits that can be seen anecdotally. According to the ASCD (2002), boosted self-motivation, an increased ability to apply concepts, increased positive attitudes toward reading; enhanced self-confidence, reduced disruptive behavior, and increased use of higher thinking skills are all benefits of an integrated program.

Teacher Benefits

Teachers benefit from core-subject integration because it has instructional relevance and promotes staff communication (Roberson et al., 2001). According to Venille et al. (1998,), "Teachers felt that they benefitted by working in integrated

environments, because they could choose content to motivate and interest their students” (p. 299). Brister and Swortzel (2007), found agricultural education teachers believe “...that the integration of science in their programs increased the support received from administrators as well as parents” (p. 233). “Integrating science may be a good method of recruiting students into their program” (Thompson & Balschweid, 1999).

Current Integration Initiatives

Few CTE curricula effectively integrate STEM into the lessons. Lesson planning and curriculum design require many hours of labor intensive work to ensure the content taught aligns with state standards, dynamic and effective pedagogy is employed, and the content is relevant to the students’ lives (Stephenson, Warnick, & Tarpley, 2007). Teachers have various responsibilities other than classroom teaching and lack the additional time needed to research and effectively integrate STEM concepts. Most teachers are required to perform ‘other duties as assigned’ which limits their lesson preparation time.

In the past, curriculum (math-in-CTE) has been developed that integrates mathematics into CTE classrooms and the curriculum has proven to be successful (Stone, Alfred, Pearson, Lewis, & Jensen, 2007). The current math-in-CTE curriculum simply provides a framework for CTE teachers to follow to enhance math competencies in their classroom. This framework still requires teachers to research mathematical concepts and how they are utilized in their curriculum, requiring additional time and effort on the part of the teacher (Stone et al., 2007). Other curriculum developed, to help bridge the STEM education gap, is the Curriculum for Agricultural Science Education

(CASE) (<http://www.case4learning.org/>). The CASE curriculum contains lessons that align with the national standards for agriculture, science, math, and English language arts (<http://www.case4learning.org/>). The downfall of the CASE curriculum is the requirement for teachers to learn an entirely new curriculum sequence and completely change the format of their classes.

Perceptions and Barriers of Core-subject Integration in CTE

Previous research indicates agricultural educators and other educational constituents support core-subject and vocational integration (Balschweid & Thompson, 2002; Balschweid, 2002; Connors & Elliot, 1994; Layfield, Minor, & Waldvogel, 2001; Roberson et al., 2001; Thompson & Balschweid, 1999; Thompson & Balschweid, 2000; Thompson, 2001; Thompson & Shumacher, 1997; Warnick, Thompson, & Gummer, 2004). Even though core-subject integration is highly supported, there are still an array of barriers that hinder the implementation of core-subject integration within classrooms: time, lack of funding, lack of faculty support, lack of equipment and supply, planning, lack of instructional materials, and curriculum development (Balschweid & Thompson, 2002; Roberson et al., 2001; Thompson & Balschweid, 1999; Thompson & Shumacher, 1997; Warnick et al., 2004).

Lesson planning and curriculum design require many hours of labor intensive work to ensure the content taught aligns with state standards, that dynamic and effective pedagogy is employed, and that the content is relevant to the students' lives (Stasz et al., 1994). According to Sturko and Holyoke (2009), "many CTE teachers, however, do not feel prepared to teach this academic content because they received minimal training on

how to teach these basic skills in their classes” (p. 212). Loepp (1999) states that an extensive amount of professional development is required for teachers to effectively execute an integrated curriculum. Teachers have various responsibilities other than classroom teaching and lack the additional time needed to research and effectively integrate STEM concepts.

The barriers to integration identified in the agricultural education literature are congruent with those barriers identified in the math and science integration literature. Previous research on curricular integration has identified increased time, coordination of students, planning for instruction as a team, coordination of student assessments, availability of instructional models, availability of appropriate curricular materials, and lack of teacher knowledge as barriers that impede curricular integration (Hinde, 2005; Huntley, 1998; Lehman, 1994; West et al., 2006). According to Pang and Good (2000), “...integration of mathematics and science is one of the most daunting tasks educators face” (p. 78).

Even though integration is a daunting task, students involved in integrated programs “...do at least as well, or better, on the standardized tests than students in regular programs” (ASCD, 2002). Researchers do recognize curriculum integration is not an end in itself but a means of achieving basic educational goals” (Venille et al., 1998, p. 300), therefore “some forms of realignment and reinvention of subject boundaries can provide an expanded range of educational opportunities for young people...” (p. 301).

Summary

The literature reviewed for this study served as justification for the study.

Literature about CTE demographics, agricultural education demographics, educational standards and assessment, highly qualified teachers, and teacher collaboration all were reviewed to demonstrate the need for more academic integration in the schools.

Following the literature review in these areas, curriculum integration in general was explored which led into the review of literature of academic integration within the core-subjects as well as academic integration within CTE and agricultural education. Upon review of the literature in reference to academic integration within agricultural education, it was discovered that multiple studies have been conducted in regards to agricultural education teachers' perceptions about academic integration (Balschweid & Thompson, 2002; Balschweid, 2002; Connors & Elliot, 1994; Layfield, Minor, & Waldvogel, 2001; Roberson et al., 2001; Thompson & Balschweid, 1999; Thompson & Balschweid, 2000; Thompson, 2001; Thompson & Shumacher, 1997; Warnick, Thompson, & Gummer, 2004).

The perception studies conducted identified barriers that current teachers believe are hindering their ability to implement academic integration in their classroom. Little research has been conducted to address those barriers and how they can be overcome. The conceptual model below illustrates the linkage between the literature reviewed and leads into the problem addressed by this study, the current tools needed to be successful in academic integration, and what tools are needed to implement academic integration in the classroom (see Figure 2.2).

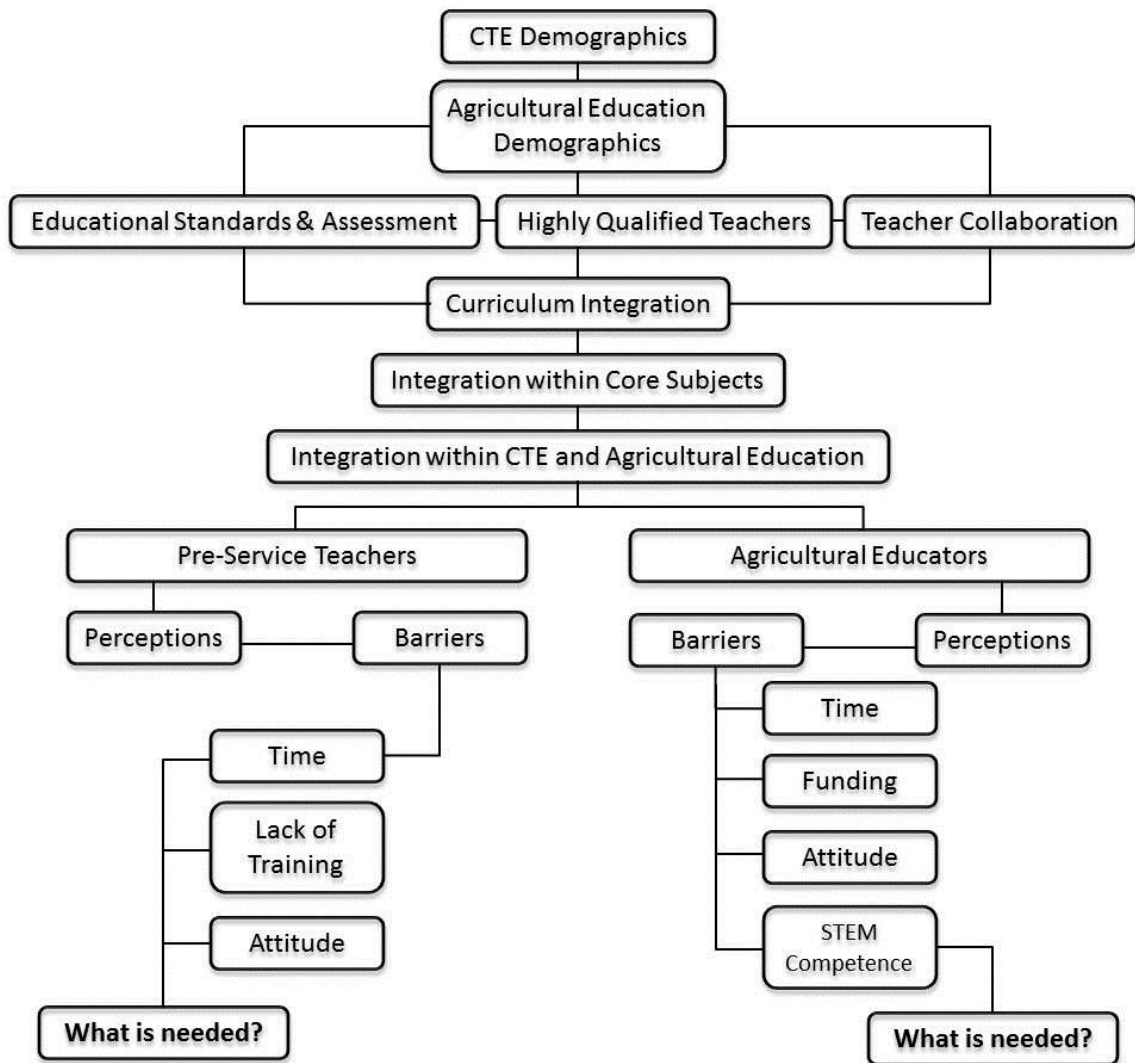


Figure 2.2 Conceptual Model Linking the Reviewed Literature to the Problem

CHAPTER III

METHODS

Overview

The literature reviewed in Chapter II identified the need for research to further explore the barriers that hinder the implementation of academic integration. Figure 3.1 illustrates the conceptual model for the study which focuses on the needs of current agricultural educators in the field.

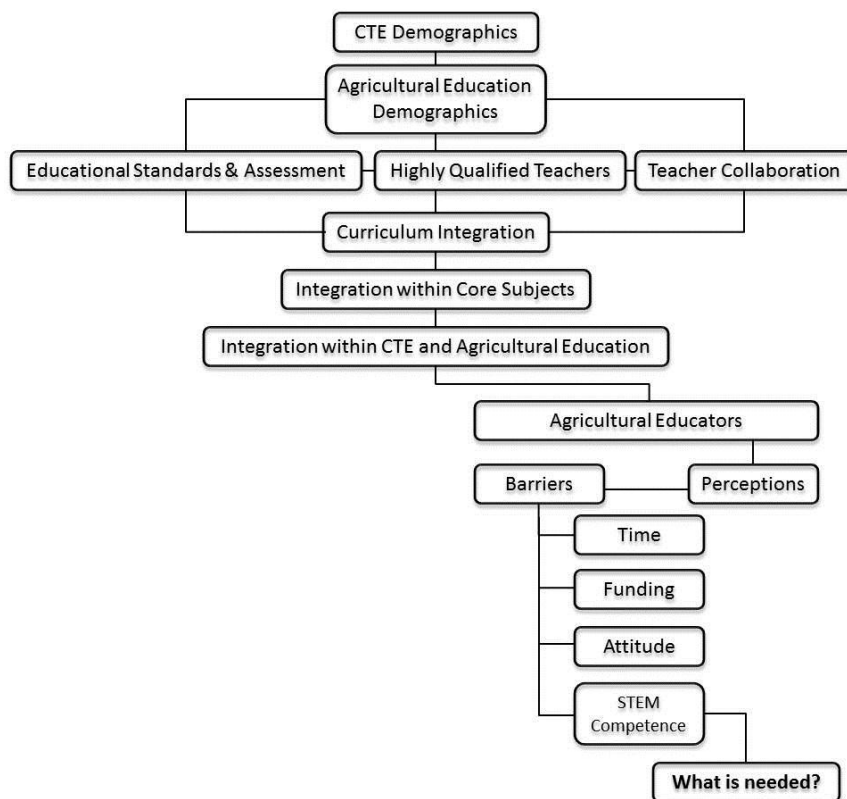


Figure 3.1 Conceptual Model for the Exploration of the Needs of Current Agricultural Educators

A comparative embedded multiple-case study design was employed for this research study. Agricultural educators from across the nation served as the population for the study. Six educators who were identified as progressive in the area of academic integration were selected as the sample. A screening process was conducted to select the six agricultural educators and each educator met operational criteria outlined by the researcher. Former students of the participants were selected by the participant to be part of the study through a snowball sampling method. The researcher performed site visits at each of the participants' schools and the data collection methods consisted of the following procedures: 1) Separate, semi-structured interview of site teacher; 2) Separate, semi-structured interview of former students; 3) Content analysis of multiple lesson plans; 4) Examination of classroom operating budgets; 5) Observational and physical inventory of site facilities.

A within-case analysis was performed for each individual case study. Interviews were transcribed and the constant comparative method was employed in order to unitize and categorize the data. A content analysis of lesson plans and operating budgets was conducted. Video footage and digital photography of the facilities, equipment, and available supplies were analyzed and the observations were recorded. The data was then triangulated to address internal validity and reliability of the data.

A variable-oriented cross case analysis was conducted comparing the results of all six within-case analyses. Matrices were created to assist in establishing converging lines of inquiry among the individual cases. An overall rhetorical narrative structure was

used to present the findings of each case study. Within the narrative, pseudonyms were included to provide anonymity for the participants of the study. Formal and informal member checks, peer reviews, an audit trail, and reflexive journaling were utilized to address trustworthiness.

Research Design

A review of the literature indicated that there was a lack of knowledge about how barriers hindering academic integration were overcome. Therefore, the researcher chose a case study design because:

- 1) Case studies are “particularistic” in nature focusing on a particular situation or case (Merriam, 2009, p. 43).
- 2) Case studies are used “...to retain the holistic and meaningful characteristics of...” (Yin, 2009, p. 4) the identified case.
- 3) A rich, thick description was desired by the researcher (Merriam, 2009).

According to Yin (2009), case study research design should be utilized when research questions are in the form of how? or why?, when the control of behavioral events is not necessary or desirable, and when the focus of the research is on contemporary events.

Yin (2009) states,

case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from prior development of theoretical propositions to guide data collection and analysis. (p. 18)

Additionally, “A case study is both the process of learning about the case and the product of our learning” (Stake, 1994, p. 237).

A comparative embedded multiple-case study research design, following the guidelines set forth by Yin (2009), was employed to answer the research questions (see Figure 3.2).

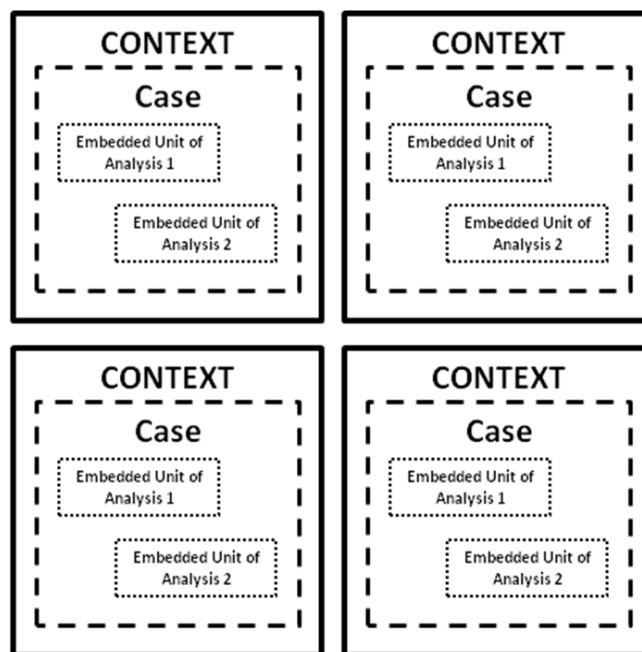


Figure 3.2 Embedded Multiple-case Design (Yin, 2009, p. 46)

“The evidence from multiple cases is often considered more compelling, and the overall study is therefore regarded as being more robust” (Herriott & Firestone, 1983 as cited in Yin, 2009, p.53). Multiple-case studies can be utilized to either; “a) predict similar results (a literal replication); or b) predict contrasting results but for anticipatable reasons (a theoretical replication)” (Yin, 2009, p. 54). For this study the researcher

utilized the multiple-case study design for literal replication purposes and to highlight individual lessons that integrate core-subject content. The embedded case study approach (see Figure 3.2) was used because the main unit of data collection was the teacher, but there are numerous sub units of data that lent credence to the data collected from the main unit of study (Yin, 2009).

Six single case studies were conducted to comprise the overall multiple-case study design. According to Stake (2006):

The benefits of a multicase study will be limited if fewer than, say 4 cases are chosen, or more than 10. Two or three case studies do not show enough of the interactivity between programs and their situations, whereas 15-30 cases provide more uniqueness of interactivity than the research team or readers can come to understand. (p. 22)

The context for the study was the agricultural education program. An individual teacher served as the case and the embedded units consisted of lesson plans, curriculum, operating budgets, facilities, supplies, and a student account of their experiences in the participants' classroom (see Figure 3.3).

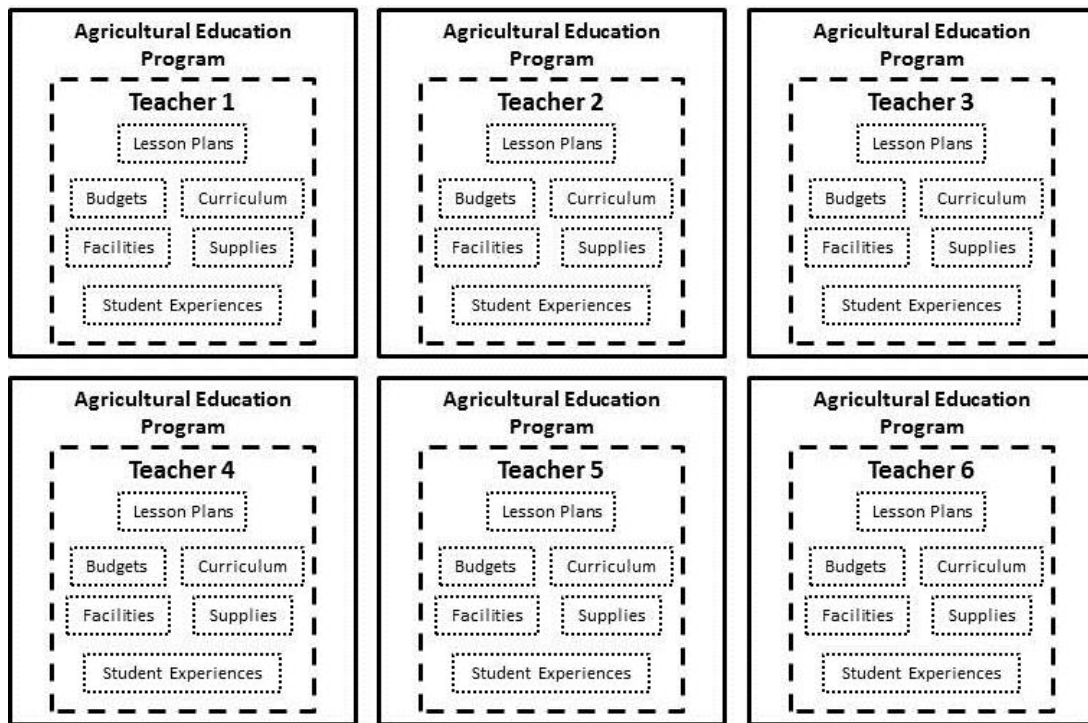


Figure 3.3. Embedded Multiple-case Study Design for Agricultural Education

Sampling Methods

A unique, purposive sample was selected from all agricultural education teachers from across the nation. According to Merriam (2009), “purposeful sampling is based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned” (p. 77). “A unique sample is based on unique, atypical, perhaps rare attributes or occurrences of the phenomenon of interest” (p. 78). Participants for each case study were initially identified by professionals (i.e. agricultural teacher educators, state agricultural education staff, and/or state FFA coordinators/directors), one from each NAAE region across the country who were directly involved with agricultural education teachers

within their region or state. The professionals were asked to identify three or more teachers who they believed were progressive within core-subject integration and who have served as leaders within their respective state.

The teachers were initially contacted via email to establish their interest or willingness to participate. Once initial contact took place, each teacher participated in a screening process to determine if the teachers met the operational criteria outlined by the researcher: 1) students in their classes could earn core-subject credit toward graduation; 2) the teachers were employing inquiry based learning methods in their classroom; 3) the teachers collaborate with core-subject teachers; 4) the teachers have a history of students competing in the FFA Agriscience Fair; and 5) the teachers were active members of the National Association of Agricultural Education (NAAE). According to Yin (2009), the goal of the screening procedure is to be sure that you identify the final cases properly prior to formal data collection” (p. 91). “Each case must be carefully selected so that it...predicts similar results (literal replication)” (p.54). The identified teachers were contacted, via the telephone, and were asked a series of questions in reference to their classroom and the content taught:

1. Can your students receive core-subject credit toward graduation for any of the courses you teach?
2. Do you use inquiry based learning in your classroom?
3. Do you collaborate with core-subject teachers in your school? If so, in what context?

4. Have your students conducted agriscience fair projects in the past and do you encourage students to participate in the FFA Agriscience Fair?

From the list of identified teachers, a total of six (one from each of the NAAE regions) were selected and individual case studies were conducted. Only teachers who met all of the operational criteria were selected. Once the final participant list was completed, the researcher scheduled a meeting with the participant and traveled to each of the participants' schools to conduct a site visit and collect data.

Prior to traveling to the participants' schools, a snowball sampling method (Merriam, 2009) was employed to identify former students of each participant. According to Merriam (2009), snowball sampling is the "most common form of purposeful sampling" and involves locating a few key participants who easily meet the criteria you have established for participation in the study" (p. 79). The participants were asked to identify and procure the presence of former students who were willing to participate in the case study and met the following operational criteria: 1) the students graduated from high school; 2) the students, while in high school, were enrolled in the agricultural education program all four years; 3) the students have taken at least two courses instructed by the participant; and 4) the student participated in the FFA Agriscience Fair. Participation in the FFA Agriscience Fair was optional because not all students are required to participate in the FFA Agriscience Fair. To ensure the teachers were able to find students willing to participate, participation in the FFA Agriscience Fair was made optional to avoid the disqualification of a few students who volunteered their time to participate. The aforementioned operational criteria were established to

insure the students had adequate exposure to the teacher's instructional strategies and course content.

Description of Samples

Agricultural educators from each of the six regions outlined by the NAAE, who were identified as progressive in core-subject integration, were selected to participate in the study. Each participant was teaching agricultural education in a public school setting where students could earn academic credit toward graduation by completing certain agricultural education courses. According to the participants, they were utilizing inquiry based instruction in their classroom and were collaborating with core-subject teachers when developing lesson plans and curricula. Participants were also required to have a history of their students participating in the FFA Agriscience Fair competition and regularly promote student participation within the agriscience fair competition. The former students identified by the teachers were high school graduates. The identified students were enrolled in the agricultural education program all four years of their high school career and took at least two courses that were instructed by the participant.

Data Collection Procedures

Similar to traditional mixed methods research designs, multiple methods of data collection were utilized in this study. This can be referred to as a "within qualitative mixed method study" (Klenke, 2008). According to Onwuegbuzie and Teddlie (2003), "...mixed methods analysis offers a more comprehensive analytical technique..." (p. 353). Yin (2009) outlines six sources of evidence that can be utilized to collect data in a case study:

1. Documentation
2. Archival records
3. Interviews
4. Direct observations
5. Participant observations
6. Physical artifacts (p. 102)

Each case study followed a consistent format of:

- 1) Separate, semi-structured interview of site teacher (Interviews)
- 2) Separate, semi-structured interview of former students (Interviews)
- 3) Content analysis of multiple lesson plans (Documentation)
- 4) Examination of classroom operating budgets (Archival Records)
- 5) Observational and physical inventory of site facilities (Physical Artifacts)

Documentation was used to “corroborate and augment evidence from other sources” (Yin, 2009, p. 103). For the individual case studies, the researcher conducted a content analysis of multiple lesson plans from each teacher to provide evidence to the components outlined in the descriptions of a typical integrated lesson plan as defined in the interview process. According to Yin (2009), “...archival records can be used in conjunction with other sources of information in producing a case study” (p. 106), therefore, the researcher performed a content analysis of participants’ classroom operating budgets to confirm the sources of funding mentioned throughout the interview process. Outlined by Merriam (2009), semi-structured interviews involve questions that “...are more flexibly worded or the interview is a mix of more and less structured

questions” (p. 90). A semi-structured interview format allows the researcher to adjust questioning throughout the interview process to “...respond to the situation at hand, to the emerging worldview of the respondent, and to new ideas on the topic” (Merriam, 2009, p. 90). The final source of evidence from which data was obtained took place through the utilization of physical artifacts. “Physical artifacts have less potential relevance in the most typical kind of case study. However, when relevant, the artifacts can be an important component of the overall case study” (Yin, 2009, p. 113). Physical artifacts were collected through a facility observation to obtain an inventory of the resources and materials available to each participant.

In opting for a “within qualitative mixed methods design” (Klenke, 2008, p. 161) rather than a “between mixed methods research design” (using both qualitative and quantitative methods) (Klenke, 2008, p. 162), the researcher obtained data from multiple sources with the intention of achieving purposes similar to the five given by Onwuegbuzie and Teddlie (2003) justifying the use of mixed methods:

1. Triangulation (i.e. seeking convergence and corroboration of results from different methods studying the same phenomenon)
2. Complementarity (i.e. seeking elaboration, enhancement, illustration, and clarification of the results from one method with results from the other method)
3. Development (i.e. using results from one method to help inform the other method)

4. Initiation (i.e. discovering paradoxes and contradictions that lead to a reframing of the research question)
5. Expansion (i.e. seeking to expand the breadth and range of inquiry by using different methods for different inquiry components) (p. 353)

The case studies all took place at the participants' schools. The researcher traveled to each of the six identified teacher's schools and conducted semi-structured interviews with each teacher in their classroom and semi-structured interviews with former students. The semi-structured interviews with the former students focused on the information learned as a student in the teacher's classroom. The student interviews also took place in the teachers' classrooms, but in the absence of the teacher. The interviews began with a series of questions and additional questions were asked for further clarification and probing (Merriam, 2009). Field notes were utilized to collect data from the interviews. The following questions were asked during the interviews:

Teacher Interview Questions

The following interview questions were developed after a thorough review of the literature:

1. Can you please provide an overview of your program?
 - a. How many teachers are in your agricultural education program?
 - b. How many students typically are enrolled in your program each year?
 - c. What classes are taught in your program?
 - d. Which Career Development Events does your chapter participate in?
2. How do core-subjects play an integral role in your curriculum?

- a. What core-subjects do you incorporate into your curriculum besides the ones you have already mentioned?
 - b. Does your school require integration within your classroom?
3. How do core-subject teachers assist in the planning of your curriculum?
 - a. What support does administration provide for collaboration among teachers?
4. What does a typical integrated lesson in your classroom look like?
 - a. Describe some of the labs you conduct.
 - b. Explain how you require your students to utilize the scientific method.
 - c. What chemicals, if any, do you use in your laboratory experiments?
 - d. How are your classes/labs funded?
5. How did you become progressive in core-subject integration?
 - a. Where does the funding evolve from for you to attend professional development activities outside of the district?
6. Can you describe your FFA/Supervised Agricultural Experience (SAE) program?
 - a. Does every student have an SAE program?
 - b. How do you link classroom, SAE, and FFA?
7. What tools/resources do other agricultural educators need to assist them in becoming progressive in core-subject integration?
 - a. What should pre-service teacher preparation programs be doing to better prepare future teachers?

- b. Who should be held accountable for providing tools and resources for core-subject integration?

Former Student Interview Questions

The following questions will guide the student semi-structured interviews:

1. What courses did you take from this teacher and what did you learn in those courses?
2. Do you believe your agricultural classes with this teacher enhanced your science and/or math knowledge? Why or why not?
 - a. Can you recall any specific core-subject concepts taught or emphasized in the agricultural courses you completed?
3. What specific teaching techniques did your teacher employ in their classroom which increased your learning and retention?
 - a. Did your teacher have a more teacher centered or more student centered approach to teaching?
 - b. Did your teacher encourage you to analyze and think about the content being taught?
4. What are your future career aspirations?
 - a. How did your teacher influence your future aspirations?
 - b. What did you learn in your agricultural courses which have or will help you reach your future career goals?

During the site visit the researcher performed a content analysis of five lesson plans provided by the teacher, documented available facilities and equipment, and took

inventory of the supplies located in the agricultural education programs. The content analysis of the lesson plans took place to identify inquiry based instructional activities. According to Krippendorff (2004), “content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use” (p. 18). “Content analysis provides new insights, increases a researcher’s understanding of a particular phenomenon, or informs practical actions” (Krippendorff, 2004, p.18). “Content analysis is a research tool used to determine the presence of certain concepts” (Klenke, 2008, p. 89). The researcher also obtained classroom operating budgets to determine funding available for instructional purposes and documented available facilities, equipment, and supplies through the use of digital video and digital photography.

Data Analysis and Interpretation

Data collected from the teacher interviews and the student interviews were transcribed and the data were unitized and categorized. Units are referred to as the “...smallest piece of information about something that can stand by itself, that is it must be interpretable in the absence of any additional information other than a broad understanding of the context in which the inquiry is carried out” (Lincoln & Guba, 1985, p. 345). The constant comparative method (Glaser & Strauss, 1967) was employed to categorize the data obtained from the interviews and the content analysis of the lesson plans. The constant comparative method allowed the researcher to repeatedly compare the responses with previous responses in an attempt to discover new relationships (Dye, Schatz, Rosenberg, & Coleman, 2000). According to Lincoln and Guba (1985), “the

essential tasks of categorizing are to bring together into provisional categories [units] that apparently relate to the same content...” (p. 347). The categories of data were sorted into emergent themes. Emergent theme titles were developed distinguishing each theme from the others (Erlandson, Harris, Skipper, & Allen, 1993). Continual revision, modification, and amendment were used until all data was classified into an appropriate theme. Negative case analysis was performed allowing for alternative interpretations of the data (Erlandson et al., 1993). Following the negative case analysis, the researcher bridged the data, linking emergent themes that include similar content. These techniques establish trustworthiness of the data collected (Erlandson et al., 1993). Two professionals within the field of agricultural education served as coders reviewing the researcher’s themes and suggesting revisions.

A content analysis of the facility video footage and digital photos was performed to determine the resources and supplies available to the participants. Operational budgets were examined to determine the source of funding utilized to provide the resources and supplies available for inquiry based instruction.

A within-case analysis took place to “provide a detailed description of each case and themes within the case” (Creswell, 2007, p. 75). Assertions were then made “...to interpret the meaning of the case studies” (Creswell, 2007, p. 75). After all data were analyzed, the within-case analysis continued, consisting of the triangulation of the interview data with the additional data collected through the facility observations, equipment and supplies inventory, the budgetary information, and the lesson plan content (see Figure 3.2). “Triangulation of data is crucially important in naturalistic

studies” (Lincoln & Guba, 1985, p. 283). According to Stake (1994), triangulation is “...a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation” (p. 241). Triangulation took place within each single case study to address internal validity and reliability of the data (Merriam, 2009). Stake (2006) states triangulation assures key meanings are not overlooked and that “each important interpretation...is supported by the data gathered and not easily misinterpreted by readers of the report” (p. 33). For this study the interview data were triangulated with the other sources of data collected (see Figure 3.4).

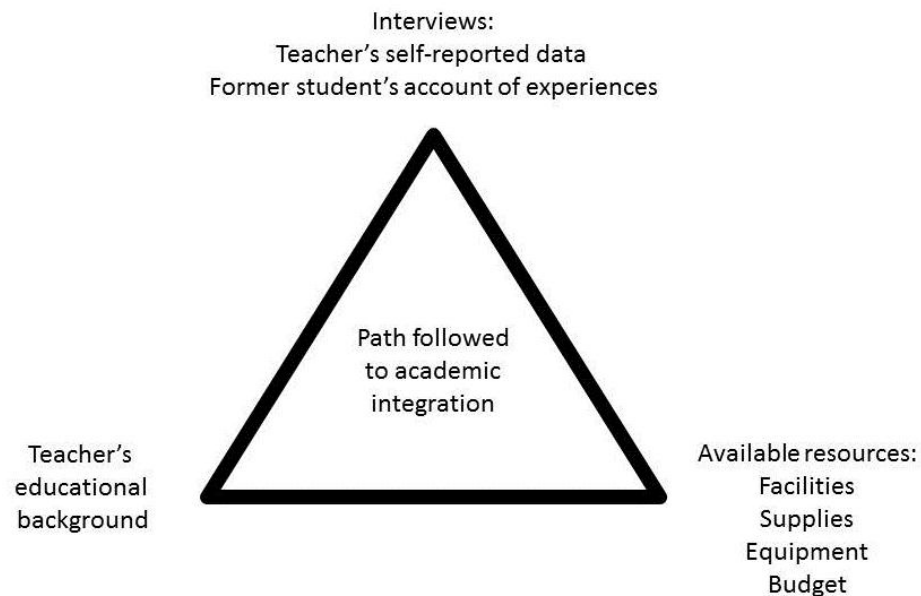


Figure 3.4. Model for Triangulation of the Within-case Study Data

Even though triangulation took place to support data collected, stand-alone data relevant to study appeared throughout the results. Stand-alone data may not be strongly

supported by a secondary set of data, but is relevant when addressing the research questions.

The data gathered and analyzed for the within-case analysis was then cross-referenced with the Integration Ladder proposed by Harden (2000), to determine the level of integration taking place within each individual program. Harden's Integration Ladder consists of eleven levels: Isolation, Awareness, Harmonization, Nesting, Temporal Co-ordination, Sharing, Correlation, Complementary, Multi-Disciplinary, Inter-disciplinary, and Trans-disciplinary. Each program was classified into one of the eleven levels of integration.

Following the within-case analysis, a variable-oriented cross-case analysis (Huberman & Miles, 1994) was performed to compare the results of the within-case analyses and establish converging lines of inquiry (see Figure 3.5) (Yin, 2009). According to Huberman and Miles (1994), variable-oriented cross-case analyses are "an often-used approach in finding themes that cut across cases" (p. 436). "Often a key variable comes clear only during cross-site analysis" (Huberman & Miles, 1994, p. 436). This strategy is "...called pattern clarification" (Huberman & Miles, 1994, p. 436).

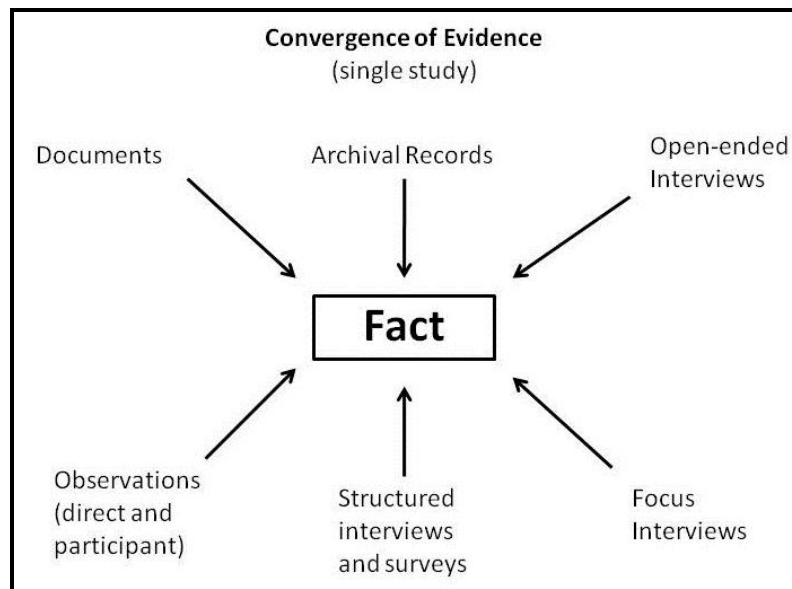


Figure 3.5. Convergence of Multiple Sources of Data (Yin, 2006, p. 117)

Matrices outlining the themes and categories from each single case study were developed to "...allow the researcher to analyze, in a condensed form, the full data set, in order to see literally what is there" (Huberman & Miles, 1994, p. 437). Following the development of the matrices, a content analysis of the matrices was conducted to identify converging lines of inquiry across the individual case studies.

Data Presentation

Pseudonyms were utilized in the results section to ensure anonymity (Holloway, 1997). According to Holloway (1997), pseudonyms are the names given to the informants of the study by the researcher or by themselves. They are fictitious names and should never be similar to the real names of the participants to safeguard anonymity... a number might disturb the storyline" (p. 130). An overall rhetorical structure was used when writing each individual case study (Creswell, 2007). Each

individual case study began with a vignette about each case and the community where each case study took place. Following the vignette, "...an extensive description of the case and its context..." (Creswell, 2007, p. 196) was presented. Throughout the extensive description, key issues were addressed. The research questions served as a structure for the organization of the description. Assertions were presented and a summary was completed and followed by a closing vignette that reminded "...the reader that this report is one person's encounter with a complex case" (Creswell, 2007, p. 196). Results of this study are only relevant to the participants of the study.

When addressing trustworthiness, Lincoln and Guba (1985) pose this question: "How can an inquirer persuade his or her audience (including self) that the findings of an inquiry are worth paying attention to, worth taking account of?" (p. 290). To establish trustworthiness of the data reported, peer reviews and member checks were conducted. Peer reviews or peer debriefing sessions occurred three times throughout the data collection/analysis process and memos were prepared (Erlandson et al., 1993). According to Erlandson et al. (p. 140), "...peer debriefing helps build credibility by allowing a peer who is a professional outside the context and who has some general understanding of the study to analyze the materials, test working hypotheses and emerging designs, and listen to the researcher's ideas and concerns."

Member checks were performed throughout the interview process to confirm the researcher's interpretation of the data collected. Following the analysis of the data, member checks were performed by emailing transcripts to participants and asking each participant whether the researchers' interpretations were accurate (Merriam, 2009).

Merriam (2009) stated member checks or respondent validation is utilized to “...solicit feedback on your emerging findings from some of the people that you interviewed” (p. 217). The purpose of the comprehensive member checks were to “...not only to test for factual and interpretative accuracy but also to provide evidence of credibility...” (Lincoln & Guba, 1985, pp. 373-374).

Additionally, the researcher kept a methodological and reflexive journal to track the details of the study as it emerged and to catalogue the researchers’ reflections including bias. The final trustworthiness verification method used was an audit trail (Merriam, 2009). “The audit trail is a major trustworthiness technique...” (Lincoln & Guba, 1985, p. 366). “An audit trail in a qualitative study describes in detail how data were collected, how categories were derived, and how decisions were made throughout the inquiry” (Merriam, 2009, p. 223). According to Dey as cited in Merriam (2009), “we cannot expect others to replicate our account...the best we can do is explain how we arrived at our results” (pp. 222-223).

Summary of Methods

In summary, a comparative embedded multiple-case study research was used. Six single case studies, which included a total of six teachers and 12 total students, were conducted to comprise the overall multiple case study design. The case studies consisted of two semi-structured interviews (teacher and former student), a content analysis of lesson plans, a content analysis of operating budgets, and facility observations and inventory. A unique purposive sampling method was used to identify six agricultural educators (one from each NAAE region) from around the nation. Data collected from

both the teacher interviews and the student interviews were transcribed and a within-case analysis took place. After all data was analyzed, the within-case analysis continued, consisting of the interview data being triangulated with the additional data collected through the facility observations, equipment and supplies inventory, the budgetary information, and the lesson plan content. Following the within-case analysis, a cross-case analysis was performed to compare the results of the within case analyses. Member checks and peer reviews were conducted and an audit trail was maintained to address trustworthiness in the study.

CHAPTER IV

RESULTS AND FINDINGS

Introduction

Six embedded case studies were conducted to comprise the overall comparative multiple case study design. The participants of the case studies were agricultural educators from across the nation, who were identified as being progressive in academic integration. To be classified as progressive in academic integration, teachers had to meet the following operational criteria outlined by the researcher: 1) science and/or math credit is available for students to earn for the courses they teach; 2) inquiry based learning methods are being employed in their classroom; 3) the agricultural educators collaborate with core-subject teachers; 4) the agricultural educators encourage students to participate in the FFA Agriscience Fair; and 5) the teacher is a member of the National Association of Agricultural Education (NAAE).

Each case study consisted of two separate semi-structured interviews: 1) the teacher and 2) the former students. In addition to the semi structured interviews, a content analysis of multiple lesson plans was conducted, classroom operating budgets were examined, and observations and an inventory of the facilities took place.

Pseudonyms were utilized in the results section to ensure anonymity (Holloway, 1997). An overall rhetorical structure was used when writing each individual case study (Creswell, 2007). Each individual case study began with a vignette about each case and the community where each case study took place. Following the vignette "...an

extensive description of the case and its context...” (Creswell, 2007, p. 196) was presented. The research questions served as a structure for the organization of the description:

1. What path did progressive agricultural educators follow to successfully integrate core-subject concepts into their curriculum?
2. What tools and resources are currently utilized in agricultural education classrooms that were identified as successfully accomplishing core-subject integration?
3. What tools and resources are needed for other agricultural educators to implement core-subject integration within their classroom?

The case studies are written predominantly through the eyes of the teacher and the students. Following case study number six, the results of a variable-oriented cross-case analysis are presented.

Case Study #1

The Larry High School Agricultural Program was selected for this case study for the following reasons: the program was recommended by both the teacher educator at the state land grant institution and the state Agribusiness/Agriscience Education Specialist; students in the Larry Agricultural Education Program can earn science credit for enrollment in certain agricultural education courses; students enrolled in the Larry Agricultural Education program regularly participate in the FFA Agriscience Fair and generally place well at the state, regional, and national competitions; Mr. Bates, the lead teacher of the program, regularly utilizes inquiry based instruction in his classroom; and

Mr. Bates works side by side with the science teachers in his school when developing curricula for the agricultural department. The case study was conducted during the summer months when school was not in session and students were not present, and the site visit was conducted within a half a day. Interviews with the lead teacher of the program and former students, teacher developed lesson plans, program budgets, and the facilities available to the agricultural education program, served as the data sources for this case study.

Larry High School is located in the Midwestern U.S. in a community with a population of 15,706 as of July 2009 (www.city-data.com). According to the U.S. Census Bureau, the community is classified as an urban cluster. A majority of the population is White (96.8%) with a median age of 34.1 years, an average household income of \$41,841.00, and a median property value of \$118,008.00 (www.city-data.com). The community is well maintained and certain neighborhoods have newer construction, particularly in the form of housing developments. According to Mr. Bates, the community is rapidly growing.

Larry High School is comprised of 1051 students in grades nine through 12 and has three agricultural educators in the high school and one agricultural educator in the middle school. Mr. Bates teaches in the high school and the following case study is based on the Larry High School. The high school is located centrally in the community, so many students can walk or ride their bike to school. Residential housing is in close proximity of the school building. The school grounds are well maintained and the high school building is made of the traditional red brick construction. As I pulled up to the

agricultural education department, I first saw the greenhouse that is connected to the back of the building and the entrance door to the school was located next to the greenhouse.

Once inside the school building, I began the teacher interview by asking Mr. Bates to describe his program and the curriculum he teaches. According to Mr. Bates, the Larry High School Agricultural Education program is vertically integrated and prepares students to enroll in the agricultural and life sciences program offered through the state's land grant university. Mr. Bates' students can start taking agricultural classes in eighth grade, where they can take the fundamentals of agricultural science and business course and receive high school credit. The courses can be stand-alone courses, so students do not have to be concerned about fitting every class into their schedule throughout their high school career. Currently, there are 157 students enrolled in the three agricultural and life sciences courses offered in the program that are designed by the university, which are the highest level courses in the program. Even though prior courses within agriculture are offered, only about 50-75 of those students were previously enrolled in an agricultural class before entering one of the three agricultural and life sciences courses. The health care program in the high school requires their students to take the animal science class because of the applied materials and activities that take place in the class. The health science teacher does not believe she can effectively conduct these activities in her classroom due to the lack of knowledge and resources, and therefore requires her students to enroll in Mr. Bates' class.

The agricultural mechanics courses are also part of the vertical integration. According to Mr. Bates, they just installed all new equipment in their agricultural mechanics laboratory and are working with the Project Lead the Way program to incorporate robotics. They started with the ‘why’, and determined that they did not want the students to just learn the skill, they wanted their students to understand the concept behind the skill and how the skill works. The Larry Agricultural Education Department did not want their program to be a traditional agricultural mechanics program.

As previously stated, the program was founded on the ‘why’ rather than the ‘what’ and because of this, the program places a lot of emphasis on the state standards, particularly in the area of science. In fact, the state science standards serve as a foundation for the agricultural education curricula. The agricultural department heavily influences the science department, meshing the biology standards with the agricultural content. According to Mr. Bates, the agricultural educators and the science teachers are trying to horizontally integrate the Larry Agricultural Education program as well. He works with the science educators in the school to learn about their standards and then attempts to integrate and focus on the standards, which the science educators do not believe they cover well in their classroom or the standards that their classrooms do not allow them to address.

Our school has now adopted a process we are going to use for curriculum mapping. We have talked to science about this and they are going to pull in our standards and we are going to pull in their standards when we are doing that mapping. We are even trying to look at what our timing is. Science would really

like for us to make our fundamentals of agricultural science and business class...a prerequisite to their biology one. (Bates)

According to one of Mr. Bates' former students, taking Mr. Bates' classes enhanced their science and math knowledge because "...it brought it all together. We had to take regular math and chemistry with other teachers, but [his classes] were more of a visual aspect instead of here is the math problem, figure it out" (Maggie). Mr. Bates' classes were "...complementary to what we would learn in the rest of the core classes. Anything that we had covered in the core classes, he would go over..." (Alex). According to the students, Mr. Bates "...would pull out lessons from other classes and show us how it relates to ag" (Alex). "We learned a lot in chemistry, but then we used it in ag and we actually did hands-on stuff" (Zeth). The students stated "Mr. Bates was on top of his stuff..." (Alex), "...there were a lot times [the core-subject concept] may not have made sense in the regular class, but in Bates' class, when we were actually using it with something we were used to, it would make a lot more sense" (Nora). "[Mr. Bates'] classes were useful for the students who struggled in chemistry; it was a second chance for them to get it" (Maggie).

According to Mr. Bates, "you will not find any research that shows that having an agricultural program in a school, or any other elective, helps [the school's] test scores." The Larry School District is attempting to show that student involvement in the agricultural program helps to increase science literacy among their students and increase state science standardized assessment scores. Mr. Bates stated that "we have two years now [of data] that I would say is beginning to show some compelling reasons for that

(electives assisting with test scores), based on the biology one end of course assessments.” According to Mr. Bates,

86% of the students that passed the Biology 1 end of course assessment had taken our fundamentals course; our passage rate was not very good as a school. They are looking at that data and going, wow! We just got the data back [for last year], so I don’t have it all processed, but just eyeballing the students I knew, I think we are going to show that one more year. We are only on the second year with the end of course exams rather than state standardized test.

According to Mr. Bates,

What’s important is that we got our science department to realize that what we do related to their core standards is real important. We incorporate the core standards in... We have two courses developed now that we are using the standards folders of; here is where you are, and here are the standards you are getting. We can sit down with the parents and say that here is where your student is, and this is why your child is getting a ‘C’.

The state agricultural education profession has adopted the core-subject standards. Mr. Bates serves on the state’s Standards Committee for Agriculture, and he believes “[the committee] could throw out, in the agricultural and life sciences classes particularly, [their] own standards and draw in those core standards.” [Mr. Bates] believe that gives [agricultural education teachers] more validity, a lot of times, in what [they] do.” In other words, Mr. Bates believes in using the core standards as a structure

to the agricultural classes rather than just complementary. Mr. Bates feels the same way about math and English.

We do different things during the year, we do not have standards in the agricultural and life sciences classes on research reports, so what we have done is, we have teamed up with the eleventh and twelfth grade English teachers and developed our research report around what they do... We have worked with them, so we are using their structure for that; I start [teaching about research] the very first week of school, because we do research projects all the way through the year. There are some things I would like to tweak if I were doing it just for ourselves and not in cooperation. I like when we sit in staff meetings [and hear the science teachers] say that [their] research stuff is easy for those students who have already gone through [our classes].

Mr. Bates mentioned he has not worked much with the math teachers, but the agricultural mechanics teacher in the department has worked with the math teachers. The agricultural mechanics teacher has pulled in the some of the math standards and is doing some lessons, in each phase of the course, that address the math standards directly. Mr. Bates stated that this “provides more structure for what we are doing.” According to Mr. Bates,

It is just a mindset that we have taken and I wish we could get everybody to have that mindset that we are not this great thing, and we have to quit looking at ourselves as what we are doing [is perfect] and complimenting ourselves, and start to pull in those standards to be the structure. I would like to pull in even

more, I would like to be doing more with math, [a local agricultural company] got us our own copy of SPSS, I would love to be working with our statistics teacher with some of that, but the problem is with them finding time to collaborate and do that is really, really tough. I don't like that time excuse, but we need to be doing more than we are, we know we are ahead of a lot places.

When asked to describe what an integrated lesson in his classroom would look like, Mr. Bates described a lesson out of his food science course. He started out by describing the chemistry standards and how they extensively address pH levels; Mr. Bates feels that the chemistry teachers do a poor job of teaching about pH. He teaches pH based on root beer production and through a plant and soils lab where they "...are bubbling through oxygen with plants and change the pH that way." According to Mr. Bates, "...we get into a real extensive look at what changes pH." The lesson is "...an extension of what they have already learned, those students come away saying, now I understand why pH is important and why that affects the way things happen."

In the pH lessons Mr. Bates talks a lot about the bonding: covalent bonds, polar bonds, etc. He stated that "...it is basically a bonding lesson that goes into the pH." Root beer falls into that because the students "...actually use the yeast and the sugar to make the CO_2 , to make the fizz for the root beer and alcohol is given off, so [the students] do an alcohol test." According to Mr. Bates,

We always make one batch that is over so they can see how much yeast is there and how much sugar does make a difference. From a pressure stand point, as long as it is under pressure, that CO_2 stays in solution, but doesn't want to stay in

solution. Where we go with that is the practical route, once there is more alcohol, the acidic level goes up, and we are able to show all those things and the students are more engaged in that because they are making something they want to see the end product from.

Mr. Bates' students recalled the root beer lab and remembered that he accidentally left one batch of root beer under the light and it did not "taste that great" (Nora & Zeth). In addition to the root beer lab, the students also recalled a food science lab where they "butchered turkeys" (Zeth) and were able to see "...the whole process from live to consumption" (Maggie). During this food science lab the students were required to "...make a product to be marketed. We had to actually make the product and it had to be completely different than what was already made, we sent it off so it could get tested..." (Maggie) so a food label could be printed for the product. The students also recalled conducting research on the European corn borer and BT corn along with doing electrophoresis. According to the students, learning how to do electrophoresis "...was helpful because in botany at [the state land grant institution] we had to do it" (Alex).

Mr. Bates' students also recalled learning a lot of biology in his classes, in addition to electrophoresis. According to the students, "we learned a lot of bonds in foods" (Nora) and "...did a lot of chemical break down stuff" (Alex). The students stated that they learned about "anatomy and physiology with animals and plants" (Alex). They learned about "mostly every species" (Maggie) and almost "every system of reproduction" (Maggie). According to the students, they recalled Mr. Bates taught them

how to use Avagadro's number; how to use a punnett square; the process of DNA extraction; the path of the water cycle and hydrogen bonding; alterations of generations; adhesion, cohesion, and diffusion; and ATP, ADP, and cellular division.

When the students were asked how their involvement in Mr. Bates' classes affected their post high school decisions, all of the students agreed that in one way or another, their involvement has lead them to where they are today. Two of the students are currently enrolled as agricultural education majors at the state land grant institution, one is studying plant breeding and genetics, and the other student intends to enter a construction management program. One of the agricultural education majors began her college career as a landscape architectural design major, switched to horticulture, and finally found her way to the agricultural education department. According to her, she "...switched to ag ed because of [Mr. Bates]" (Maggie). The other agricultural education major stated that "I have always wanted to teach, it was always something I wanted to do, but once I had [Mr. Bates'] classes and saw how he taught and how much he loves his job, it made me want to teach the same thing" (Nora). The plant and breeding major, "holds [Mr. Bates] responsible for everything."

I was studying to be a civil engineer, before I got into [Mr. Bates'] classes.

When he got me involved in the research projects with [the local agricultural company], it was actually something I didn't want to do. I had always thought that genetic research was something that I didn't want to mess with and that it was religiously controversial, and I wasn't sure that I could be content with myself being a Christian and all. He showed me that I could achieve the same

results without genetically modifying anything, so that is what really got me interested, and now that I have seen that and done the research, I want to go out and be an advocate in the field and do the same things that they can do without something that is that controversial and find an alternative for GMO. I will give him that, he showed me that I could do good out of what I thought was bad, and it helps me because I really wanted to do something agriculture and they didn't really have anything that I thought I would like. He really influenced a lot of the decisions I have made in my college career. I am going into plant breeding and genetics and my classes emphasize the counter breeding to the genetic alterations. (Alex)

The future construction management major thought he knew that he was definitely going into construction management field, but “with the economy I was looking at a back-up and I was looking into ag genetics” (Zeth). According to him, “[Mr. Bates] taught me leadership skills and stuff like that, and wood doesn't just automatically get there. He taught me about trees and more efficient means” (Zeth).

Three of the four students interviewed have completed FFA Agriscience Fair projects during their high school career. The agriscience fair projects were all relevant to topics that the students learned in class. Two of the students (Nora & Zeth), conducted an FFA Agriscience Fair project together that centered on digestion and absorption of lipids. The project required the students to learn the process of “how fat was broken down and absorbed in the body and the bile was obtained from the pigs that

were brought in [by the one student]” (Nora). According to Nora and Zeth, they conducted

lots of tests to emulsify the fats. We weren’t exactly sure what tests to use. [Mr. Bates] knew how [to emulsify the fat], but we had to figure it out on our own; a lot of trial and error. At least 30 different trials, then we had to figure out the proportions, and he kept encouraging us to do it and supplying us with what we needed. We didn’t research a lot, it was more hands on. It wouldn’t have been exciting if he would have just told us how to do it, it was really exciting to see how one of them wouldn’t work and how adding a little bit of something how it totally changed, what occurred to the things when we would do it.

For his FFA Agriscience Fair project, the other student conducted research on a plant disease with the assistance of a local agricultural company. According to the student, “I helped with the research [the local agricultural company] was doing and talked about what could have been done with anti-GMO to develop resistance for disease” (Alex).

The former students who were interviewed believe that Mr. Bates is a “great influence on most of his students and gets those students who don’t really care about school interested in at least something” (Maggie). Mr. Bates “makes you step out of your box and do things you never expected yourself to be able to do (Nora); he is just one of those teachers you could just talk to about anything” (Maggie). Mr. Bates is “good at multi-tasking, he is working on his Ph.D; he is the main advisor of FFA; he does a good job at everything he does” (Zeth). According to one of the students Mr.

Bates always said, “The day he hates his job is the day he will retire, that has always stuck with me and that is one thing that I will always remember” (Maggie).

The Path Followed to Successfully Integrate Core-subject Concepts

Mr. Bates has 26 years of teaching experience and has taught at Larry High School for the last seven years. Mr. Bates’ path to becoming successful in the area of academic integration began when he first earned two bachelor of science degrees, one in animal science and one in agricultural education. Following the completion of his undergraduate work, Mr. Bates went on to earn a master’s of science degree in animal science, and is currently working on his Ph.D. in administrative leadership. Along his path, Mr. Bates earned his agricultural teaching certificate, but does not possess a science teaching certification. Mr. Bates is an articulate man who was willing and eager to be a part of this case study because the concept of academic integration is one that he enjoys and also believes is a problem that needs to be addressed within the agricultural education profession.

According to Mr. Bates, the agricultural education program at Larry High School is young and has just completed its seventh year in existence. Larry High School’s original agricultural program was closed in 1963. According to Mr. Bates, “when the Larry High School administration decided to reopen the agricultural program, they decided that they were going to do it the ‘right way’ in the beginning.” At the start of the planning process, the superintendent of the Larry School District was Mr. Bates’ supervising teacher during his student teaching experience and then served as Mr. Bates’ principal before moving to the Larry School District as the superintendent. The Larry

School District superintendent enlisted Mr. Bates to assist in the program planning process. At the beginning, Mr. Bates agreed to be a consultant for the program and did not realize that the superintendent intended for him to serve as the lead teacher in the program once it opened. Mr. Bates eventually learned about the superintendent's plan and was willing to fill the role of the program's lead teacher.

When the planning process began, the school district began designated budgetary funds in preparation for opening the program, thus allowing the proper tools and resources to be purchased so the program could accomplish the objectives outlined. In reference to the school's planning ahead, Mr. Bates stated, "we were able to do everything right from the get go". In addition to the school designated budgetary funds for the program, grants were also obtained to assist in equipping the agricultural education facilities with the resources necessary to meet the objectives of the program. The program is ahead of the curve in computer technology, because just under \$100,000.00 was obtained through grants specifically for technology purposes. Currently, the Larry School District is in the process of revamping and upgrading the technology in the agricultural education program.

In the beginning, the Larry School District administration met with students, parents, and community members to develop a course offering list for the program. The development of this list was approached from the 'why' rather than the 'what'. To clarify, the program planning committee designed the program by asking themselves, "Why are we opening an agricultural program?", rather than designing the program from the aspect of what does an agricultural program look like. This approach and model to

the development of an agricultural program was a little different than most approaches. According to Mr. Bates, local businessmen and community members seemed to enjoy the developmental process that included community input to insure that the program would address the needs of the community. When planning this program, Mr. Bates and the committee felt that there were a lot of things that could be offered in the program, but at the time Mr. Bates was involved with the university teacher educator in piloting and starting a new agricultural and life sciences program and that program ended up serving as the flagship for the course development of the Larry High School Agricultural Education Department.

According to Mr. Bates, “we wanted our students to have a dual credit program and a very hand-on applied chemistry/biology...oriented program.” Dual credit was sought after to assist his students in preparing for a post-secondary education. With the current course structure, students can complete the program with 10 college credits that are accepted at most universities in the state. The Larry agricultural program offers all of the state approved courses, except landscape management. There are plans to add landscape management into the course offerings, but Mr. Bates is not sure just how that is going to happen.

After listening to Mr. Bates tell the story of the conception of the program, I gathered that Mr. Bates was very proud of the Larry Agricultural Education program and his fellow teachers who have assisted him in building the program. He was eager to inform me of the program’s accomplishments and did so with a large smile on his face.

He was a very systematic individual and this was evident by his explanations of the procedures that are followed within his program.

According to Mr. Bates, “for a teacher to truly be a non-traditional program, very science oriented... [they] need to be very personally motivated to do it, because the state is not going to give [them] everything [they] need...” Mr. Bates had a slight advantage over some teachers, as his state “...has been very good about having agricultural and life sciences workshops” (Bates). The state hosts two workshops each summer on different topics and it is “...not just on content, but on inquiry based [learning]... which is real important” (Bates) when practicing academic integration in the classroom. Even though his state offers these workshops, he believes “you also have to do some professional growth types of things on your own” and “professional growth needs to be driven by the person.” For example, Mr. Bates spent two weeks with scientists from a local agricultural company, which employs his students regularly, so that he “could be more prepared.” Even though he knows that his program is ahead of a number of programs in the area of academic integration, Mr. Bates admits that he would still like to be further along in this area.

In addition to professional growth activities, grants also play a large role in the success of the Larry High School Agricultural Education Program. Mr. Bates tries to regularly complete grant applications and was recently awarded a teacher fellowship grant that totaled \$50,000. This grant was in collaboration with the state’s land grant institution. According to Mr. Bates, writing this grant “was a great thing for lots of reasons, [the land grant institution] dedicated a grant writing person to help me write the

grant, so I learned a lot from that stand point.” Bates stated that learning how to write a grant “...is important for a program like this, because the more grants you get the more you can do.”

The grant required Mr. Bates to team up with a professor at the state’s land grant university and exchange time and resources. Mr. Bates teamed up with the food science professor who teaches the class that relates to the agricultural and life science course from which his students can obtain college credit. One day a week, Mr. Bates would travel to the land grant institution and teach part of the class that the food science professor was teaching. The food science professor would then travel to Larry High School and teach Mr. Bates’ students once every other week (due to time constraints he could not travel every week). In addition to the exchange of teaching time, Mr. Bates’ students had the opportunity to travel to the land grant institution and participate in the labs conducted by the food science professor and work side by side with the college students completing “the actual labs for those classes” (Bates). The students traveled to the land grant institution one time during each nine week session of school, so they received four opportunities to experience the college classroom. According to Mr. Bates, this was “...one whale of a learning process.” Furthermore as a result of the grant,

...a lot of workshops now that [the land grant institution] does in the summer are kind of geared around what we did with that project. Those professors [of the classes] that our students were testing out of need to be involved in the training,

because if we are going to have the students truly ready for those classes, they need to have gotten everything.

Mr. Bates is still very active in the grant writing process and was just recently awarded another grant, sponsored by SMART technologies, which is a result of him being named the state's educator of the year by the state's department of education. This grant totals \$10,000 and is not earmarked for any specific project. The school, in conjunction with Mr. Bates, has decided to renovate his room into a model 21st century classroom. This includes multiple SMART boards and the necessary supplementary equipment. Mr. Bates' school is extremely supportive and he knows "...that [his] school will provide [him] with other funds if needed, if [his] idea requires more than the \$10,000." He is "...proud of the way [his] school operates." In order for a program to truly be successful and become more like Larry High School, "...the school has to be committed to it as well." According to Mr. Bates,

A school is just as guilty if an ag program is not doing what it needs to be doing, if all they are doing is saying this is what we want you doing, but aren't going to give you the support to do so. Teaching agriscience at the level that I feel it needs to be taught at, is not cheap.

Tools and Resources Currently Utilized in the Agricultural Education Classroom

The Larry High School Agricultural Education Program "...has a classroom operating budget of \$18,000 a year for all three teachers at the high school and \$5,000 a year for the middle school program" (Bates). Mr. Bates recognizes that this budget "...is great compared to most schools, all schools." According to the Mr. Bates, the

program has 585 students enrolled for this school year, so when you look at the total dollars that are being brought into the school, it is a "...chunk of change..." The Larry Agricultural Education Program is blessed with state Perkin's funds. Each year, Mr. Bates meets with the school district's business manager and creates a budget for the year. The Perkin's funds that come into the school go back to the programs which generated them. According to Mr. Bates, the school "...takes care of us."

The Larry Agricultural Education Department consists of three fully equipped classrooms (Mr. Bates' classroom, an animal science classroom, and a horticulture classroom), an agricultural mechanics laboratory with a classroom area, a greenhouse, an outside ornamental garden area, a small storage room, and a chemical storage room, which is shared with the science department. As a result of the operating budget and the grants, Mr. Bates has a "fully supplied science lab at [his] disposal..." Prior to beginning this school year, Mr. Bates' classroom consisted of individual student desks; a laptop for each student that was bought with grant money; six lab stations that were equipped with gas, air, water, and ventilation hoods at each station; an eye wash station, cabinet storage along the back wall; and a teacher work station located at the front of the room. At the beginning of this school year his room will have two SMART boards on the back wall and a SMART board on the front wall, in order to have triangulation; the student desks will be replaced with tables and swivel chairs; I-touch will be installed at each student work area and scales that attach to the I-touch will be available; a student response system will be installed; and the six lab stations will remain in the room. The purpose of the three SMART boards is to eliminate the concept of a front and back of the

room. By having SMART boards on both walls, allows the students to focus their attention whichever direction they are most comfortable. The teacher workstation will be eliminated to assist in achieving this goal as well.

The animal science and horticulture classrooms were very similar in their design and available resources. The animal science classroom contained 30 individual student desks, a whiteboard in the front and rear of the classroom, a bulletin board on the side wall, three upright storage cabinets, and a teacher desk located in the front of the room. The horticulture classroom contained 24 individual student desks, a whiteboard on the front and rear walls, chalkboards on each side wall, a small floral cooler, two shelving units in the rear of the room, two storage cabinets, and a teacher work station.

The agricultural mechanics classroom had 25 individual student desks; six, eight foot wooden work tables with open storage underneath; eight oxyacetylene fuel rigs; eight individual metal welding booths equipped with either a MIG welder or shielded metal arc welder, and each individual welding booth has a self-contained ventilation system that recycles the air rather than piping it outside; a radial arm saw; a band saw; a metal shear; and ten individual tool storage cabinets. All parts of the available facilities were well kept and organized.

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

According to Mr. Bates, there needs to be a mindset change among agricultural education teachers before much else can change. He states “there has to be a little bit of a different mindset...[teachers] need to understand the why” behind their program

because currently many “other programs look at their program as a what.” Mr. Bates believes a mindset change has to begin with a change in the “framework of those programs.” According to Mr. Bates,

...it would be incredible if ag had a set of national core standards that all states accepted. The whole mindset change comes down to educating all of our ag educators in that the core standards in science, chemistry, and biology are very important and that they have a part in those ag classes.

In addition to the core set of standards, Mr. Bates believes there needs to be “...some type of curriculum across the board where the standards are there; it almost goes back to a national curriculum mapping.” This is not Mr. Bates preferred solution to increasing academic integration, but he does believe that it would help other teachers in the process. The reason he is not a big fan of standardized curriculum is because he has noticed new teachers entering the profession tend to want to teach “...canned lessons...” New teachers have the mentality of: “I can go on the internet and get what I need” (Bates). As opposed to developing their own lessons or modifying lessons they may find. According to Mr. Bates, “knowing the mentality [of the new teachers] out there, we probably need more of those kinds of things for them to use that are truly standards based for teaching science in the context of agriculture...”, but “it has to be something very useable, more project oriented.”

Mr. Bates also believes a mindset change needs to begin at the pre-service teacher level. He stated that the local land grant institution will admit they are not teaching the pre-service teachers enough about academic integration. Because our pre-

service teachers are not receiving enough instruction on the topic of academic integration, there is a "...fear of the unknown..." (Bates). "The whole project based, inquiry based learning, needs to be incorporated into the pre-service teacher curriculum" (Bates). Mr. Bates does not think "we need to spend our money on the more experienced teachers, because they are either going to make the conversion or not. You could spend all the money that you want on these more experienced teachers..." but they "...are going to be what they were." For example,

I can take you to the other school in our county and you would find almost zero science and you could send him through all the training you want to, but he isn't going to change, unless [administration] either forces the change or he isn't there anymore.

According to Mr. Bates,

the thing that has probably helped me the most is that of cross collaboration with those core teachers. When you get those teachers involved that is when [academic integration] happens. That is why I don't think the separate [agricultural] building works.

Mr. Bates also has taken the time to make strong community connections, which have resulted in many opportunities for his students. According to Mr. Bates,

...the key component for us is [the local agricultural research company], which is a key component of the science integration in our program. Our students are doing actual research projects for them, because they don't have time to do it.

To accomplish all of this though Mr. Bates "...had to be willing to say, I don't know anything about XYZ and you guys do."

Summary

In summary, the Larry Agricultural Education Program is a highly integrated program and unique for the following reasons:

- Mr. Bates and the other agricultural education teachers work closely with the core-subject teachers within the high school to plan out the agricultural education curricula each year in an attempt to horizontally integrate the programs. Regularly scheduled meetings are held between the agricultural educators and the science educators to ensure curriculum alignment between classes.
- Students enrolled in three different agricultural education courses at Larry High School can earn science credit towards graduation
- Mr. Bates regularly utilizes inquiry based instruction to teach agricultural concepts in his classroom through the use of experiments that stem from current problems in the agricultural industry.
- Numerous students enrolled in the program participate in the FFA Agriscience Fair and conduct experiments that are highly scientific. A few of the students have worked very closely with a local agricultural business and have conducted agriscience fair projects that help to solve a problem that the local business is experiencing.

The data from this case study reveals that the Larry Agricultural Education Program can be classified as a complementary agricultural education program when

cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

The complementary approach has both subject-based and integrated teaching.

The integrated sessions now represent a major feature of the curriculum. These sessions are recognized to be, in terms of time, allocated resources and assessment as important, if not more important, than the subject-based teaching.

The focus for the teaching may be a theme or topic to which the disciplines can contribute. (p. 554)

Mr. Bates stated that in an attempt to horizontally integrate the agricultural education program the agriculture teachers and the science teachers meet each year before the students arrive and map out both the agriculture curricula and the science curricula, as a team. The agricultural department is a leader within the science program because they mesh the biology standards with the agricultural standards when planning out their curricula. The new procedures within the Larry School District require teachers to develop a curriculum map for each class they teach. The agricultural teachers and the science teachers take the time to discuss the curriculum maps for each of their classes and attempt to align concepts. The students are hearing and seeing the connections between the agriculture concepts and the science concepts simultaneously in more than one classroom.

By correlating lessons and working closely with the science teachers, the science teachers and other core-subject teachers have recognized the benefits that participation in agricultural courses have provided their students. In addition to the correlation of

lessons, Mr. Bates has been tracking agricultural education students' progress on the state science assessment through the collection and analysis of student data to see if students' participation in the agricultural concepts course affected student performance on the state science standardized assessment. At the time of the case study, only one year of data had been analyzed, and a positive difference was detected. The teacher claimed that he had skimmed over the most recent results and from initial glance; the teacher believes that the students, which had taken the agricultural concepts course, outperformed their constituent group for the second year in a row. As a result, science educators in the school would like the agricultural concepts course to serve as a prerequisite to the biology one course.

To assist in aligning the curricula between the classrooms, Mr. Bates infuses inquiry based instruction into many lessons he teaches. According to Mr. Bates, inquiry based learning can be recognized in his classroom by observing the numerous experiments that take place in his classroom. He claims many experiments begin as a practical agricultural concept and lead into an experiment. Additionally, when requiring his students to write research reports, his students are expected to follow the same guidelines that are prescribed by the English department and the science department to ensure consistency and repetition. According to Mr. Bates, he would have the students write the research reports slightly differently than the science department and the English department, but he wants to keep the instruction consistent between classrooms.

Students within the Larry Agricultural Education program, who are members of the Larry FFA, are highly encouraged to develop and conduct an agriscience fair project

to be entered in the FFA Agriscience Fair competition. Due to the frequency at which experiments occur in Mr. Bates' classroom, students become enthused about agriscience fair projects, and each year numerous Larry FFA members compete in the regional and state FFA Agriscience Fair competitions. The Larry FFA and Mr. Bates have a long history of winning entries at the state FFA Agriscience Fair competition and have represented their state at the national FFA Agriscience Fair competition.

Case Study #2

The Gavin High School Agricultural Program was selected for this case study for the following reasons: the program was recommended by both the teacher educator at the state land grant institution and a regional FFA coordinator in the state; students in the Gavin Agricultural Education Program can earn science credit for enrollment in certain agricultural education courses; students enrolled in the Gavin Agricultural Education program regularly participate in the FFA Agriscience Fair and generally place well at the state competitions; Mr. Chris, one of two teachers in the department, regularly utilizes inquiry based instruction in his classroom; and the Gavin Agricultural program is part of the science department. The case study was conducted during the summer months when school was not in session and students were not present, and the site visit was conducted within a half of a day. Interviews with Mr. Chris and former students, teacher developed lesson plans, program budgets, and the facilities available to the agricultural education program served as the data sources for this case study.

Gavin High School is in a community located in the Northeast U.S. with a population of 683 as of July 2009 (www.city-data.com). According to the U.S. Census

Bureau, the community is classified as a rural community. A majority of the population is White (98.7%) with a median age of 39.0 years, an average household income of \$56,302.00, and a median property value of \$155,551.00 (www.city-data.com). The community was small and the buildings appeared to be older in age. There was little to no evidence of a strong school spirit within the community.

Gavin High School is comprised of approximately 400 students in grades seven through 12 and employs two agricultural educators. The Gavin High School building was similar to many of the buildings in the community, such that it was also an older building with a few new additions. The agricultural department was housed in the older part of the high school building at the opposite end of the new additions. The high school building is located just outside of the town square next to the Gavin Elementary School and has residential housing across of the street from the school building. Gavin School District is rural and many students require some form of transportation (i.e. bus, parent vehicle, personal vehicle, etc.) to get to the school building each day. The agricultural department is housed at the opposite end of the building from the entrance into the school district property. When you first pull up to the agricultural department you see the greenhouse located on a little hill next to the road. Behind the greenhouse there is a set of solid double doors that lead into Mr. Chris' classroom.

To begin the case study, I asked Mr. Chris to first provide an overview of his program and the curriculum taught. According to Mr. Chris, the Gavin Agricultural Education Program focuses on all three elements of a complete agricultural education program: classroom and laboratory instruction, FFA, and Supervised Agricultural

Experience (SAE) programs. Mr. Chris mainly teaches animal science and the other agricultural educator teaches plant science and biotechnology. Mr. Chris tends to have a younger audience in his class, due to the nature and structure of the program. The second agricultural educator at Gavin High School mainly teaches students in grades 10 through 12. The Gavin Agricultural Education program includes seventh and eighth grade coursework, which Mr. Chris prepares and delivers. According to Mr. Chris, “I see about 120 students per day, some of those are repeaters. [The other teacher] sees 90 or so.” The Gavin High School runs on a traditional bell schedule, which means Mr. Chris teaches six or seven classes a day that are about 40 to 42 minutes in length.

Mr. Chris possesses a very energetic personality and answered the interview questions with enthusiasm and pride. When he talked about his students and how proud he was of their accomplishments, the volume of his voice would raise and he would become very excited. He appeared to love his job as he continuously smiled throughout the interview as we talked about something that he loved to do: teaching.

According to Mr. Chris, he tries “...to incorporate as much of each of [the core-subjects] as possible...” He stated that he incorporates the core-subjects from “...more of a traditional standpoint as opposed to a degree where [he is] actually looking at algorithms or something like that...” According to Mr. Chris, he incorporates “...science heavily, and the different sciences, as far as biology vs. physical science and chemical science, we have been integrating a lot more of those kinds of things than before.” In addition to the sciences, he stated “...math is a part of [the integration]...” as well. Mr. Chris explained that he incorporates English in his curriculum through

journaling activities and speeches and he tries "...to enhance [the agricultural curriculum] where [the core-subjects] are naturally incorporated." Mr. Chris' goal for this school year is to start incorporating more core-subject concepts and go beyond simply enhancing the lessons that he already teaches.

When asked about specific science and math concepts that naturally occur in the agricultural curriculum, Mr. Chris talked about "probability within genetics, balancing rations in nutrition, balancing chemical equations, and discussing chemical bonds." According to Mr. Chris, "we actually produced ethanol...in the classroom." Mr. Chris's student, Emma, stated she recalled one of Mr. Chris' classes was given the opportunity to make ethanol. She said that she wishes that she could have been involved in that process, but she did not take a class that year where biofuels were a topic. She said she had to opportunity to watch the ethanol making fuel process all week.

Mr. Chris talked about the incorporation of percentages and the discussion of pollution and titrations in the environmental ecology class. According to Mr. Chris, when you pull some of the [the core-subject concepts] into the class... [there] is a vocabulary that we have to learn to use in an ag classroom. That is one of our biggest misconceptions; that we as ag teachers don't use the science and math vocabulary. For instance, weighing something, well don't weigh something, mass it, what is the mass of it. I can give you a weight; it is around one pound, that's giving you approximate weight. But you want me to mass. I'll tell you what the mass is. That's the terminology that we really have to give them, that goes with math, we need to use that vocabulary in our classroom and then they

connect it when they are in that classroom with the vocabulary they are using there.

Increasing his usage of vocabulary terms directly related to core-subjects is “...going to be one of [Mr. Chris’] goals this year.” When asked to expand on the future goals for his classroom, Mr. Chris talked about adding in some new and innovative methods of disseminating materials to the students, particularly through IBI or inquiry based instruction. According to Mr. Chris, “[he] always professes that every good teacher questions students.” He just questions whether he is “...doing it to the right format...” and whether he “...can utilize that questioning technique better...” Mr. Chris believes that “...[the students’] reflection of what we have done... is a big part of [the questioning process].” Mr. Chris stated that,

I ask [the students] questions, but really how hard am I asking them to analyze that. One thing that I have done in the past that I really liked this past year, was I gave them the material for some of these labs that I have had done, and that I used to have everybody go through and do, and I made them come up with their own procedures without looking at one. There are some students that couldn’t come up with a procedure; there were some that had wonderful procedures for an experiment with the same materials that definitely were not along my line to get to the similar result. I was excited about that. The kids liked that, they saw that other people looked at it differently and saw it differently and that is what research is about, so I want to incorporate a little more of that in there, that I have not done.

In his classroom, Mr. Chris uses a few chemicals to teach his lessons, but it “...depends on the class and the content.” For example, in his veterinary science class this past year, Mr. Chris “...was able to get into ionic exchange and so forth, where as in the past, [he] never went that deep on potassium ions versus calcium and calcium pumps...” According to Mr. Chris, “...you got to kind of adapt it to the audience that you are addressing.” He also stated that SAEs allow for mathematics integration where the students “...are calculating net worth statements, [they] are looking at opportunity costs..., and depreciable inventories.”

According to Mr. Chris’s student, Emma, she “learned a lot about how genetics worked and everything with the plant and animal biotech and [she] got into the DNA and that kind of thing, some pretty detailed stuff.” Emma has taken his basic environmental studies course, his plant and animal bio-technology course, his animal bio-technology course, and his veterinary science course. According to Emma, she “could relate a lot of what [she] learned in Mr. Chris’s class to what [she was] doing in...” her other science courses. According to Emma, she “learned things in [Mr. Chris’s] class before [she] learned things in biology and vice versa, so [she] got a double dose of everything...”

One of the most memorable lessons Emma recalls was learning “...the pathway the air goes through from your mouth down to the lungs into the blood stream and how oxygen goes through there.” She also said they “...did a lot with how we make energy within our bodies, like the chemical formula or the equation that is used for that.” She mentioned that she “...learned how sodium works with the nervous system and just making that work.”

When asked about the involvement of the core-subject teachers in the planning process of the agricultural curriculum, Mr. Chris mentioned that the "...agricultural department is part of the science department" at Gavin High School. According to Mr. Chris, the "[teachers in the science department] sit down and [they] look through [their] planning, specifically this year [they] will be going through [their] science standards and so forth." Mr. Chris stated the science teachers determine

who is doing what, when, where, and how; then we... reevaluate who is going to do what and when they are going to do it. ...As far as, how do we incorporate them into our classroom... [this] is done more informally; for instance, discussions with the biology teacher in the faculty room, or in the office at the end of the day, or going down to her classroom and discussing stuff. Same way with the chemistry teacher, I can't tell you how many times I was in each of their classrooms at the end of the day this past year to discuss different things, where are you at, how do you present this, how can we do this together without just repeating. I have done this consistently with both of these teachers this past year. I have never done that in the past. I have talked to them in the past when I had questions, but this year it wasn't just how do you do this, how do you do that, it was what are you doing, how do you use this in your classroom, I don't want to do the same thing, but how can we enhance what the kids are learning there.

Mr. Chris feels that the science teachers are "very receptive" and he has not "...heard any reservations otherwise, even through students." He would not go as far to say that the science teachers are incorporating agriculture into their classroom, it is

mainly "...how [he] is getting it out of them" (Chris). Mr. Chris has questioned his students about the examples the science teachers use in their classroom and according to him "...some of [his] students pull [agriculture]..." into the science classroom when they ask questions. Mr. Chris listens to his students and "...if the kids are talking about [science class], and saying [they] just covered something like this with [the science teacher], that's when [he] goes and talks to [the science teacher] and [the two of them] sit down and talk about it." Mr. Chris believes there could be more organization implemented to help smooth out the integration process in his school.

Following the conversation about core-subject teacher collaboration, Mr. Chris proceeded to describe what typical core-subject integration would look like in his classroom. According to Mr. Chris, he tries to integrate all the time, where it is fitting. Some of his integration stems from "...teachable moments where a light bulb goes on and it is like 'OK' I am going to take this further." Mr. Chris believes integrating core-subjects into agriculture is "...kind of a mindset, see you have got to change your mindset and I want mine to be that, I am going to do it whenever, as much as I can, rather than necessarily organizing the lessons..." Mr. Chris stated "[he] tried this past year..." to write the integration into his lesson plans as much as possible and "...get as much of [the integration written] as [he could], where it happens."

Gavin High School is now requesting all teachers begin writing out their lesson plans, so those lessons can be taught again similar to how they were taught the previous year. Mr. Chris does not plan to teach each lesson the same as the year before; he is now in the evaluation process of his lesson plans and intends to modify each lesson to

incorporate even more core-subject integration, over the next few years. In Mr. Chris's eyes it is going to be "...a three to four year process..." before he reaches the point where he can just pull his lesson plans out and teach from them.

When asked to go further in-depth and describe specific highly integrated lessons that added rigor to his classroom, Mr. Chris revisited the time where he made ethanol with his freshmen students. According to Mr. Chris, before he learned about academic integration, "[he] would have never considered doing an ethanol experiment with a freshman class." Mr. Chris said in

...the chemistry that we did, we pulled in all types of chemistry, we actually almost had a chemistry lesson. Some of the students in there, my advanced students, had an intro to chemistry; others hadn't even... seen chemistry. It was starting from ground one, utilize the students that had it, they've seen it from a different perspective, they were like wait I didn't quite learn it that way, but then I'm like well can you?

According to Mr. Chris, the ethanol lesson "...was one example of where [he] hit on [integration] pretty hard, as far as chemistry." Mr. Chris then shifted his attention to his veterinary science class and stated "...biology is big time in veterinary science." He mentioned that

Vet science is a big anatomy and physiology class and you know it is almost your health class, or your biology class; however you want to look at it. The chemistry in the veterinary anatomy and physiology is just not learning the parts of stuff, but how are they actually working, what makes them work the way they

do, so you know muscle contraction, breaking that clear down, that would be an example of chemistry.

The biology integration was confirmed by Mr. Chris's student, Emma, when she was asked to describe lessons or labs that Mr. Chris conducted. Emma recalled the labs where "...they got to dissect a beef heart, lungs, and the reproductive tract." The students were given the opportunity to dissect a digestive system, and Emma stated, "[she] learned so much about how a cow's digestive system works." According to Emma, Mr. Chris "...gets the whole digestive tract of the cow and puts it outside and we slice it open." The students then proceed to "...identify the different regions of the stomach...the three regions of the small intestine, and the three regions of the large intestine." When discussing the digestive tract lessons and labs, Emma pointed out that they "...learned that the bacteria and the microbes that are in the rumen..." are "...really what starts the whole process and breaks down all the stuff that the cow takes in and then it moves on and all the lipids swept out."

When it came to the chemistry taught in Mr. Chris's classroom, Emma mentioned that chemistry was taught more in the lessons where they learned about the muscular and nervous systems. Emma remembered that "...calcium is needed to allow the muscles to contract, and without calcium, the muscles cramp up and they can't really move and that is what causes the disease, hypocalcaemia." According to Emma, "...we got a basic understanding and he did scratch the surface on the chemistry and a lot of biology. In the beginning we learned about the basic cell and the different parts of the cell..."

When thinking about other core-subjects integrated within his classroom, Mr. Chris stated “we don’t have a lot of ag math...” He mentioned that the Gavin Agricultural Department does offer a small gas engines and landscaping course, which “...is the only class that we have in the shop laboratory setting.” He has taught the class “...for the last two years.” According to Mr. Chris, he has “...pulled in the physics along with the chemistry, chemistry and fuel, the physics of how the engine works.” Mr. Chris said he talks “...about torque and stuff so...” he has started “...doing all this stuff on this math and it is just blowing them out of the water.” The students “...are like well I don’t need to know this stuff, but I’m like well yea you do. “Another example is masonry” (Chris). According to him, the

...kids love [masonry] and the reason they love it, is it makes them feel smart. They like to do the work, they like to work, so they go down there and they work. We pull that into the landscaping, because a lot of these kids will be able to do that on their own, on their own property doing what we cover in the classroom. We have done circumferences, you start talking about areas, surface, all those types of calculations that you pull into masonry, as far as figuring out how much concrete you need to do a circular pad for a silo or for your swimming pool or building garages, calculating all of the block that is needed in the core, those types of things. I had one math problem in there, where we were doing one math problem encompassing all those different areas, it took them easily an entire period to do, just that one problem. You know you go to a math class and those kids would have never ever attempted to do it and some of them weren’t

even sure they were going to attempt it in my class. Once you start breaking it down and going through it, you start jumping on your own wall here in the classroom and break it down. They were sponges, so that is the kind of stuff. Stream velocity when you start talking about stream velocity. Seventh graders you talk about densities and velocities and so forth and these kids, you know, it's not just stream velocity, it's what really is velocity, and you talk about that, so that's where you pull that kind of stuff in. I'm excited about it actually.

Mr. Chris then reverted back to talking a little more about biology integration.

According to Mr. Chris,

One of the other things is microbial growth, you start getting into biology, with microbial birth, we get into microbial birth on food sciences and things, and it is unreal, as far as kids doing a swab test of kissing disease or something. Just things like that, you start talking biology, what is micro-biology as opposed to just biology.

Emma confirmed Mr. Chris's teaching of microbial birth and mentioned learning about DNA and genetics. According to Emma, the class did a DNA lab where the students had to conduct "...a cheek swab kind of thing and mixed it with a bunch of stuff that pulled the genetic material out and [the students] could see it floating in a test tube..." She also "...got to see the DNA of an onion and strawberries."

When asked to expand more on the labs conducted in his classroom, Mr. Chris mentioned the dairy lab he conducts. According to Mr. Chris,

with the dairy lab we go through all the different milks, percentages, fats, butter fats, creams, so we go through the milk. We go through comparing sherbets vs. ice creams. We look at the difference. I buy all these different ice creams, how they are packaged, what ingredient is in there, why do they use extenders and things like that. So you can get into some of your food science labels, learning how to read the labels.

He also mentioned his muscle tenderization lab in his animal bioscience class where the students are "...comparing microwave thawing vs. natural thawing, vs., refrigerated thawing." He also conducts a "...ground beef lab, where [the students] do the percentages of fats" and the students "...have a poultry lab where [they] do processed poultry. The different ways of processing and preserving, [the students] get into chemistry there with sodium nitrates and so forth." According to Mr. Chris, at one point he used

...salt peter to do the curing and everything right there, but with salt peter, it is kind of a dangerous thing in the classroom if you do it wrong. I'm trying to figure out how I can do it without necessarily [using salt peter], but you know you make your pork loin pink, but it still tastes like pork loin, or you would let it white and it would taste like a ham and kind of play with their heads a little bit. We would talk about why you need that and we would talk about the food science as far as the preservation behind pickling and curing and drying. So we go through all those methods of preservation and how that affects the meat or the

muscle. We look at all types of process food; we even do that in eighth grade too.

Mr. Chris also talked about an erosion lab conducted in environmental ecology. According to Mr. Chris, “we do erosion labs, we do pollution and run off, we do the stream velocity one.” In the erosion lab Mr. Chris talks about “...surface run off...” and how it is affected by “...different elevations, speed of the water, and what it takes with it.” According to Mr. Chris, “I don’t do this every year, but we test nitrogen that would run off with that and what’s in the soil.” Mr. Chris also

...lets [the students] develop their own topographical map on the floor with newspaper and plastic. One person is the rain; food coloring is the different types of things and situations. We put sponges down as buffers and they rain on it and you can see how a riparian buffer works. The sponge soaks up all the powder and different things like that; those are some situations with that.

The final examples Mr. Chris provided took place in his eighth and ninth grade classes. Mr. Chris said that “in ag exploration we hit on recycled paper, we do ice cream labs where we make it in a bag, we talked about endothermic and exothermic reactions.” He also talked about,

Quantitative vs. qualitative measurement, we hit that in ninth grade, with a bubble gum lab. That is one of my first labs, where I had them chew gum and mass it and we talked about terminology, we talked about how you graph stuff, is it a line graph, a bar graph? The process of research and scientific method, so we go through that with the bubble gum lab.

According to Emma, the students "...do more labs in [Mr. Chris's] class than any other class." She mentioned that Mr. Chris "...presented the material in every way possible, so [the students] were exposed to it in every way, more or less." Mr. Chris "...really gives us a lot of hands-on kinds of things, which most of the teachers don't do" (Emma). Emma stated that Mr. Chris "...is so energetic..." and "...always keeps the kids excited and he is really willing to adapt to whatever works best for the class."

According to Emma,

I know in a lot of our ag classes you get the kids that aren't so academic and seeing them actually understand scientific principles and staying engaged in the class, that is pretty impressive that he can do that because the other teachers don't seem to do it that well. He is so personable that there is not a kid in the school that doesn't like Mr. Chris, and because of that they respect what he says and they respect what he teaches us.

Emma stated, "he is not a just a teacher... he could be considered some of the kids' his best friend." Mr. Chris "...has such open arms and is always ready to help and listen. I know that if I had any kind of problems or issues, he and [the other teacher] would be the first people I would go to. They are like second parents."

Throughout Emma's time in the Gavin Agricultural Department, Mr. Chris has encouraged Emma to participate in various events and activities. One of those events was the FFA Agriscience Fair where Emma conducted two different agriscience experiments. Her "first year [she] did the effect of soil pH on plant growth." According to Emma,

I had some trouble changing the actual pH of the soil, but the idea was to grow plants in alkaline soil, neutral soil, and acid soil. That went alright, but since I had some trouble changing the pH, it wasn't the greatest experiment.

In her experiment, Emma "...tried to use lime." Emma said, "I tried to find acid soil and use lime to make it neutral and more lime to make it alkaline..." According to Emma, "Mr. Chris found two chemical substances used for the fish tank, which were supposed to make aquariums alkaline or acid. So we mixed that with water and mixed it with soil and then used a pH meter to check and see how it worked." The results of Emma's experiment showed that "...the plants grew and there was a difference between alkaline, neutral and acid, but it wasn't anything major."

Emma's second FFA Agriscience Fair project took place her sophomore year. She conducted an experiment to determine the "...effect of wheat, soy, buckwheat, and rye flours on the quality of bread." According to Emma, "[she] made wheat bread, bread using soy, buckwheat, and rye flours." Emma further explained that

we were mostly looking at how the different flours affected the breads ability to rise and get fluffy and everything. So we measured the height and length, the width and the volume by doing a displacement test and we did measurements to see how much it rose. We let the bread rise twice and we measured how much the bread rose each time and then measured the final baked loafs.

Emma stated, "[she] didn't get that much of a difference, as far as the size of each loaf and that kind of thing, but it was still a neat project to do and that also went really well at the agriscience fair." According to Emma, Mr. Chris

...was more of a guide, but we were responsible for the research, like he is not doing the project for us. He is there to help pick out a project and he is there to help us whenever we need it, but it is our responsibility to get it done and to not look like a fool whenever you are presenting it.

Emma's "...future plans include college." She is "...hoping to attend an out of state university. Majoring in something related to agriculture." Emma is "...thinking maybe veterinary, ag ed, or something with agronomy." When asked how her involvement in the agricultural program has influenced her future plans, she said "the vet science class..." had a big impact on her decisions because "...[she] really enjoyed learning about the anatomy." Emma said the "...digestive tract lab...was really gross, but... [she] wanted to get [her] hands dirty and [she] wanted to see what this is about." She realized from this lab that she wanted "...to do something that [she] has to be engaged in and not just sitting in an office and talking to a computer all day." According to Emma, "the animal parts and animal systems interest me and they don't gross me out. That was a big thing that I wasn't grossed out about this sort of thing and I didn't find it nasty but more interesting than some kids may have." Emma, "...shadowed a vet this year and [she] could relate a lot of what [she] learned in Mr. Chris's class to what I did with the vet..." During her shadowing experience, she

...did herd checks and ...when [they] did herd checks, the vet would talk to [her] about what she was doing, and whenever [they] talked about it in class [she] had such a better understanding of what [they] were talking about because [she] had actually gone through some of that.

The Path Followed to Successfully Integrate Core-subject Concepts

Upon arriving at the school, I was greeted by Mr. Chris at a set of glass double doors that led into the hallway where the entrances to the agricultural classrooms were located. Mr. Chris has nine years of teaching experience and Gavin High School is his second place of employment. To begin his path of becoming an agricultural educator and successfully integrating core-subjects into his classroom, Mr. Chris earned a bachelor of science degree in agricultural and extension education with a minor in animal science. He then followed up his undergraduate work by obtaining a master of education degree in agricultural and extension education. Mr. Chris possesses an agriculture teaching certification, as well as a general science and biology teaching certification.

When asked how he has advanced his knowledge in the area of academic integration, Mr. Chris stated, “professional development, [and] staying involved in the [State] Association of Ag Educators. I think that is a key, in addition to the NAAE.” He mentioned, “attending those professional development opportunities that [the state association and the NAAE] offer at each of those conferences and sessions is a big thing.” Mr. Chris has also learned a great deal working with the university staff and the state agricultural education staff. He said the university staff and the state agricultural education staff assist in informing him about “...what are we supposed to be doing in the CTE program.” Mr. Chris admits that “sometimes we lose track of the fact that [the state agricultural education staff] have this 190 page document that we need to be looking at; ...incorporating more academic standards and anchors into the classroom.”

Mr. Chris' master's education work helped him in realizing what he needed to be doing. According to Mr. Chris,

I did a wonderful project as part of my master's program, connecting all the standards and anchors to career development events in [the state]. Each one of those career development events is connected to environment, ecology, mathematics, science, reading, writing, and listening. [For] every one of them, I had specific examples. So anyone can just pull it off and take it to the administration and say this is where we are doing [integration].

Mr. Chris also mentioned that working with the science department has really opened his eyes to the complexity of incorporating integration. He said by "incorporating more agriscience types of activities in the program to suffice for our science education program" has impacted their enrollment. Mr. Chris mentioned that the Gavin Agricultural Education Program "...doesn't have quite the number of traditional ag students" so adding more agriscience activities is "...a big thing." According to Mr. Chris, he had to heavily recruit students into the agricultural program when he first arrived. He said,

one of the things that I did do when I first came [to Gavin] was we used to have to go around and gather, I had these four classes that were empty, in other words, they were study halls, if I didn't go to study halls and pick up kids for like an intro to ag class. It was in eighth grade. So we went, and I worked with guidance and administration and now anybody that is not in band or chorus as an eighth grader is automatically in ag exploration. So we've incorporated a new

class there. Those classes went from three classes of about five kids, to fifteen kids, to about forty kids a year. So we over doubled that number.

In addition to NAAE and the state agricultural educators association, Mr. Chris has also "...joined a new organization..." and has "...attended the National Science Teachers convention." According to Mr. Chris, "I think anybody that is an ag teacher should be a part of [the National Science Teachers Association]." Mr. Chris is very thankful NAAE and the National Science Teachers Association (NSTA) "...are partnering together this year and trying to come up with incorporated dues."

Mr. Chris is very active in professional development workshops and has "...presented IBI at national levels, at national convention, NAAE, I was at the national science teachers' convention in Philly, and I will actually be attending [the NSTA convention] out in San Francisco to present..." Mr. Chris "...thinks those kind of things really keep your interest, being a part of this group that I was just at. I guess just one of the biggest things is changing that mindset too as a teacher coming into it."

According to Mr. Chris, his "administration is supportive of [his professional development attendance]..." and "...would pay for substitutes and allow [him] the opportunity to go, which doesn't always happen." Some of the presentations Mr. Chris conducts are paid for through the sponsors of the presentation. Some of the sponsors "...even paid [his] dues for the one organization, but [he] will be paying those [himself] this year."

Mr. Chris is also, "...hired by the ETS as an independent consultant." According to Mr. Chris, "the only reason [he works for ETS], is because [he] wanted to be actively

engaged in what student teachers are facing as far as testing across the nation. So [he is] helping [ETS] rewrite [the student teacher test] and reevaluate that program.” Mr. Chris has learned a lot through the reevaluation process. According to Mr. Chris, “[he] had to diversify [himself] just to understand [the national] test and that enabled [him] to grow and that allows [him] to relate to [his] students in the classroom.” Mr. Chris said “...it all comes back to if you can relate to kids in the classroom and explain those things that make it more practical and real to them...”

Tools and Resources Currently Utilized in the Agricultural Education Classroom

Mr. Chris has two classrooms, an agricultural mechanics laboratory, and a greenhouse available for teaching his classes. In addition to those teaching areas, the agricultural department contains an office and an additional storage room located in the agricultural mechanics laboratory. In Mr. Chris’s classroom, he possesses six foot tables with seating available for 25 Students. His classroom has a teacher work station at the front of the room and five lab work stations along the side walls. Each of the lab stations has a sink and cabinet storage both above and below the work station. In addition, the classroom contains six foot tall storage cabinets, multiple sets of shelving units, a full size refrigerator, and a microwave. There is a chalkboard located in the front of the room and Mr. Chris has access to an LCD projector, a videoscope, a digital microscope, and a computer to assist in teaching. Supplies within Mr. Chris’s classroom includes six microscopes equipped to view to the level of oil immersion, electrophoresis kits, centrifuges, a chemical testing kit, and distillation apparatuses. A majority of the chemicals utilized in his classes are stored in the flammable cabinet in the chemistry

classroom and Mr. Chris utilizes glassware from the other science teachers in the school to conduct experiments. Over the last few years, Mr. Chris has been slowly purchasing some glassware as he increases the science integration in his classroom. Mr. Chris said the biology teacher has just recently begun borrowing some of the agricultural department's equipment, because they have just learned of the equipment. Much of the equipment was purchased through grants.

The other classroom available to Mr. Chris contains six foot tables with space for 18 Students. The classroom is equipped with 13 computers located along the outside walls of the classroom and the department owns two laptop computers. There is cabinet storage above the computers and additional cabinet storage located at the front of the room in the form of six foot cabinets. Also at the front of the room there is a teacher's desk, a television, a chalkboard, and a SMART board.

Mr. Chris also has access to an agricultural mechanics laboratory. The agricultural mechanics laboratory contains an oxy-acetylene rig, a welding table, six welding booths that possess "cracker box" Lincoln welders, three 5' x 5' work tables, a metal cutting band saw, and metal storage along the one wall. Attached to the agricultural mechanics laboratory, there is a small gas engines storage room that houses all of the small gas engine tools and the engines themselves. Mr. Chris has 30 engines to use in class. The storage room contains shelving units along all of the walls and a shelving unit in the center of the room. There is also a flammables cabinet that houses all of the cans of paints that are utilized in numerous classes. The tools were all

purchased with grant money and the engines were obtained through the Briggs and Stratton Company.

The Gavin Agricultural Department facilities also include a greenhouse that encompasses over 500 square feet with a head house attached. Located in the greenhouse is an aquaponics system, heaters, and fluorescent lighting. The walls are all lined with metal work tables for plant storage. The head house contains a sink, a potting table, and attic storage. Mr. Chris mentioned there was a small storage shed on order, and it will be utilized for the community garden, maintained by the Gavin Agricultural Education Department.

When asked about the Gavin Agricultural Department's annual budget, Mr. Chris mentioned there was no prescribed budget for the program. He said the administration at the Gavin High School worked well with the agricultural department and if he or his co-teacher needed supplies or equipment they could simply submit a purchase order and the supplies or equipment would be purchased. According to Mr. Chris, in "our program we have a pretty decent budget." As a result of certain professional development workshops and programs, Mr. Chris has been awarded upwards of \$5,000.00 to be used to purchase supplies and equipment to conduct inquiry based instruction. Mr. Chris and his co-teacher are avid grant writers and much of the equipment is purchased through grant dollars. The budgetary information was confirmed when analyzing the budget forms that were provided by Mr. Chris. Mr. Chris also has a great deal of community support, which provides for additional resources when needed.

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

When asked about the tools and resources that other teachers need to be successful, Mr. Chris stated, “I think a big barrier is communication.” According to Mr. Chris,

A lot of [agricultural education teachers] are still; I’m the ag department, you are the science department. I think that misconception needs to be taken care of. I think they need to be actively involved in their science department. I think that is one of the first big steps in the communication among themselves on that. I think we need some professional development resources to show how it could happen. The unfortunate thing is that those one day workshops just don’t always cut it. I think they learn about it in a one day workshop, but then you need an extensive training program on integrating academics into science.

In addition to the professional development, Mr. Chris believes that “one of the biggest resources would be utilizing what other people have created.” Mr. Chris mentioned there is a

...website for power points, [but] what about something like that for ways you use it in your classroom. Activities that you put on, what is that community to practice that the National FFA has now, there could be something that could be utilized for something like that. That would be a big resource, using what other people are doing and how that works.

According to Mr. Chris, "...[learning what others are doing] is another thing that [he] came away with from professional development." He said "...it is like, ok this is how they are doing it, this is what they use, and this is how they do it. So then I could use that in my classroom that's probably the biggest way I incorporate it." Mr. Chris understands there are some programs struggling financially, but he stated, "the other way [agricultural teachers] can get supplies and things like that, if you can't afford it, you just make it up or develop it or you just don't do it." According to Mr. Chris, "Lab Aids has brought some of that to [his] classroom. [He has] been using some of their materials to utilize in the classroom. That has helped [him] get started. That is kind of one of those primers..."

Mr. Chris also feels there needs to be some changes made in the pre-service agricultural education programs. According to Mr. Chris, "...our pre-service [teachers]...go through the methods class and find out these methods and stuff and...they are not even exhibiting academics to that degree or informing them." Mr. Chris said "[he] thinks pre-service is a big part of it. Our Universities really need to reevaluate their pre-service programs. Not that they are bad, not that they are good." Mr. Chris does understand "when you add something, you need to take something away... But [in his mind] we need individuals...to continue to work on some of these things.... But not to just work on them, but [determine] how are we incorporating this in our pre-service education."

Mr. Chris also feels that in his state, the connection to CTE tends to get "...put behind..." Ultimately, Mr. Chris believes agricultural educators "...underestimate our

students at times” and the pre-service teachers need to be taught to realize this fact. Mr. Chris feels agricultural educators need to “...speak the language...” and he “...would love a professional development opportunity on speaking the languages.” He has a “...vision in [his] mind that it is not about Spanish and French...” and “...thinks you could literally sit down and have this wonderful workshop speaking different languages.” Mr. Chris hopes to do a professional development on speaking the academic language in his state in the future.

Mr. Chris believes the transition into a more rigorous agricultural classroom is a “...relational thing and it is a process. It is a systematic process in order to be used in the classroom. It is not going to just happen...” According to Mr. Chris, “it takes time and [he has] a personal goal of five years to see where the difference is in five years. That is [his] personal goal and [he] thinks [agricultural education] could really change in that context...” Mr. Chris said his state is localized in the control of curriculum within agricultural education. He said “some states are not as localized as [his state]” and feels because his state is so localized in the control of curriculum “[the agricultural teachers in his state] would have different barriers than a school that has an agricultural state curriculum. You are dealing with a state that has no state curriculum and dealing with a state that does, did they incorporate [core content] into their state curriculum?”

Mr. Chris also believes, for teachers to be successful in academic integration, the integration needs to be reciprocated by the science teachers. For example, Mr. Chris has “...two teachers, one that I was in high school with him...and a new one that is younger. [They] have been able to communicate both ways and [he] thinks that you need to get

agriculture into their classroom too, not that [he] wants to do away with [his] job or anything, but [the science teachers] need to be able to make that application.”

According to Mr. Chris, “everybody says that ag is where the application takes place, that’s why we handle kids differently than others, we don’t have any problems with them.”

Summary

In summary, the Gavin Agricultural Education Program is a moderately integrated program for the following reasons:

- The Gavin Agricultural Program is part of the science department within the Gavin High School which allows Mr. Chris and his teaching partner an open line of communication with the science educators within his school. Being part of the science department promotes collaboration with other teachers outside of agricultural education.
- Students enrolled in certain agricultural education courses at Gavin High School can earn science credit towards graduation.
- Mr. Chris regularly utilizes inquiry based instruction to teach agricultural concepts in his classroom through the use of inquiry based questioning as well as experiments based on the agricultural concepts taught in his classroom.
- Numerous students enrolled in the program participate in the FFA Agriscience Fair and have earned awards at the state and national levels. The students agriscience fair experiments have enlisted the help of the science teachers within the school to conduct the experiment properly.

The data from this case study reveals that the Gavin Agricultural Education Program can be classified as a nesting agricultural education program when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

Nesting occurs when a teacher targets, within a subject-based course, skills relating to other subjects. Content drawn from different subjects in the curriculum may be used to enrich the teaching of one subject. The term 'infusion' has also been applied to this stage of integration where teachers 'analyze the separate subject's goals and identify ways in which these generic skills can be refined into existing subjects.' (pp. 552-553)

Mr. Chris said he meets informally, as well as formally with the science teachers at his school. A large part of his interaction and collaboration occurs informally before or after school hours, following questions that arise while Mr. Chris is teaching or planning lessons. According to Mr. Chris, the entire science department meets a few times each year and those meetings allow both the science teachers and the agricultural teachers to openly converse and discuss curriculum. Mr. Chris has a good working relationship with the science teachers in his school and does not hesitate to stop by their classrooms and ask questions. Mr. Chris also encourages his students to discuss what they learned in the science classrooms during his class, because then he is able to make stronger links between the material being presented in the science classroom and the concepts being taught in his classroom.

To assist in connecting the curricula between the classrooms, Mr. Chris infuses inquiry based instruction into many lessons he teaches. According to Mr. Chris, inquiry based learning can be recognized in his classroom by observing the experiments that take place in his classroom as well as through the questioning techniques that he employs. Mr. Chris claims he infuses core-subject concepts into his classroom whenever they naturally occur in his curricula. Allowing the students to openly discuss the happenings in the other classrooms enables Mr. Chris to draw from the students' experiences and alter his teaching to insure that the students truly understand the link between the information taught in other classrooms and the content taught in his classroom. Many times student discussions can change the direction of a lesson within Mr. Chris' classroom and the planned lesson for that day is postponed.

Students within the Gavin Agricultural Education program, who are members of the Gavin FFA, are encouraged to develop and conduct an agriscience fair project to be entered in the FFA Agriscience Fair competition. Each year a few Gavin FFA members compete in the regional and state FFA Agriscience Fair competitions. The Gavin FFA and Mr. Chris have a long history of winning entries at the state FFA Agriscience Fair competition and have represented their state at the national FFA Agriscience Fair competition. Additionally, Mr. Chris has received the National FFA Agriscience Teacher award in the past and was recognized at the National FFA Convention.

Case Study #3

The Becky High School Agricultural Program was selected for this case study for the following reasons: the program was recommended by two agricultural education

teacher educators, one that is currently employed by a state land grant institution and one that has recently left the state to take a job elsewhere; students in the Becky Agricultural Education Program can earn biology credit for enrollment in the applied biology course taught by the agricultural teacher; students enrolled in the Becky Agricultural Education program are required to conduct science fair projects as part of the curriculum for the applied biology course and a few students have continued those projects and entered them in the state FFA Agriscience Fair competition; Ms. Gates, the full time agricultural teacher in the department, tries to regularly utilize inquiry based instruction in her classroom; and every teacher within the Becky School District is assigned to a professional learning community, and those communities meet regularly to discuss curriculum changes and needs of the students. The case study was conducted during the summer months when school was not in session and students were not present, and the site visit was conducted within one half of a day. Interviews with Ms. Gates and former students, teacher developed lesson plans, program budgets, and the facilities available to the agricultural education program served as the data sources for this case study.

The Becky High School is located in a community in the Southwestern U.S. with a population of 8,173 as of July 2007 (www.city-data.com). According to the U.S. Census Bureau, the community is classified as an urban cluster and still consists of numerous farms and dairies. The population race within the community is largely comprised of White (48.5%) and Hispanic (38.3%) residents with a median age of 30.0 years, an average household income of \$44,074.00, and a median property value of \$150,686.00 (www.city-data.com). The town is a bedroom community for the

neighboring city less than an hour away. Even though the town has become a bedroom community for the city, the number of students attending the Becky High School has recently declined.

The community is surrounded by agriculture, and the school building is located within the community with railroad tracks running behind school property and residential housing on the other three sides of the school property. Becky High School is comprised of approximately 1250 students in grades nine through 12 and possesses one full-time agricultural educator and one part-time agricultural educator. The school property was well maintained and appeared to be of newer construction. The school was constructed of white brick and there appeared to be ample space for instruction to take place. The agricultural complex was a separate building located behind the main school building. To reach the agricultural complex, you had to possess a pass or know the code to open the metal gate. Proper credentials were required to open the gate, because during the school day students were traveling outside of the buildings to get the agricultural complex. For students to traverse from the main building to the agricultural complex, they were required to walk about 100 yards in between buildings. When I first arrive at the agricultural complex, I was greeted by a large sign stating the agricultural department's name and there was a door into each classroom and another gate that you would be required to pass through to gain access to the outside portion of the agricultural complex.

In the 2009-2010 academic year there were 135 students enrolled in Ms. Gates' program. The Becky FFA is affiliated, so every student is an FFA member as well. The

Becky High School operates “...on a traditional six period day, 55 minute periods” (Gates). According to Ms. Gates, “next year [the bell schedule] will be on a 4 x 4 block”, and therefore her course sequence is going change. She currently teaches an introduction of agriculture and an applied biology course. Ms. Gates said, “after [the students] completed those [courses], they can choose from animal science, plant science, ag mechanics and ag business...” Ms. Gates mentioned, “there has been talk about letting students who have taken general biology, come over and take our third and fourth year classes, but they wouldn’t be completers by state standards, so [she] doesn’t know if that is going to happen or not.”

To begin the case study, I asked Ms. Gates to provide an overview of the curriculum she teaches within her classroom. Ms. Gates teaches an applied biology course in her program, which students can attain science credit towards graduation. According to Ms. Gates, “science...has the most prevalent role in [her] classes. It is also the easiest for [her] to make the connection” between science and agriculture. Ms. Gates stated, “...within the context of teaching ag, it is a really friendly way to teach science, because the kids don’t associate ag, at least my students don’t associate ag, with being a science.” She mentioned, “you can talk about things, and then [the students] come back and say, hey we talked about that later in the year in science or hey we tested on that in the state test.” According to Ms. Gates, “...science is real easy...because [she] is pretty familiar with the science standards; at least the biology related ones.”

In addition to science, Ms. Gates also believes “...reading and writing is super important. It is harder for [her] to teach literacy and writing strategies, but it is

something [she is] trying to do more and more.” She feels “...if kids can read and write, they can be successful in anything, it doesn’t have to be science or whatever.” Ms. Gates tries to incorporate reading into her classes often, but she “...does not use text books, so a lot of the stuff that [she] pulls in are articles or web stuff, where they have to go out and read something on the internet...” By incorporating reading into her classes, Ms. Gates is teaching the students how “...to summarize, or synthesize, or apply...” information they learned from the reading.

Ms. Gates has also “...tried some writing assignments and [she feels that she is] really terrible at teaching [her] kids to write.” According to Ms. Gates, “[she] has tried doing some collaborations with English teachers on campus, like just getting some help in writing lessons and help in teaching it, but it is totally not [her] strong point.” Even though it might not be one of her strong points, Ms. Gates said, “[her] goal is to have a writing assignment each semester, a sizable one that actually matters, but that doesn’t always happen.” Ms. Gates also incorporates writing when testing her students; she stated

...[her] kids don’t really like to take tests in [her] class, but [she] thinks it is another good way [for them] to realize what they are learning, and so they always have short answer essay type questions on their tests, because they have to be able to literate in their own words, stuff they have learned.

In terms of mathematics integration, Ms. Gates said, “...there is a lot of basic math...” included in her curriculum. She teaches a nutrition lesson that includes “...a lot of math...” For example, Ms. Gates provides the students with an “...excel program

where kids can play around and try to make their own rations. Lots of conversions, like average daily gain, conversions, those types of things.” Ms. Gates’ student, Kala, recalled Ms. Gates’ nutrition unit and stated that “...we had to go through and calculate what feeds had to go into what protein content...” Kala also mentioned the class “...did activities where [Ms. Gates] had us look at feed labels and we had to calculate and make certain rations for different scenarios.” Ms. Gates’ other student, Amy, also recalled learning about math through the genetics unit Ms. Gates taught. In class the students “...had to have a punnett square and calculate different things. [The class] talked about the math part and that was a huge thing that we did.”

Ms. Gates also teaches agricultural mechanics and is “...always surprised how some kids can’t measure...;” in her mind “...that is a life skill.” According to Ms. Gates, “in ag mechanics [she has] tried some stuff, like calculating application rates, fertilizer, measuring.” She claims “[she] is not really very comfortable teaching [higher level math], like geometry, but [does] a little bit of it in all the classes.” Even though Ms. Gates may not have been comfortable with the math integration, her students mentioned there was “...a lot of fractions and a lot of things of that sort, measurements” (Kala). According to Kala, “you know you learn that in a classroom, but when you actually have to put it to use, it just sticks.” Ms. Gates’ student, Amy, remembered a class contest in agricultural mechanics where each student “...had to come up with a different picnic table design and at the end [they] basically had to see whose could hold up” (Amy).

When asked about the planning process of the curriculum, Ms. Gates mentioned she has "...started incorporating the standards of those core-subjects that [she] is addressing." She believes "if there is nothing that is identifiable for me to list as a standard, like an English or a science..." then it "...obviously is not apparent in my lesson." According to Ms. Gates, "[she] has a notebook of other strategies and stuff that [she] tries to look through if [she] needs something to bring it together..."

In addition to the notebook, Ms. Gates is required to participate in a professional learning community once a week where she collaborates with some of the other teachers. In those meetings, the group has "...cross walked [the] ag standards to the state biology standards. We have shown them that here is our foundation, so we know what we are teaching and how it addresses [the biology standards]." According to Ms. Gates,

...all our students receive biology credits through the science fair at school. So if they had both of our classes, [biology and applied biology], they can count the one project for both classes and so we try to do some things at the same time. We have the same deadlines, like turning in proposals by the certain dates. This past year we had new biology teachers, so that wasn't the same. ...If I have questions or something that I don't know how to teach or answer, I typically just e-mail them. The English teacher, we haven't had any formal collaboration time, but it is just something like, hey I need some help with this or do you have a lesson plan that I can adapt for this?

Ms. Gates not only has support from the core-subject teachers, but also from administration. "One of [the Becky High School] counselors...taught biology and so she

comes in to observe and gives [Ms. Gates] some feedback” (Gates). Ms. Gates stated “in math there hasn’t been any formal collaboration.” She has also invited some community members to speak to the class and they have taken the time “...to help explain some things that are hard for [her] to do.”

Becky High school is transitioning from traditional bell schedules to a 4 x 4 block format bell schedule. When teaching on the traditional bell schedule, Ms. Gates “...typically starts with announcements, bell work, that type of thing...” According to Ms. Gates’ “...professional development trainer, the most important time is in the beginning and [she] is wasting far too much time in the beginning of the class...,” doing bell work and such. Because she was wasting time, Ms. Gates will “...probably do 20 minutes or so of content, whether it is notes or discussion...” in the beginning of class from now on, ”and then [she] will try to do something with it, where [the students] are going to take that content and either do some type of activity or do an extension of that on their own with some guided stuff.” For example, the guided work may “...be an article they have to read, or it might be just talking about this...,” or she will “...give them some independent time to either work on [the activity] and then wrap it up at the end, to kind of close the loop up.”

Now that the Becky High School is transitioning to a 4 x 4 block schedule, Ms. Gates is “...going to chunk it up more.” According to Ms. Gates, she learned at some of the professional development workshops (provided by the school) that she “...could do a learning theme. We could do a group activity and take some time to do that and not be

so rushed and then come back together and wrap it up and maybe preview for the next day.” For example,

if it is like the English component, reading, writing, that is how we are going to apply it to them. If I deliver the content or we did something where I presented a new topic, they are going to have to take something from that and read it or write it and extend it somehow. Using English and stuff, is kind of how we are going to do a guided activity, make it more concrete and apply it to them. They might have to extend some of it on their own. If I gave them some foundational knowledge... they might have to go and do some additional research on their own and then write something to synthesize and apply it. Science is probably way more integrative. Because it is not just, here is some ag info, and here is some science. From the get go, it is an easier union for me, whether it is notes or group activities, or reading. Science is way more integrative for me, but then I use the English stuff, more as a follow up to extend that or help them learn it better.

According to Ms. Gates, “[she] uses inquiry in labs and in [her] intro class. In [her] intro class, [she] does a lab, probably every other week.” Ms. Gates believes “this is probably going to change on block, since we will have a little more time.” She said “as far as [the amount] inquiry, that is hard for [her] to gauge. Because even with questioning [the students] and stuff, definitely a weekly basis, but trying to allow [the students] to do some independent thinking on their own...probably every other week or so.”

Ms. Gates has attended the inquiry institute hosted by Dupont and the National FFA. According to her, “a lot of the stuff [she] brought back applied to [her] classes”... and it “...fit right into [her] intro class.” Ms. Gates has “tried incorporating some inquiry stuff in [her] ag mechanics, but problem solving and building stuff kind of limits” the time for other forms of instruction.

When asked to describe an example lab she conducts in her classroom, Ms. Gates described a cell transport lab.

We did a cell transport lab using a chicken egg. I spent a considerable amount of time on...function and transport. It was a week-long lab and the students would spend about 15 minutes a day collecting data, checking on their egg and putting it in different solutions to see how it reacts. For the most part, I set them up at the beginning of the lab with some basic information. We go through and explain the concepts, but it is like in one ear and out the next. But then the next week they have to observe and take some quantitative data, but they also have to describe it and draw it. And at the end of the week-long lab, they have to go back and make some observations and have to explain what type of transport they are seeing and what caused it based on the data they collected.

According to Ms. Gates, the cell transport lab required the students to “...make a good conclusion supported by their evidence.” When asked about chemistry integration, Ms. Gates stated she did not get into chemistry too much in the cell transport lab, but she has done a lab in the natural resource class where the students learned “...how to extract metal from rocks.”

According to Ms. Gates' students, Ms. Gates "...did a big reproductive unit" and "...really taught us a lot about that." "Ms. Gates just made [the reproductive unit] so interesting with the activities she put with it and the videos and all the hands-on stuff" (Amy). To enhance the reproductive lesson, the class "...had a field trip that [they] went on. [The class] palpated and got to do stuff like that" (Kala). In addition to the reproductive unit, Ms. Gates also had the students conduct a herd management project where the students "...had to go through and pick out what cattle [they] wanted, which field [the cattle] had to be in, have the right ration and all sorts of stuff" (Kala) and then the students "...had to give an actual presentation. One group was given dairy cattle, one group was given hogs, and we had to go through that" (Kala). Ms. Gates also taught an artificial insemination (AI) class where the students "...were certified to AI after the class" (Amy). In the AI class, the students

...were taught about the technique and the overall dealing with the semen tank and with the semen and we went through and we had a reproductive tract; a heifer and a cow. We had to go through and figure out what it was and each part. (Kala)

When asked whether Ms. Gates' classes enhanced their core-subject knowledge, the students said they "...think it did, because they look at [core concepts] in a different way..." (Kala). According to Amy,

it is like a different aspect, when you are in math class, you are like ok well today I have to solve this equation, it is just giving me a headache, but when you

are in ag class and you are calculating something you know, it is something that I am interested in, something that is real, and I am going to use.

Kala then mentioned

...the science part is a completely different aspect and the math is a huge thing too. You just look at it in a different way, it allows you to think through it and problem solve rather than sitting with a book in front of you.

The students further expanded on the how Ms. Gates' classes assisted them in core-subject concepts. According to Kala, her knowledge of biology was enhanced, because in the anatomy class they went through "...the anatomy of humans and animals..." and "...actually put it to use for something, like breeding, or what feed you need to feed." Amy stated that "to go along with math, the record books helped a lot." According to Amy, "we had to do a lot of financial record keeping, keep track of our money. That was nice, because we got to see how it is going to be when we have money to keep track of." Kala then mentioned that "along with the record books...it was a more computer science thing too. You have to know how to work the spread sheet or learn how to use the power point or whatever you are doing at that time."

According to Ms. Gates' students, Ms. Gates "...was really good about bringing in people and helping get a new perspective on things" (Amy).

She is big on, hands-on [learning]. She will teach a lecture and then she goes through and shows us, or shows us a video or brings in a presenter. She is huge on bringing in people. When she can get the kids out in the field, I know she definitely goes out there. She is very, I guess, just friendly and the way she

teaches... is not forceful on you, but she is more relaxed and a good environment to be around. (Kala)

According to Amy, Ms. Gates is "...relaxed in a good way so that students want to learn. She just makes everything interesting and she brings in people. She has so much background herself, and she has just been everywhere." Because Ms. Gates has been so many places, "she has all the connections to bring in the people that you need to be around and learn from and stuff like that" (Kala).

"Ms. Gates is just a very caring person. She cares a lot about her students. So just knowing that if you have something wrong, you can go to her. Even if you have trouble in another class, you can go to her" (Kala). According to Amy,

I am with her more than any other teacher, because she is an FFA advisor also. She is just so loving and caring. You can just go to her for anything. We are with her all the time. She knows another side of us. At school she is our teacher. In the classroom, we talk about stuff like that. We get to know each other more outside. It is not just with me; it is with everyone.

Ms. Gates also

...keeps all the students organized. She has great ways in keeping her classroom organized. She has folders for all the kids. Her note taking is very easy to go along with and understand. She uses a lot of her resources and I think that makes her a good teacher. (Amy)

When asked to talk about the Becky FFA, Ms. Gates explained that "every student [enrolled in the agricultural department] is required to have a Supervised

Agricultural Experience (SAE) program and be a part of FFA.” According to Ms. Gates,

SAEs and CDEs are both required for the students, but do they all do them? No. The way that [she] incorporates FFA into academics is: there is an intro to ag course and FFA, and I spend probably six weeks on FFA and leadership, not just FFA, but leadership, what is it, how do you do it, speaking, that type of thing and then from there, there is a really short review at the end of each class.

In Ms. Gates’ classroom “there is a point scale that [the students] can earn points on and then that is incorporated into their academic grade. [A student] can’t get an ‘A’ without doing some FFA activities.” She also mentioned, “there are a few in class things that support the leadership grade too, because the point is to teach leadership and [she] would love them all to do FFA but they all don’t.” Ms. Gates has

...found the point scale to be helpful, because for [the students] it gets posted constantly, so [she] can see where [the students] are at, or where they are really involved. As for SAEs, [the Becky Agricultural Department] has [their] own computer lab, so [they] can do bi-weekly... updates on record books. Record books instruction is a part of every class.

Ms. Gates “...would like to do an SAE visit [for every student], but honestly [she] has never gotten 100% of SAE visits done.” She said in her program there are “...a lot of traditional livestock production oriented projects...” Ms. Gates mentioned, “a handful of kids grow crops on their farm with their families....”, but “we have about 35 kids with livestock projects of some kind.” According to Ms. Gates, “some kids

chose to go a science project route and keep track of it...”, but she is “...still trying to figure out how to do that and make it worthwhile.” She is

...trying to work out the details and some kids have chosen to keep track of their research and what they are doing. A lot of kids that are new to Becky High School, who live in tract homes, want to do small animal care, but they already have a dog at home, and they are like, yeah I take care of my dog.

Ms. Gates stated she is “...trying to work out some things, where next year it will be a portfolio system, where it is great that they have their dog, but they will have to do something that increases their knowledge.”

According to Kala, Ms. Gates “...has a lot of group projects. Not a lot of kids that are heavily involved really understand what FFA is about; it is not just about animals and showing. She really encourages them to get involved.” Ms. Gates “does incentives and is just very encouraging” (Amy). For example, “...for the freshman creed thing, the student that finishes the creed first and recites it in front of the class gets a free FFA jacket.” Ms. Gates “...tries to get everyone on a team and forces them to get involved” (Kala).

As mentioned by Ms. Gates, a few of her students have done science fair projects as their SAE project, but none of them have actually competed in the FFA Agriscience Fair competition. She stated “...they have participated in the school science fair, but our state one is during the summer, so it is like hit or miss.” According to Ms. Gates, “one kid really wanted to [participate in the state FFA Agriscience Fair], but had church camp, so he couldn’t do it and another girl, who had [an agriscience fair project], wanted

to compete, but she was on another team that was competing, so she was getting a little overwhelmed.” Ms. Gates “would really like to have someone [compete] next year, but, it is just a matter of getting them [to the state competition] during the summer...” One of her students

...grew oats under growing lights in a trailer that her dad helped her build...

[The student] cut it, so it was like green chop. She had bags of oats and she sent off samples to get tested for nutritional value and trying to determine what one was going to have better nutritional value for her sheep and goats and what was more affordable for her to feed.

Ms. Gates “...would like to see her [student] do [the oats project] a couple more times to work through some of the bumps that she experienced.” According to Ms. Gates, “a lot of [her] livestock kids wanted to do testing different types of feed, feed preferences, what affected gain. They would do that for a couple of months to see if there was a difference in weight gain.” Then “a lot of [her] freshmen, with cats and dogs, would do food preference, wet or dry.”

When asked about their future plans, one of the students (Kala) is going to major in dairy science at a land grant university outside of her state, and the other student (Amy) is attending a junior college majoring in biology in order to enter into an animal science related major later on down the road.

Kala was raised on a large dairy farm and eventually wants to become a large animal veterinarian, focusing on dairy cattle. She is attending a university outside of her state, because the universities in her state do not place a lot of emphasis on dairy science.

By attending this other university, she feels that "...it will be easier to get into vet school because [she] is right there. So [she] is majoring in dairy science and hopefully will continue into vet school specializing in cattle." When asked how Ms. Gates has influenced her future plans, Kala stated,

she has helped me a lot in getting there. It is something that I have been raised with, something that I have been goal driven for, but just going through her courses and learning more in depth, I think really pushed me towards the major that I am going towards.

Amy is currently enrolled at a junior college majoring in biology and plans to transfer at some point. According to Amy,

I have a lot of interest in biology and stuff like that, not sure where I want to take it. I kind of have a few different options, maybe taking it further and getting like an animal science degree or maybe like an animal nutritionist or something like that.

Amy mentioned,

...just being through Ms. Gates' class, has just really opened [her] eyes and [she] had never really thought about it before and it just really interested [her] and it was something that [she] could see [herself] doing; [she] knew that if [she] ever had any trouble [she] could always come back to Ms. Gates and use her resources and such.

Ms. Gates' classes

...opened [Amy's] eyes to what [she] was interested in. [She] never really thought of [herself] as wanting to do anything with animals or wanting to be a nutritionist or anything like that. [She] think the way [Ms. Gates] taught [her class] just opened [her] eyes to what [she] could see [herself] doing.

The Path Followed to Successfully Integrate Core-subject Concepts

Ms. Gates is the full-time agricultural educator in the department and has three years of teaching experience, all of which have been completed in the Becky School District. To begin her path to becoming a successful agricultural educator, Ms. Gates earned a bachelor's of science degree in animal science and then earned a master of science degree in agricultural education. Ms. Gates possesses an agricultural teaching certificate and is working on her science teaching certification. Ms. Gates is a young female teacher who exhibits a lot of drive and determination. She has a positive outlook on teaching and thoroughly enjoys her job. This was evident by the enthusiasm she displayed when answering the questions asked during the case study and when informing me of the numerous accomplishments within her program.

Beyond her formal schooling, Ms. Gates mentioned she is "...a conference meeting junkie, and [she] likes to go and learn new things." Her "...personal motto is continuous improvement. [She] wants to be better all the time." Ms. Gates teaches lessons "...once and [she] either fails or it is ok, but then [she] tries to make it better..." Ms. Gates "...knows that [she] is not going to be better if [she] is isolated and not asking questions and try going to things and try to figure it out."

Ms. Gates is continuously going to conferences and professional development workshops within her state and outside of her state. According to her, "...[the state teachers' association] has a teacher summer conference here, and [they] have a fall retreat...", and she attends "...both of those." Ms. Gates has "...gone to the National Ag Science and Integration Institute, but she has not

...gone to any literacy workshops. [She] is trying to get [her] principal to pay for [her] to go to [a literacy conference]. [She] would really like to go and receive intensive instruction on how to teach literacy, either in a science classroom or whatever.

Ms. Gates also claims she asks "...a lot of questions to teachers on our campus and veteran ag teachers; [she] e-mails people." She stated she is

...always on the internet trying to see what other people are doing. [She] asks ag teachers for their lessons, even though the content is always the same. [She] always want to see how they are introducing it or how they do it, and when [she] messes up [she] asks a lot more questions, because if it did not go very well [she] needs to know why.

Ms. Gates likes "...to gather a lot of information and make changes every time [she] does something."

Ms. Gates believes to truly improve and advance the field of agricultural education it is "definitely the whole idea of a community..." She believes educational community support

...is really important, because when [she] left [her] master's program... [her] group, [her] cohort, got along really well. The first year [the cohort] e-mailed a lot, like hey how did you do this, how did that go, so that was a nice safety net of people that [she] could go to and feel comfortable and say hey I messed up and what did you use.

Now that she is back in her home state, Ms. Gates is

...establishing a new community of people that [she] can go to and say, I'm trying this, or how do you do this, [she] thinks that is really important. [She] consistently goes to the same people, and has a group of five or six other ag teachers, [in her state] and other places too that [she] can ask for specific things all the time.

When asked about travel expenses and funding for the professional development activities, Ms. Gates mentioned, "both of [her] state level [workshops] in the summer and fall are funded by [her] district career tech director." According to Ms. Gates, her school has "...a phenomenal district director." Ms. Gates' career tech director "...also funds one out of state trip per year for each CTE teacher. It could be a national meeting or it could be a regional meeting." According to Ms. Gates, "if [she] wanted her [career tech director] to fund [her] literacy out of state meeting, she would, so we could attend one out of state meeting per year." "So far [Ms. Gates] has not paid for anything [herself]" (Gates). Ms. Gates also said the university, where she earned her master of science degree, puts on tech updates. The tech updates are "...a two day intensive thing

and [she] went to as a student just to go.” Her attendance at the tech update helped her some in the area of integration.

As previously mentioned, Ms. Gates’ career tech director is very supportive of her attendance at various professional development events, but Ms. Gates “...is not sure how much [her] principal...” actually knows, in regards to the number of days that she is not in the classroom, due to professional development. She realizes “...he lets [her] go when [she] wants to go,” but he has not “...questioned the number of days [she] has been gone.” Ms. Gates is not sure if [her principal] is really cognizant of [how many days she is gone]. She stated “if [her administration] kept a tally on their computer, every time [she] sent in [her] leave request, they might say no, but so far they haven’t said no, because [she] is still completing everything [she] needs to do.”

Ms. Gates also mentioned, while she was completing her master’s degree, she was required to “...to take a couple of classes in the Department of Ed and one of those was on content area literacy.” According to Ms. Gates,

[the course] was one of those courses that was a little bit boring, but you know the principles are excellent. There was a textbook that was solely on content area literacy, and as a part of that [she] had to take lesson plans that [she] had or create them and [she] had to incorporate those literacy strategies into it and into [her] objectives for it and that type of thing.

The required literacy course was “...really where [Ms. Gates] was exposed to a lot of [integration].” Ms. Gates stated she was exposed to a lot of “...different things too, what type of strategies were appropriate for what place in the lesson that [she] is

doing, like how to introduce it, or in the middle, or wrap it up.” According to her, “it was extremely beneficial to take that course.” Ms. Gates also attended “...a workshop on literacy” at the state agricultural teachers convention, while earning her master’s degree. In addition to the professional development work during her master’s degree program, Ms. Gates also learned a lot from the science teacher who has been attending the Dupont Agriscience Integration Institute with her and the others. Ms. Gates claims that

...the teacher for Agriscience Integration Institute is a really good science teacher, but she also is super into literacy as well. Everything that she has done, she was always telling us you could use this strategy, so she constantly, over the five day period, was exposing us to a ton of things to do.

Tools and Resources Currently Utilized in the Agricultural Education Classroom

Becky Agricultural Education Department is housed in an agricultural complex, detached from the main school building. The agricultural complex consists of two classrooms divided by a removable wall, an agricultural mechanics laboratory, a computer laboratory, a biotechnology laboratory, a livestock arena, a greenhouse, a storage shed, and a chicken coop. The entire complex is surrounded by an eight foot metal fence that attaches to the one side of the building and wraps around and attaches on the opposite side of the building.

Ms. Gates’ classroom consists of seating for 34 students, equipped with eight foot tables with chairs. The room has two whiteboards, one in the front of the room and one on the side wall. There are two magazine racks, two file cabinets, shelving units,

and a six foot upright storage cabinet. At the front of the room, close to the exit door, there is a teacher's desk that houses a computer. The classroom encompasses about 1600 ft².

The second classroom is equally as large as the first and can hold 34 students. This classroom is also equipped with eight foot tables with chairs. The second classroom contains a bulletin board on one of the side walls and a whiteboard on the front wall. There are six foot upright storage cabinets located in the front of the room along with book shelves and a teacher desk that is also located at the front of the room. Classroom #2 is equipped with a window into the biotechnology laboratory.

The biotechnology laboratory is used mainly as a food science laboratory. The biotechnology laboratory contains countertops along the back wall with cabinet storage above the countertops. There are two refrigerators, a sink, and a microwave in the lab. Along the back wall of the lab there is a whiteboard and there are two laminar air flow hoods located along the wall opposite of the countertops. Stored on top of the cabinets are ten compound microscopes that can be adjusted up to 100x.

Becky Agricultural Complex also contains a computer laboratory that has 25 student work stations and a teacher work station. There are two whiteboards in the room, one located on the side wall and one located along the back wall. Across the hall from the computer laboratory, there is a storage room, which has file cabinets and shelving units that house a majority of the FFA supplies and many classroom teaching supplies.

The agricultural mechanics laboratory encompasses 3200 ft² and is equipped with two overhead garage doors to allow for large projects to pass straight through the lab. The laboratory consists of five welding booths and contains 12 MIG welders, six shielded metal arc welders, and a TIG welder. The agricultural mechanics laboratory has a band saw, a drill press, a metal shearer, a flammables cabinet, tool cabinets, and two tool rooms. There are eight work tables in the lab, a set of lockers, and a welding helmet and jacket storage rack.

Outside the walls of the building, a 2400 ft² show arena that contains moveable bleachers, portable wire panels, and fluorescent lighting is constructed. The Becky Agricultural Department owns a set of small livestock scales and a set of large livestock scales, as well as two tractors that both have front end loaders attached and a small stock trailer.

The Becky Agricultural Complex also includes a 960 ft² polycarbonate greenhouse that contains two large fans for ventilation, a shade cloth, propane heaters, and six – eight foot work tables. Beside the greenhouse there is a chicken coop and an 8' x 16' storage shed.

A majority of the funding utilized to operate the Becky Agricultural Education Department is provided by the district and dependent on the total number of students enrolled in her classes. Ms. Gates charges lab fees for most of her classes to supplement her budget and works closely with her career tech director when additional funds are needed.

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

Ms. Gates believes one of the first things that needs to take place in the agricultural education profession before teachers can advance in the area of academic integration, is the teacher realization that “we are not just teaching ag, but everything is a natural extension.” According to Ms. Gates, “everything goes hand in hand,” and “we are not just teaching ag as an isolated concept or principle. Ag is integrated science, so teaching science is a great fit for that.” Ms. Gates stated that

teaching reading and writing are worthwhile in our ag programs. It makes our students better learners for us. I think making a case for it and helping them see that it is worthwhile, it is a good fit, and making a case for it is important.

Ms. Gates believes “...having good professional development is important in providing [teachers], not just the things for their tool box...,” but things they can

...take away from [the workshop] and they can just implement right away and use. But [she] thinks teaching [the teachers] the strategies and how to incorporate it and how to write lessons that include it [are important], not just, here is a really cool lab, but when you are writing your curriculum, here are places where you can put it in, in the beginning, or in the middle, or the end.

Ms. Gates also believes discussions among agricultural educators are another resource and method that would assist in advancing teachers. According to Ms. Gates, “any round table discussion or just sharing experiences...” helps her learn and advance, “...because [she] thinks a lot of times...ag teachers feel that they are isolated.” So in her

mind, "...it is important to provide that community to people so that they can say that we are in similar situations. We might be the only ag teacher at the school, but what we are going through isn't unique to just us."

According to Ms. Gates, current professional development workshops are good, but are "...short segmented workshops" where "[teachers] are getting a lot of cool ideas and things that [they] can put in [their] classroom, but [she] doesn't feel that [they] are getting intensive instruction. [She] feels those professional development workshops should be a little bit longer." According to Ms. Gates,

you can't teach someone how to teach literacy strategies in an hour. You can give them some cool things and cool copies, and you can get the process started, but I think watching a good teacher model those strategies, or teach an ag lesson using those strategies, or seeing someone model it and give it to you. It doesn't have to be a whole day or whole week of it. Given time constraints and how conferences work, that is kind of how it is. I would like to see longer professional development for those things.

Ms. Gates believes agricultural teachers "...don't know what they don't know. [She] doesn't think it is a matter of how many years you have been teaching..."

According to Ms. Gates, "there can be really good veteran teachers, but their methods classes were far different than [younger teachers'] methods classes..." Ms. Gates believes,

...for some of our veteran teachers it is like making the case for different methodologies, it is research supported, it works, it is worthwhile, it is easy to

do. You don't have to throw out all the old lessons; you just have to incorporate some new methods and new ways of doing things. Just making the case for it and teaching them how to go forward...

is one thing that could be done to help advance academic integration within agricultural education.

Overall, Ms. Gates "...thinks it is really important for ag teachers [to understand] we are not just teaching ag." Ms. Gates "...tells [her] kids: [She] am not teaching you how to be a farmer, in fact [she] doesn't really care if you are a farmer." According to Ms. Gates,

we, [agricultural educators], are going to make [our students] better students, and our ag content is going to be more effective if we incorporate those other core academics into our instruction. They are going to get more out of our classes and be more prepared, whether it is being a farmer or whatever, knowing those things, and in ag, we read, we write, we do math, and that there is science involved. I think it is important both for our production ag kids and our urban kids.

Ms. Gates continued by stating,

I have a lot of kids who come in and are really excited about a career in science, but they never considered how much science is in ag and that they could possibly do research their entire life focused on ag. It has implications for feeding the world.

Ms. Gates also

...thinks it is more effective to be taught [academic integration] as a pre-service teacher as opposed to doing professional development as a current in-service teacher, ...because [current agricultural educators] don't always feel that professional development at the school level or even at [their] district level is as effective. It is either too short or it is not applied enough to my own situation or that type of thing. It is more effective to be taught as a pre service teacher how to do these things.

Summary

In summary, the Becky Agricultural Education Program is a moderately to highly integrated program for the following reasons:

- Ms. Gates is part of a professional learning community within her school and has cross walked the state agricultural standards with the state biology standards. Ms. Gates and the biology teacher work closely and establish the same deadlines for research proposals for science fair projects.
- Students enrolled in Ms. Gates' applied biology course can earn a science credit towards graduation
- Ms. Gates frequently collaborates, mostly informally, with core-subject teachers to help better teach her students and to help her teaching remain consistent with the core-subject classrooms
- Every student enrolled in the applied biology course is required to conduct a science fair project to exhibit at the school science fair

- Ms. Gates utilizes inquiry based instruction in her class often through structured questioning and experiments.

The data from this case study reveals that the Becky Agricultural Education Program can be classified as a temporal coordination agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

In temporal co-ordination, each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines. The timetable is adjusted so that topics within the subjects or disciplines, which are related, are scheduled at the same time. Similar topics are taught on the same day or week while remaining part of a subject-based teaching program. Students study the concepts of the different subjects separately, and are left themselves to uncover the relationships. This approach has been described also as 'parallel' or 'concurrent' teaching. (p. 553)

Ms. Gates stated she meets informally, as well as formally with the core-subject teachers at her school. A large part of her interaction and collaboration occurs informally, before or after school hours, following questions that arise while Ms. Gates is teaching or planning lessons. Many times, her questions are answered through email. According to Ms. Gates, she is part of a professional learning community that meets every Wednesday morning before the school day begins. In those meetings, the teachers talk about curriculum as well as other issues that may be present amongst their students and their school. Ms. Gates tries to maintain a good working relationship with the core-

subject teachers in her school and does not hesitate to ask questions, many times through email. Ms. Gates said “one of [the Becky High School] counselors . . .taught biology and so she comes in to observe and gives [her] some feedback.” Ms. Gates also stated she has begun to incorporate core standards she is addressing into her lesson plans. According to Ms. Gates, “. . .science [standards are] typically the easiest because [she] is pretty familiar with the science.”

Ms. Gates teaches an applied biology course based around agricultural principles. Every student, enrolled in this class or a traditional biology course, is required to participate in the Becky High School science fair. If students are enrolled in both the applied biology course and a traditional biology course, then they will receive credit in both courses for the same science fair project. Because students are required to conduct science fair projects in more than one class, Ms. Gates coordinates with the biology teacher and establishes the same deadlines for the science fair projects as the biology teacher.

To assist in connecting the curricula between the classrooms, Ms. Gates infuses inquiry based instruction into many lessons she teaches. According to Ms. Gates, inquiry based learning can be recognized in her classroom by observing experiments and the questioning techniques she employs. Particularly, Ms. Gates conducts a lot of inquiry based instruction in her introduction to agriculture course and is working at infusing more inquiry based instruction into her other classes. She feels she could be conducting much more inquiry based instruction than she currently accomplishes. Ms.

Gates claims she infuses core-subject concepts into her classroom whenever they naturally occur in her curricula.

Case Study #4

The Harriet Agricultural Program was selected for this case study for the following reasons: the program was recommended by the agricultural education teacher educator at the state land grant institution; students in the Harriet Agricultural Education Program can earn science credit for enrollment in three agricultural education courses; students enrolled in the Harriet Agricultural Education program are highly encouraged to participate in the state FFA Agriscience Fair competition; Ms. Cale, the Harriet Agricultural Program teacher, utilizes inquiry based instruction in her classroom mainly through the delivery of the standardized agricultural education curriculum; and Ms. Cale has been extensively involved in the development and revision of the state standardized agricultural education curricula and the state assessment for the standardized curricula. The case study was conducted during the summer months when school was not in session and students were not present, and the site visit was conducted within one half of a day. Interviews with Ms. Cale and former students, teacher developed lesson plans, program budgets, and the facilities available to the agricultural education program served as the data sources for this case study.

The Harriet Vocational Center is located in a community in the Southern U.S. with a population of 3,827 as of July 2009 (www.city-data.com). According to the U.S. Census Bureau, the community is classified as an urban cluster. The population within the community is mainly comprised of Whites (57.8%) and Blacks (36.3%) with a

median age of 35.2 years, an average household income of \$28,224.00, and a median property value of \$78,065.00 (www.city-data.com). This was an older appearing community that possessed buildings that appeared to be in need of repair. The community appeared to be living at or below the poverty level.

The Harriet Vocational Center was located off a side street from the main road that led into the square of the community. Harriet Vocational Center was a stand-alone school that was comprised of 315 students, which originate from two different high schools. Students at the Harriet Vocational Center can choose between eight different programs. The center was located next door to one of the area high schools and the school grounds were surrounded by residential housing. The high school and the vocational center are of older construction, constructed of traditional red brick. There was an addition to the high school in progress.

The Harriet Vocational Center's original agricultural program was agricultural mechanics based, and prior to Ms. Cale's arrival, enrollment was dropping on a regular basis. Therefore, the agricultural education program was recently redesigned and Ms. Cale was recruited to facilitate the redesign. As a result of the redesign, the name of the program changed from agricultural mechanics to Agricultural and Environmental Science and Technology (AEST). The redesign was funded by the state legislature and the school district conducted the renovations. When Ms. Cale first arrived at the Harriet Vocational Center, she said the center "...closed down the mechanics program and started the Intro to Agriscience for a year and then [the program] converted over to the AEST program."

The AEST program consists of four different classes. The first year class is Concepts of Agriscience Technology and students in ninth through twelfth grade are eligible to enroll in the class and receive science credit towards graduation. During their second year of enrollment in the Harriet Agricultural Education Program, students can either choose to enroll in Plant Science or Environmental Science. Both of those classes can be taken to earn science credit towards graduation, but a student is required to complete the Agribusiness and Entrepreneurship course in the third year to be awarded the science credit. According to Ms. Cale,

we are state tested in our program. As of last year, the only students that were tested were the plant science or the environmental science students. This year there is a possibility that we are going to have to test the concept students.

Last year 45 students were enrolled in the program and this year the number of students jumped to 85. This upcoming school year, Ms. Cale will have three sections of the Concepts of Agriscience and Technology course that contain 18-20 students in each section. Ms. Cale stated, “we try to limit our classes to 20 students.” At the time of the case study, Ms. Cale and the administration were “...in the process of checking the student’s backgrounds, like their grades on their MCT...” Student numbers per section may decrease depending on the results of the background checks. At the conclusion of the third year of the AEST program, 10 students will be considered completers, which mean the students have completed the Concepts of Agriscience Technology, either Plant Science or Environmental Science, and the Agribusiness and Entrepreneurship course.

In addition to the classroom instruction, Ms. Cale also advises the Harriet FFA. The Harriet FFA consists of 32 high school members and 20 junior FFA members at the middle school. When the program was first redesigned, there were only 17 members enrolled in the FFA, and they "...just wanted to weld and tractor drive" (Cale).

According to Ms. Cale,

I saw that the program wasn't going to go anywhere, so I talked to the principal down there at the middle school, and he said 'OK' go ahead with a junior FFA. That very first year for the Jr. FFA, I had 45 kids, and those kids will be juniors this year. That Junior FFA really helps with recruiting.

When asked about FFA involvement and Supervised Agricultural Experience (SAE) programs, Ms. Cale stated,

all of my students are required to have SAEs, whether they do them or not is another story. We are on a nine week schedule, (there are four-nine weeks) and each nine weeks [students are] required to have 15 hours on their SAEs. I'm really flexible on their SAEs. If they get 15 plus hours on their SAE forms, I give them a 100 test grade. It can be anything from taking care of their dogs at home, to cattle, or horses. I pretty much count anything just so they have something that they are doing. About once a week on Fridays, I try to make them update their SAEs, but if they've been busy over the weekend with cattle or horses, I have them update on Mondays, so they don't forget what they've done over the weekend.

When talking about her FFA chapter, she stated, “[she] tries to offer as much to them at the beginning of the school year. [She] has sign-up sheets of all the different contests that are available.” After Ms. Cale’s students sign-up for events and contests, she analyzes the lists and decides the events and CDEs that the Harriet FFA will participate. She also determines from the lists whether there is a need for a chapter contest. According to Ms. Cale, “to be on the teams, [the students] have to have a 70 or above, because if they are failing, they need to be in that class instead of practicing.” Once teams are set, then she takes the time to sit down with each team and set up practice schedules. Last year, Ms. Cale had a team compete at the national level in the Floriculture CDE. This year, she did not have a team qualify for nationals.

As far as proficiency awards, Ms. Cale “...had two students who got state proficiency awards this year. One in Diversified Livestock Production and the other in Specialty Crop Production” (Cale). She had one state degree recipient, “...which was a first for this program in a really long time” (Cale). This year, the chapter completed the National Chapter Application. According to Ms. Cale, “our junior FFA has been winning a lot of state awards; they really want to get involved in a lot.”

As stated previously, Ms. Cale teaches four different classes: Concepts of Agriscience Technology, Plant Science, Environmental Science, and Agribusiness and Entrepreneurship. According to Ms. Cale, “the concepts class is computer based right now.” There is currently a group that “...is writing the curriculum for the program,” because “we are trying to make it computer based or teacher based...” in order to

“...alleviate the [the problem of the] lack of computers in the classroom.” Ms. Cale has a limited number of available computers and tries to plan for “...two kids per computer, and then [the students] rotate.” The students would then “...rotate partners and go to the different modules” (Cale). The Concepts of Agriscience Technology students learn about “...10 major areas of agriculture...” (Cale). Each computer in her room is set up with one of the 10 different areas of agriculture. “There is a computer on Ag business, Ag mechanics, plant science, animal science, aquaculture, natural resources, horticulture, forestry, soil science, and crop science” (Cale). The students do different activities.

According to Ms. Cale,

the students work with chemicals, electricity, and fire; they will do internet research, and they will do reading. Each module is different and it is fun. I have a problem with my students not wanting to read, so several of us came up with questions to answer, to make them read to find the answers and this would help them on their quiz. All the quizzes are on the computer. Once they are done, I have a sheet that they fill out. Whenever they are done with their quizzes, they write it down, and I average everything out with their other work for their grade. Some of the kids sometimes compare it to our computer discovery or career discovery class, but it is much more fun than those.

The plant science class contains pretty much everything that has to do with plants. According to Ms. Cale, “we have a greenhouse out back that we do projects in. We are almost to the point where we grow plants year round. That is a big task that we try to do every year.” In the environmental science class, the students spend about

“...75% of their time outdoors” (Cale). According to Ms. Cale, this is difficult at times, because “...you are dealing with the environment.” For example, “...if it is too hot to be outside, we wait till it gets kind of cool and do most of our activities outside” (Cale). In the agricultural business classes, “we are going to look at pretty much the ins and outs of business management, how to start your own business, finances and stuff like that” (Cale). The agricultural business course is not a state tested class, so the Harriett Agricultural Program is “...kind of a little bit more relaxed in that class” (Cale).

When asked how core-subjects play an integral role in her classes, Ms. Cale states they

...play a big part, because I’m always making the kids write and I grade on their writing. That is one of the things [the students] hate, when I grade on their grammatical, they say this is ag, not English, but I say, you use English in ag classes.

The English integration was confirmed by Ms. Cale’s student, Cara. Cara stated that she recalled doing English in Ms. Cale’s class and Ms. Cale “...would even circle grammatical errors” on her worksheets. Cara also mentioned that

the science part was just so interesting. It was very relatable, because at home I grew up on the farm, we’d grow things. We don’t have animals anymore, but we used to and is very relatable to that and it made it more interesting, so it did help a lot.

Ms. Cale makes it a point to listen to her students talk about their other classes and ask questions, so she can tie the other classes into her agricultural classes. She states,

“usually when I’m listening to the kids talk about their other classes; I ask them what they are doing in their botany and zoo class and biology and stuff like that. I usually can tie that in.”

According to Cara, Ms. Cale’s classes “...[were] a good help to the biology, especially when [she] got to biology in college, because this class was to fulfill my life science credit, and I was already through with my app and the only other thing I had left was my English four.” Cara stated, “when [she] got to college, [Ms. Cale’s classes] really helped with the biology, because I could remember the concepts about photosynthesis, how plants grow, talking about the plant and animal cells...” Ms. Cale’s classes were also beneficial in respect to biology “...because instead of just having the biology in eighth grade and not getting it until college, I had it in my senior year again, so then, when I got to the first year of college I really could recall it.” Ms. Cale’s classes did not just help in the science related fields, they also assisted in math. According to Cara, “the math...helped a lot when I got to college algebra as far as solving an equation,” and the English integration assisted in many ways as well. Cara stated that

...because I had been taught how to formulate a plan and to elaborate on that plan and go through it step by step, that made my papers so much easier when I got to college, because I could say I have to read this book and write about it. Now here’s the main idea of this book, and I could expand on that and write a three-page paper on it, turn it in and get a good grade on it.

According to Ms. Cale, the Botany and Zoology classes play the largest role in the curriculum development of Harriet Agricultural Program. Botany and Zoology are

classes taught at the high school. “There is either one or two teachers teaching Botany, one or two teaching Zoology, and two teaching biology” (Cale). Botany and Zoology classes serve as an “...intro for those kids. I can really tie that into the plant science classes and the environmental class. ...Most of it comes from the plant science class” (Cale).

Due to the fact that the Harriet Agricultural Department is enrolled in the state AEST program, most of the courses that Ms. Cale teaches are fairly prescriptive and do not allow for a great deal of improvising. According to Ms. Cale, “[the state] has one curriculum that is standard for everybody. What [the state] has been writing has been a task that has been going on for about three years now.” There is a group of about 30 teachers and other state agricultural education staff that meet each summer to review and revamp the curriculum and the state tests, which are referred to as CPAS. According to Ms. Cale, the group reviews the CPAS tests to “...make sure that they met the objectives in the curriculum.”

The state standardized curriculum consists of all the lessons for the class, the course schedule, and all the supplemental materials (i.e. worksheets, lab sheets, tests) required to teach the course. The state standardized curriculum consists of Concepts of Agriscience Technology, Plant Science, Environmental Science, Agribusiness and Entrepreneurship, and Agricultural Mechanics and Technology. For a student to be considered a completer of the program, they must enroll in the agricultural business course their senior year. In the future, Agribusiness and Entrepreneurship will not be required, as long as the teacher is offering two of the other state approved agricultural

science courses. As a result of needs assessment conducted by her student teacher last year, Ms. Cale is "...going to be adding animal science next year as a class." According to Ms. Cale,

[Her] background is in more plants, [but, she] grew up raising sheep, and cattle, and horses. [She] was just more comfortable in those two areas [plant science and environmental science], plus with the money the legislature gives us, you get more equipment out of the plants and the environment than you do the animals, so [she] was trying to get more bang for the bucks.

When asked about collaboration with other teachers, Ms. Cale stated she does not collaborate much with core-subject teachers; she has "...worked with the eighth grade science teacher." Ms. Cale stated her and the eighth grade science teacher "...did a project on DNA, we actually got a grant to do that..." According to Ms. Cale, "the biology teacher works more with the electricity teacher, with the solar car program, because her son is in that program. They will ask us to do stuff for them, but they don't want to integrate; we are the outcasts so to speak."

When asked to describe what an integrated lesson would look like in her classroom, Ms. Cale stated, "in one of my lessons, we may get them to do an internet search on a certain item and then they have got to write a paper or poster." Following the research project, Ms. Cale requires her students to present their findings to the class. Ms. Cale stated, "I like for them to make their presentation to the class. They don't like it, but I like for them to do that. It is kind of like team teaching project." According to Ms. Cale, "we review what they have gone over that day. Like if they are doing a lab

experiment, we will talk about that and do a couple other activities that are related.” For example, “if we are talking about DNA, we may extract DNA from a strawberry, but also we may take pipe cleaners and beads and make DNA chains, so we try to do a couple different activities, just so I can get the point across” (Cale). This year Ms. Cale plans to “...designate each color [of pipe cleaner] as something...when making the DNA chains. When they are done creating their chain they will have to explain to me what it looks like and then we will put those chains all together and see what it looks like.”

Ms. Cale also described a soil testing lab she conducts with the students. According to Ms. Cale, the soil testing lab is “...usually in environmental science...” class. During the soil testing lab, Ms. Cale has the students “...look at micro-organisms in the soil. [The students] do soil texture lab and a soil pH lab. Ms. Cale mentioned, to conduct the soils testing lab, the students are required to use the chemicals included in the soil testing kits provided. Cara recalled conducting the soils testing lab and stated she remembered when Ms. Cale “...asked [the students] to bring a [soil] sample from home. [The students then] looked at [the sample] against different samples in books and things and tried to figure out what type of soil it was, what level our soil was from, and whether it was from deeper in or right on top.”

Ms. Cale also has done a lab where the students “...do water testing to determine the dissolved oxygen in the water.” Water pH testing is also conducted in the concepts class as part of the aquaculture lesson. The students have “...about six or seven activities where they will test the water for dissolved oxygen, nitrates, pH, and hardness, so they have got to know about the chemicals and everything.”

According to Ms. Cale, in the plant science course, the students "...like to take cuttings and put those in the roots view and then [they] will have seeds, [they] put seeds on one side and cuttings on the other and see which one develops roots quicker, and what kind of roots that they produce." When asked about chemicals used in her classroom, Ms. Cale stated,

most of the chemicals that we use, like in the plant science class, are all pesticides and herbicides and those things... We do a fertilizer test to see what does better, so we might pick a plant and use Miracle Grow or an off brand and see which does better.

A majority of the labs Ms. Cale conducts are built into the standardized curriculum for the AEST program. She said "the suggested teaching strategies in the curriculum may not be the exact ones, but in the references we may suggest the different companies that you may get those types of labs from."

When Ms. Cale's student was asked to describe some of the specific teaching techniques that Ms. Cale employed in her classroom to increase retention, she was quick to talk about repetition. Cara stated, "repetition was a big one, even after you moved to another module; you could always find a way to relate what you had just learned in the previous module from the one that you were in." According to Cara, "repetition is a big help in retaining information." Cara also mentioned Ms. Cale allowed for discussion on different topics in her classroom and utilized several different types of visual aids.

According to Cara, Ms. Cale created a "...relaxed environment..." that provided for a "...more enjoyable experience..." Cara mentioned the relaxed environment "...made it

much easier to come [into the classroom] and do our work, because it was interesting and it was made interesting because of the different things we got to do on the tests.”

Cara believes Ms. Cale conducted a “...straight forward...” classroom that was self-directed and hands-on. Ms. Cale would allow the students to have some freedom, according to Cara, “if [the students] all finished the work and [they] all understood the concepts, they could all move forward faster, but if you didn’t understand or those types of things, you just sat on it a little bit longer.” Ms. Cale also encouraged discussion on a regular basis and joined in the discussion as if she were a student in the class. According to Cara, “[discussion] really helped with the retention, because you could talk about it and discuss it with [Ms. Cale].”

In the past, students in the Harriet FFA have conducted agriscience fair projects. According to Ms. Cale, “the two students that [she] had do the agriscience fair did a project on the greenhouse effect.” The students found the project in a book and with help from Ms. Cale, they modified the project to better meet the guidelines posted. “Both of those students were eighth graders when they conducted this agriscience fair project” (Cale). According to Ms. Cale, “...it has been a couple of years, but it was a good experience for [the students] and me.” Ms. Cale had “...never done that competition before and now [she] has a really good idea of what needs to be done.”

The Harriet FFA has not recently participated in the state FFA Agriscience Fair because the junior FFA members have just been too busy. Ms. Cale states, “...most of the kids are doing all different kinds of sports here, because [they] are a small school.” Ms. Cale hopes that this year she can get more students talked into the FFA Agriscience

Fair. Ms. Cale has offered the FFA Agriscience Fair as an option for students and they sign up for it, but when Ms. Cale informs them that "...they need to start thinking about what they want to do...it kind of stops, because they don't know what they want to do."

Ms. Cale's student, Cara, had not participated in the FFA Agriscience Fair, but was heavily involved in the FFA. Cara is currently a music education major at the state land grant institution. When asked how Ms. Cale has influenced her career pathway decision or what things she instilled in you before entering college, Cara stated, "What has she not instilled in me?" As a member of the FFA, Cara participated in the job interview competition. Cara explained that [she] was not a shy person by any means; let us just say I was unpolished about that." Her participation in the job interview competition "...really helped; now [she] finds that when [she] meets someone for the first time, who is older than [her] or might be a colleague when [she is] thru with school, that [she] could possibly meet them and sit and talk with them like a 21 year old, instead of that bratty 17 year old that [she] was in high school." Ms. Cale taught Cara a lot of discipline. According to Cara, Ms. Cale did not

...stand on top of her and say you are going to act disciplined, but because of her putting me in different competitions and she pushed so hard in class that made me say 'OK' I have go to school all day, come home and do my homework and get up and do it again. That was a huge deal; I really noticed a change from that junior year to the end of my senior year. It was a big difference that really helped.

The Path Followed to Successfully Integrate Core-subject Concepts

Ms. Cale has nine years of teaching experience and has been teaching at Harriet Vocational Center for the past four. She is the only agricultural educator at the center, but would like for the school to hire a second teacher in the near future. Prior to arriving at the Harriet Vocational Center, Ms. Cale taught agricultural education at two other schools. Ms. Cale's path to becoming a successful and progressive agricultural educator began when she earned a bachelor of science degree in integrated crop management then earned a master of science degree in agriculture information science and education. Ms. Cale possesses an agricultural teaching certification and a general science teaching certification. She also possesses a special certification, specific for Agriculture, Environmental Science, and Technology (AEST), so the Harriet Agricultural Program can be recognized by the state as an approved AEST program.

Ms. Cale is a very self-motivated individual who has chosen to be a leader within the state agricultural education profession. She keeps her classroom and facilities organized and clean. It appeared as though everything had a designated storage place. Ms. Cale possessed a friendly personality and it was evident she was passionate about teaching and the agricultural education profession. Her passion was evident through the enthusiasm she expressed when answering the questions during the case study, particularly the questions related to the development of the state standardized curricula.

When asked about how she came to the point of feeling comfortable teaching the higher level biology and chemistry concepts in her class, Ms. Cale states, "I have been pretty comfortable from the beginning, because science is my thing." In addition to

feeling comfortable teaching the concepts, the standardized curriculum provided by the state also aids in teaching more science type concepts. According to Ms. Cale, there are multiple pathways of standardized curricula that school districts can opt into at the state level, besides the AEST program.

The other programs we have in the state are ag and natural resources, which is similar to [AEST] but it is only a two year program. Then there is ag mechanics, horticulture and aquaculture, and an intro to ag science, but it is just one class for ninth graders. Usually programs that do the ag and natural resources will be for tenth through twelfth graders, and they will teach the intro to ag for the freshmen. ...There is also forestry as well.

Most of the agricultural teachers in the state will get their agricultural education degree, but then "...they have to have a 992 Certification, which is for [the AEST] program" (Cale). According to Ms. Cale, the state's Department of Education, "...up until several years ago would do a three week training for [992 certification], but now the [state land grant institution] is in charge of that training for three weeks in the summer." Traditionally, the first week of the training would be focused "...on the modules and the next week we would [travel around the state] to a couple different programs that would have [AEST] and the teachers there would talk about what they did for those classes." Due to budgetary restraints, Ms. Cale is not sure if "...the land grant institution conducts more of the training on campus now rather than traveling around the state." The three week professional development workshop is required to remain a state

certified AEST program. The other pathways possess required professional development workshops as well.

According to Ms. Cale, “[her] district does not do much professional development. [She] gets [her] professional development at [the] state meetings, National FFA Convention, or NAAE Convention.” Ms. Cale has played an integral role in the revisions of the standardized curricula in the state and she considers her time spent revising the curriculum, as some of the best professional development that she could get. Ms. Cale is involved in the National Association of Agricultural Educators and the state agricultural teachers association and attends those organization’s conventions and meetings. During those conferences and meetings, Ms. Cale attends professional development workshops and converses with other agricultural teachers to learn new things.

Tools and Resources Currently Utilized in the Agricultural Education Classroom

Funding for Ms. Cale’s program mainly originates from the state legislature. They provide a great deal of monetary support for education within the state. According to Ms. Cale, “this year we are actually able to get Carl Perkins, which we have never been able to get before.” Because they were never able to get Carl D. Perkins funds for their programs, the teachers “...would go to the legislature and ask for 1.8 million every year to implement the AEST program and for upgrade money” (Cale). According to Ms. Cale, the state Supervisor worked with the state Department of Education to secure Perkins funding this year; although, the funding is “...probably going to very limited.”

When Ms. Cale took over the program at the Harriet Vocational Center, the agricultural facilities were completely renovated. “The school district funded the renovations; the state legislature provided the money for the equipment” (Cale). Currently, Ms. Cale possesses a large classroom (approximately 2000 ft²) that contains a white board at the front of the room; eight work tables with two chairs at each; a computer center at the rear of the classroom with 10 available computers; five sinks; and cabinet space for storage. The room also contains a microwave, a full size refrigerator, and a 100 ft² storage room, where the computer server is stored. Ms. Cale also possesses three compound microscopes that magnify up to 100x, two wiring board trainers, hand held GPS units, and numerous other supplies that can be used to conduct inquiry based instruction.

In addition to the classroom, the Harriet Agricultural Department is comprised of an agricultural mechanics laboratory, a large storage room, a welding room, and a greenhouse. The agricultural mechanics laboratory contains a limited number of tools and in one section of the laboratory there was a non-functioning aquaculture system and two potting benches. The welding room measured approximately 300 ft² and contains five welding booths that include a total of three shielded metal arc welders and two oxy-acetylene rigs. On one end of the welding room, there is a large overhead door and opposite of the door there is a shelving unit where the welding helmets and gloves are located.

Located at the rear of the building, not attached to the school, is a 1200 ft² polyethylene and polycarbonate greenhouse. The greenhouse is located inside a secure

chain link fence. Inside the greenhouse, there are nine - eight foot work tables, fluorescent lights, a heater system, and a limestone floor. The construction of a second greenhouse is planned for the future. Ms. Cale thought the grant money was just recently secured for the construction of the second greenhouse, but “due to budget constraints, the construction of the greenhouse has been put on hold.”

Inside the building, the Harriet Agriculture Department has an FFA resource room that will serve as the classroom in the future. The resource room encompasses approximately 600 ft² and is currently where FFA CDE practices are conducted. The resource room contains a bulletin board, a white board, cabinet storage, and six tables with seating for approximately 12 students. The last two rooms that comprise the department are a teacher’s office and an additional storage room. The teacher’s office is approximately 65 ft² and contains a work table with a computer and a printer. Ms. Cale does most of her work from her desk in the main classroom. The final storage room covers approximately 300 ft² and all four walls possess shelving units.

As previously mentioned, Ms. Cale utilizes a state approved and state tested standardized curriculum. The standardized curriculum is structured as follows,

At the front we have got your objectives and the teaching methods, and then it refers to a teaching strategy. They will refer you to a page and you can flip to the back and you will get that page, that worksheet, that lab whatever. If you look on some of the objectives, you will see 5.2, so you flip back to 5.2, it will have your activities, there are rubrics, sample questions in there. We have actually correlated this by the National Science Standards. (Cale)

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

When asked what other teachers need to become progressive in the area of core-subject integration, Ms. Cale pointed to the obvious, standardized curriculum. From her experience, standardized curriculum has helped the teachers in her state because, according to Ms. Cale, agricultural educators

...have been doing these inquiry based instructions, but just didn't realize it. We actually have two teachers that went to a week-long workshop. They came back and presented about the inquiry based research at our summer conference. I think we are doing it and we just don't realize it, to label it that.

Ms. Cale feels the standardized curriculum has been a huge help in her state, "...especially since we have added the worksheets and the rubrics and all of that..." Most teachers "...beg, borrow and steal where we can, and if you have got the worksheets here, it just makes it a lot easier to plan your day out." The standardized curriculum is helpful, because doing lesson plans takes a lot of time. "When you have got FFA after school, the greenhouse, seeing kids who have SAE projects, or go to livestock shows then your time becomes very limited" (Cale). In Ms. Cale's mind, "...that was the whole purpose of [the standardized curriculum] was to try to help everybody as much as possible". According to Ms. Cale, the standardized curriculum does a good job of linking agricultural concepts to core-subject concepts. She stated, "we correlated everything in there" and you can definitely "...show the link between the two."

In addition to the standardized curriculum, Ms. Cale believes teachers need numerous opportunities to share ideas amongst themselves. She states, "...one of the great things about our conferences is that we sit around and talk about ideas, and I think if we had more round table talks, picking each other's brains..." we could advance ourselves greatly. Ms. Cale mentioned the Dupont workshop held each summer, and she "would really love to go..." (Cale). Ms. Cale believes it "...would be a really great if every ag teacher [attended the Dupont conference], because the knowledge and the equipment and the people you get to talk to" would really aid in advancing our knowledge in the area of inquiry based instruction. Ms. Cale learned a lot of new ideas and methods of teaching at these conferences. According to her, "sometimes [many agricultural educators] are doing the same thing and we don't realize it. They may be doing something a little bit better."

Ms. Cale believes teachers need to be attending more professional development and talking to other agricultural teachers. In her opinion, "...most ag teachers don't travel because of the money issue or time." Attending conferences and professional development activities takes time, and in her mind, "we really have to make time for that."

Summary

In summary, the Harriet Agricultural Education Program is a moderately integrated program for the following reasons:

- The standardized curriculum utilized in Ms. Cale's classroom is correlated with the National Science Standards.

- Students enrolled in Ms. Cale’s program can earn science credit towards graduation, up to two credits, as long as they take classes necessary to be considered completers of the program.
- Ms. Cale regularly utilizes inquiry based instruction to teach agricultural concepts in her classroom through inquiry based questioning and experiments.
- Ms. Cale encourages participation in the FFA Agriscience Fair competition.

The data from this case study reveals that the Harriet Agricultural Education Program can be classified as a nesting agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

Nesting occurs when a teacher targets, within a subject-based course, skills relating to other subjects. Content drawn from different subjects in the curriculum may be used to enrich the teaching of one subject. The term ‘infusion’ has also been applied to this stage of integration where teachers ‘analyze the separate subject’s goals and identify ways in which these generic skills can be refined into existing subjects.’ (pp. 552-553)

Ms. Cale’s state has “...one curriculum that’s standard for everybody.” The standardized curriculum consists of six different classes: Concepts of Agriscience Technology, Plant Science, Environmental Science, Animal Science, Agricultural Mechanics, and Agribusiness and Entrepreneurship. Students enrolled in the courses within the standardized curriculum are required to take an end of course exam that is developed by the state. In her state, there are different standardized curriculum

programs such as: "...ag and natural resources, which is similar to [the AEST] but it's only a two year program. Then there is ag mechanics, horticulture and aquaculture, and an intro to ag science, but it is just one class for ninth graders" (Cale). Schools have the opportunity to pick and choose what they want to do and that determines the end of the year test that their students will take. Ms. Cale spent countless hours in the past working with other agricultural educators to revise and fine tune the AEST standardized curriculum, so she is vested in the program.

To assist in connecting the curricula between the classrooms, Ms. Cale infuses inquiry based instruction into many lessons she teaches. Ms. Cale allows students to openly discuss the happenings in the other classrooms to help enable her to draw from the students' experiences and alter her teaching to insure that the students truly understand the link between the information taught in other classrooms and the content taught in her classroom. Ms. Cale is fairly limited in her teaching due to the standardized curriculum but manages to interject her own style of teaching into the curriculum through personal stories and examples. Also, because Ms. Cale took it upon herself to assist in the revising of the standardized curriculum, much of the curriculum mirrors how she prefers to teach a class. With that said, Ms. Cale also claims she infuses core-subject concepts into her classroom whenever they naturally occur in her curricula.

Ms. Cale also encourages students to conduct agriscience fair projects and compete at the state FFA Agriscience Fair competition. She has not had too many students pursue agriscience fair projects because they are busy with many other school related activities, but she is trying to develop a system to motivate more students to

compete. A few of her students have done science fair projects for the school science fair that were agriculturally based, but few have taken those projects to the next level and entered in the state FFA Agriscience Fair competition.

Case Study #5

The Carla Agricultural Program was selected for this case study for the following reasons: the program was recommended by the agricultural education teacher educators at the state land grant institution; students in the Carla Agricultural Education Program can earn arts credit for enrollment in certain agricultural education courses; students enrolled in the Carla Agricultural Education program regularly participate in the FFA Agriscience Fair and generally place well at the state, regional, and national competitions; Ms. Paul, who is the lead teacher of the program, regularly utilizes inquiry based instruction in her classroom; and Ms. Paul works closely with the core-subject teachers in her school in an attempt to assist students in retaining information. The case study was conducted during the first two weeks of the school year after school had been dismissed for the day, and therefore there were no students present at the time of the case study. The site visit was conducted in one half of a day. Interviews with Ms. Paul and former students, teacher developed lesson plans, program budgets, and the facilities available to the agricultural education program served as the data sources for this case study.

Carla High School is located in a community in the Southern U.S. with a population of 86,679 as of July 2009 (www.city-data.com). According to the U.S. Census Bureau, the community is classified as an urban cluster. A majority of the

population is White (69.3%) with a median age of 21.9 years, an average household income of \$36,463.00, and a median property value of \$176,400.00 (www.city-data.com). The community covered a large land area and possessed numerous housing developments. There was a broad spectrum of construction ranging from brand new homes to older homes.

Carla High School is located along a four lane highway and is surrounded by residential housing. The school building is well maintained and constructed with traditional red brick. The school appeared fairly new, and the agricultural department was recently renovated. Carla High School is comprised of approximately 2,800 students in grades nine through 12 and has four agricultural educators in the high school.

This year, the Carla Agricultural Department has approximately 432 students enrolled in the program, which includes duplicated students. According to Ms. Paul, unduplicated students comprise about 85% of the total enrollment and the program continues "...to grow, especially since we had to add a fourth teacher." Of the over 400 students in the Carla Agricultural Education program, approximately 120 to 150 of those students are FFA members.

The Carla Agricultural Education program attempts to provide "...four different career pathways...for the students. There is animal science, horticulture, ag mech, and a wildlife leadership type..." pathway. According to Ms. Paul,

we encourage the students to come in as a freshman and take the expected classes, because we feel that is important. As a foundation our school is very supportive of trying to obtain those students. We have an eighth grade tour that

we actually do for two days, where the eighth graders are brought into all career technology courses. That has definitely helped out a lot in recruitment.

Ms. Paul said the Carla Agricultural Department is "...not a livestock based program. [They] have students that show at the county mainly, but also show at the majors, but we have more expertise and interest in the CDEs and the LDEs." According to Ms. Paul, "we have had a lot of success over the years with our students holding upper positions in the offices" at the district, area, and regional levels.

The Carla Agricultural Education Department tries to provide four different pathways for students to select from when entering into the agricultural department. Ms. Paul's coursework focuses mainly on floral design and veterinary medicine. When asked how core-subjects play a role in her classroom, Ms. Paul mentioned that at the Carla High School, the [career and technical education] (CTE) department...looks at [standardized test] scores and looks at the overall percentages of the school, but we also look at how the CTE students perform and then develop [the yearly] goals." When reviewing the standardized test scores from the previous year, the CTE department looks for weaknesses, and if they

...find a weakness in [the core] areas, then [they] make [improvement in that core area] a goal for the year... For instance, one year we had very low scores in English, so we went to a [standardized assessment] formatted test. At first it was a difficult transition, just from the stand point of trying to set the test up and the formatting... After that year, [the school] saw that the scores went up and [the CTE department] likes to think that [the CTE Department] had a part of that.

Ms. Paul said, "...[the CTE department] looked at the CTE students' [scores] and how they performed and [the CTE students] increased as well." The Carla CTE department "...looks at [the scores] every year and this year [the school] had a little decrease in Math with certain grade levels. [Math] is something that basically [the department] needs to work on." According to Ms. Paul, "all of us in our department are mentors of students that have not passed one or more of their sections on their [standardized tests]. So we try to help them out with extra help."

Ms. Paul stated, "...a lot of the times the students will say in their science classes, because we are very science based, that they have lots of repetition. [The students] learn it in [the agricultural classroom] and go and learn it in [the science classroom]." According to Ms. Paul, "[in agriculture] we actually do more hands-on components, and it really hits home with [the students]." According to Jacob, Ms. Paul's student, Ms. Paul's classes

...are just a lot more hands-on than most other classes that we took in high school... Like in vet med, every other day we actually took care of the animals in the lab, and we actually do a lab and have hands-on material to actually work. It is a lot easier to learn when you are actually doing it [rather] than just reading it in a book.

Ms. Paul "thinks when the kids are able to utilize different methods of learning that is when it definitely helps out." One of Ms. Paul's students, Allie, confirmed this idea and stated,

there was a lot of times in biology [where] I was learning something and I was like I learned that in floral, or if we are talking about animals, I was like I learned that in canine. That happens a lot in your ag classes, you are learning something in ag and later on like in chemistry you go, I already learned that, sometimes even like in history, because we have to go back and research ancient times and what they used flowers for. There was a lot of repetitive information...

According to Ms. Paul,

[science] is very easy to implement [in her classroom] and [she] tries to put graphs and charts on [her] tests to where the students are accustomed to the format of the [standardized] test. Several times we hear kids say...this isn't English class, but they still have to do the writing in ag as well.

Ms. Paul said,

in the past, [the department] has had some of [the core teachers] come to department meetings and they gave us some examples of what they are needing the kids to understand. This year, one of my former students from [the first school she taught at], who is in our [CTE] department now, was an English teacher before, so she is able to help us out and understanding the new ways that will be coming with the end of the course exam.

According to Ms. Paul, “[the agricultural teachers] try to sit down with [the core-subject teachers]. In the past, [Ms. Paul] has gone to the science teachers and asked them when [they] have had work days, what exactly [she] could help out with.” During

those informal meetings, the [core-subject teachers] tell [her] where the kids have weaknesses or have a harder time understanding, so there is the collaboration that way. But as far as a time where [they] would be able to sit down and able to prepare things together, it is not available.” Ms. Paul did mention, “...there was one year, in the last three years, where the science teachers actually did a workshop for everybody in their science department. [She] attended that and was able to see how [the science department] made their kids do experiments.” Following that workshop, “...some of the activities that [Ms. Paul] has done, replicated that.” Ms. Paul explained that in

a typical lesson, we have a form of bell work, where the kids will have some type of [core problem], depending on the lesson. Sometimes it would be a math problem they have to solve, or predominantly it will be a form of writing. [The students] have to write in complete sentences. Then [she] has a lecture with an activity that is involved with it, either individually or within a group.

According to Ms. Paul,

mainly [she] does a lot of group work, due to the size of the classes, and a lot of times they work better. They can feed off of each other. Occasionally they have to take home an assignment and it will just be reinforcement for like the projects; a lot of the tests are projects...

In Ms. Paul’s animal science class as well as her veterinary medicine class, when she teaches body parts and the different skeletal varieties, “...[the students] would actually make a model, after learning about it.” After grading the models in class, Ms. Paul “...would also use those models on the test. (i.e. Label ‘A’ is pointing to this type

of skeletal structure). [The students] would have to say ok it is located in this area so it is this type..." Jacob recalled "...making a paper mache [model] of a rabbit, showing all the different systems for the rabbit, the circulatory, the respiratory, skeletal, nervous, all that and all the different systems for it" and Allie recalled learning "...the parts of the inside of the dog" and "the dog breeds." According to Ms. Paul,

...when [the class] studied about the nervous system, [she] actually had the students make a model of the brain out of play dough, and the students would use different colors to indicate what the different parts or areas were. [The students] would have to say what the function was.

This activity worked for most of the students, but "the color part became an issue though, because [she] had two students who were color blind, so [she] had to change [the activity]..." So she changed the activity such that the students "...would also have to make shapes, so they could associate it with that, and again [she] would use that as a form of their tests to answer questions."

According to Ms. Paul, she also "...does a skills lab test, where the kids learn how to restrain different animals. They then take part of a written test after they have gone through and practiced the different methods on the different animals, and [she] may use stuffed or live animals." On the day of the skills lab test, "...[the students] would draw for the animal that they are actually going to demonstrate how to restrain." She also mentioned she would have the students conduct fecal tests on animals, and as far as the fecal lab, [the students] do a lot of the blood smears. The kids will learn the purpose

if it and how to do it. They then work with a partner to do the lab itself and look for different things under a microscope.

The fecal lab was a memorable lab for Jacob. According to Jacob, "...we did a fecal lab, a fecal float, we had to count the eggs, like we did dogs, we did blood smears, that was a fun lab, yeah we put two blueberries in a cup and we were like squeezing it." In addition to the fecal lab, Jacob also recalled conducting labs where the students "...cut a cow heart up, a lamb heart, [and] ...brains." The students also conducted a lab where they

...cut up a cow femur, boiled part of it in water, and the middle fell out...and in the other [lab, the students] shaved off [part of the bone] and looked at underneath the microscope to see the different skeletal cells, and to see how different they were from other cells. (Jacob)

Ms. Paul "...was able to purchase a dual sided microscope this past year and that has been very beneficial from the stand point if one student can't see something the other student can." To assess the students' retention of information during the fecal lab, "[the students] actually go through the steps [of conducting a blood smear], and then [Ms. Paul] grades them." For example, Ms. Paul is checking to see if the students are: "...putting the correct measurements in, are they allowing enough time, are they prepping their slides correctly, and are they observing and detecting the things they are supposed to." To conduct the blood smear, Ms. Paul even "...makes [the students] actually take a fecal sample from a dog." During this lab the students are doing "mainly just observation, then diagnosing if there is any type of worms." According to Ms. Paul,

Most of the animals that are being brought in by my students are on worming and vaccination schedules. [Ms. Paul] has been able to obtain the fecal matter from the animal shelter, and that is when [the students] really do see the live things... A lot of [the students] can tell [Ms. Paul] if there is an egg and things like that...and they can diagnose if it is round worm or whatever.

Ms. Paul does not use many chemicals in the labs she conducts. She stated “we do use iodine, the stains, if we are trying to look at certain blood cells. After the kids do the blood smears, I will have them stain it and they are able to see if it is crystallizing.”

Ms. Paul mentioned

[she] had a tumor that [she] had obtained from a rat that [her] very first vet med class had. [She] had the rat put down and [she] asked for the tumor. Last year, [Ms. Paul] wanted to take a slice of the tumor, and [she] talked to an anatomy teacher, and [the anatomy teacher] and [Ms. Paul] really wanted to do that, but [they] both ran out of time. [Ms. Paul] really wants to do that this year to see the cancer cells underneath a microscope. [She] thinks that would really be cool.

The kids, when they see the tumor, they can't believe how big it is. They say:

That was inside of a rat?

Ms. Paul said, “when [the class] goes to watch the surgeries, [she] gets the reproductive systems and preserves them so [the students] can see, because comparing the different species; even just the male and female reproductive tracts are so different.”

Ms. Paul

actually had a student that had banded one of her sheep one year and she did it incorrectly, and it sucked up one of the testicles. We had to go to the vet school, and my students were actually able to prep, as far as putting the iodine, and [Ms. Paul] was like I hope they remember to do that, and the young lady was able to give the injection to make the animal go down and another student was able to give another injection to bring it back out.

Ms. Paul also mentioned her class has "...went to Sea World...and did a behind the scenes tour." Ms. Paul's

...CTE director was one of the chaperones, and she couldn't stop talking about it. We were able to see the sting rays being taught signals by using targets. We learned how psychology plays a big part in the training aspects. They used a lot of that terminology and the kids were like, I learned that word in my psychology class.

According to Ms. Paul, she tries "...to at least take [her veterinary medicine class] to our local vet. We always watch a spaying or neutering." Jacob confirmed the trips to veterinary offices by stating, "...we saw a dog get spayed..." Ms. Paul then mentioned she "...has not had a student obtain their certification through the TVMA yet." She has "...had at least two [students] complete the actual qualification part of it, but due to the price, the students weren't able to take it at the time, and the other young lady went off to college and was not able to get it." According to Ms. Paul,

this year [she] is really going to push [the TVMA certification]. [She] has an agreement with two vets in the area, who will sign off on it. The only thing I am

not comfortable in teaching is the imaging equipment part, so when we go in to watch surgeries, I have them go through anesthesia machines and things of that sort so the kids at least have that knowledge of it, because we do not personally have that equipment here.

Ms. Paul's students recalled other labs they conducted in class. According to Allie, she recalled doing "lots of arrangements...", she stated "...we were always doing something." In floral class, Allie remembered the students "...had to come up with [their] own little business, come up with a name, arrangements, and [they] had go in the cafeteria and sell them, for like two days; it was like a competition between everyone." In reference to floral lab, Allie stated, "we had to do everything, like how many flowers we had to order, how much everything was costing, we had to make a profit, we had our own little flower shop. We were in groups when we did that." Jacob recalled

...in Vet Med we were learning how to convert milliliters to pounds and grams, all the conversion factors that you go over in chem and physics...we had to do in [Ms. Paul's class] just to learn to convert a lot of it. That was part of our unit, was going over different medicines, because you go this is this and you can actually explain it to them in pounds or whatever it is. In America, we don't do metrics, so this conversion and all that was a big thing.

Jacob also recalled learning

...simple biology, like just from animal science, canine, and vet med, like that. You think, oh it is just science, but it is a lot of biology based too, because we are going over living organisms, which is pretty much biology. So we are hitting

a lot of the basis of cells, different systems and how different animals react in the ecosystems; all the basis of biology.

Allie mentioned, “occasionally chemistry comes into it.” Jacob confirmed this statement by saying, “...especially in vet med, we [were] mixing chemicals...” To expand on how they used chemicals in veterinarian medicine class, Jacob stated,

we did do some labs where we mixed [chemicals], like for the oxyfication lab, we were putting different chemicals in...the bones, to see how it affected them over a time period, we let them sit for a while. So you see how different acids affected that. It was chemistry to find information, it wasn't just using chemicals with chemicals, and it was like a more learning based chemistry to where we were actually looking for something, not just seeing how different things reacted.

Jacob also mentioned,

...geography plays into the floral design and animal science, because of the different ecosystems, the longitude and latitude of this earth, this grows differently, the same latitude coming up to the equator, things grow in the same cycles, because of how the sun goes. It is just how the geography changes, how plants and animals change from getting closer or further away from the equator or the North Pole.

Ms. Paul believes, “...over the years just changing [her] way of teaching...[she] can see the kids really grasp the concept and objectives that we are trying to do that day, by finding different ways to have that hands-on experience.” Ms. Paul's students stated, “she tried to make things more creative and hands-on.” “Because everybody learns

different, some people are the hands-on, visual people, others read the book, and bam, they know where it is going. [Ms. Paul] uses a lot of different techniques, and she doesn't do everything the same way, because every student learns different" (Jacob). According to Allie, "she helps every student, in their own way, she understands each student, like who learns one way and who learns another." Ms. Paul is "...always trying to find new things; she is always researching things" (Allie).

She even asked us, what do you all want to do, if you all have a better or more exciting way, like that paper mache project, she gave us a choice, whether we wanted to do something else or the paper mache. We all wanted to do paper mache, and she said yeah that is a good idea. She did have a lot of good ideas by herself, but she also brings that to her students, because you know everybody learns a little different, and so she asked for our opinions. Is there anything better we could do for us to try to grasp the concepts of what we are trying to go over more intensely? (Jacob)

Ms. Paul "is the kind of teacher, where if she sees that it wasn't exciting or something, ...she is going to change it immediately, so next time she teaches it, she knows ok let us not do this" (Allie). "She is going to change it to where we do learn the subject material, that we do grasp the knowledge of it, that we do it in a way that we can learn more efficiently" (Jacob).

Some days she will be teaching something and she will be like, you know what, this just isn't that great, and in the middle of the lesson she will change

something up. She always has something for you to do, it is not like, look at this picture and watch this video, it is like, here is the chicken. (Allie)

According to her students Ms. Paul “is a really nice person who does listen, not like one of those teachers who just talk” (Allie).

She definitely can read her students, she can tell if they are not getting it and saying they are, she will say well let us do this. She doesn’t destroy the information, she says we are going to learn this, she makes sure you know what you are doing. (Allie)

The Carla Agricultural Education Department has “...a lot of support from [their] administration and [their] CTE director. [The CTE director] has been able to purchase items for [the agricultural department] that have helped out in...” the process of changing her way of teaching. According to Ms. Paul, she has “...also tried to make connections with individuals at the state [land grant] university or within the community to help the kids if they are doing an agriscience fair project or they have an interest in a certain career.” In fact, “several years ago [Ms. Paul] was able to have several different kids do internships at [the state land grant university] for the summer in three different areas: exotics, feline, and canines. That was a really good experience.” Ms. Paul said “one of the young ladies [who did the internship] thought she would like to be a vet, but after that experience she decided that wasn’t her cup of tea...” Ms. Paul “...really believes integrating other people in the community into the classroom helps out a lot.”

When asked about how her program integrated Supervised Agricultural Experience (SAE) programs, FFA, and the classroom/lab, Ms. Paul was quick to talk about agriscience fair projects. According to Ms. Paul,

when [she] taught horticulture, [she] actually had the kids come up with a science project that they would do here at the school. They would have to come up with a hypothesis, and once [she] would approve it and how they were actually going to do [the project] [she] would obtain the material for them, they could utilize anything from our greenhouse, or they would bring things from home. On a weekly basis, [the students] would take photos of [the science project] and make observations every day or every other day, depending on what type of experiment that they did. [The students] would have to write, at the mid-way point, about how their experiment was going, and then they turned in a portfolio with the photos and a conclusion and if the hypothesis was proven correctly or not. That was very beneficial.

Because Ms. Paul required her students to do science fair type projects as a class assignment, she "...had a young man do an [FFA] agriscience fair project." Ms. Paul is currently "...thinking of incorporating [the science fair type projects] into some of [her] other classes, especially like food technology." She believes "the kids could definitely relate to the food area and in the [FFA] Agriscience [Fair], [food science] is not always participated in." Ms. Paul "...doesn't consider [herself] the best in science, but [she] thinks it has a lot of value to it, so that is where [she] has kind of driven students to go into the agriscience area, because it is so broad."

Ms. Paul "...also had to incorporate proficiencies into that as well." "[She] has had students that actually had animal projects." According to Ms. Paul,

one young man had breeding heifers, so he did an agriscience fair project where he did a sensor with a CIDR in his heifers to tell [if they were in heat], it would make a reading with a fiber optic. His dad was involved and [the state university's] engineering department developed a fiber optic type of system to where it would do a reading. They patented it just in case.

Ms. Paul said she encourages the students to "...take their SAEs, as far as an animal project..." and develop agriscience fair projects. Every student in the Carla Agricultural Education Department is not required to have an SAE project. According to Ms. Paul, she "...can understand [requiring every student to have an SAE]. Growing up from a smaller school they were required, but these days and in [the community they are in], there is not a way we can..." require every student to have an SAE project.

Jacob and Allie both competed in the FFA Agriscience Fair and many other CDE events. Jacob's FFA Agriscience Fair project was a

...series of three projects. Two of them were based over the same thing, and one was over a different topic, but for the same species. [Jacob's] first two projects were on the basis of how amino acid in a broilers diet will affect their meat and breast development as a whole. [He] was a freshman when [he] first started [his] first project. [He] was doing it by [himself]. [He] had 25 chickens and put them in two groups; a control group and a treatment group. The control group was fed just plain feed and water. The treatment group [he] used amino acid in their

water, 2 oz. per gallon, actually whatever the bottle called for, actually [a local specialist] helped [him] come up with how much to put in the water. Because amino acids were not labeled to be used in chickens, that kind of messed [them] up at Nationals.

During Jacob's sophomore year he "...had a partner" to conduct his FFA Agriscience Fair project. He "looked at [his] first project, [him and his partner] split it to get more data. [They] had a hundred chickens, [Jacob] had 50 and [his partner] had 50."

According to Jacob,

we wing banded every single chicken, so we could identify each chicken singly. When we first started out the project we weighed every single chicken, from day one, so we could get our first weight. Then every week we weighed every chicken every single week, for a hundred chickens every single week. We did at least a hundred, because when you are looking at treatment groups in an experiment, you want at least 30 per group, so having 100 was enough to have, to find some significance in the data. We took weekly weights, and at the end of the experiment, which was about 6-7 weeks, in the market boiler industry you wait that long before you send your boilers to get butchered. At the end of the six weeks, we took a final weight, the next day, we took a live weight, butchered every single chicken, then we took a dressed weight to get a dressing percentage. Then we went through every chicken still having a wing band number and cut out the breast, because that is the best cut of the chicken. Every single chicken we weighed the breast individually just to see what the breast weight was,

because in a chicken the body can weigh a lot, the breast is the main part of the chicken, and that is what you want to grow big especially in the broiler show industry, that is what they are judged on. We also took a breast score from a poultry person to get a good sample breast score to base that off of it, not only to get the weight from it. We took all this data, which was a ton of numbers, spreadsheets and spreadsheets, that time we put it into SAS, statistical analysis system, and we used at the alpha level of .05, which is saying that one out of ten thousand, chance of whatever happened in that experiment was random. And from that experiment we learned that amino acids don't do much in their diet. Because in a broilers diet you have your feed and water, which in that feed, the nutritional people in that feed industry make sure that feed has all that the chickens need. If amino acids help build muscle, why wouldn't it help more? We learned that putting extra amino acids in the body, a chicken actually had to burn a little more energy to help burn that extra amino acids out of the body that actually helped them. So we won state with that experiment and we went on to Nationals and we won second in the zoology division.

Jacob's third experiment dealt with how "...different bedding types effected broiler growing." Jacob compared "...three different types of bedding. [He] had rice hulls, sand, and shavings."

Allie's FFA Agriscience Fair project was conducted with a partner and they compared "...white bread vs. wheat bread." According to Allie, her and her partner "...made little muffins and the muffins were 0% wheat flour, 25%, 50%, 75%, and

100% wheat flour.” They mainly “...just wanted to know what the public preferred, because the society today is more towards health conscious and watching what we eat. [Her and her partner] were wondering what exactly the public does like to eat.” Allie stated they “...had testers that ate them and we found that people liked to eat the 25% wheat flour. We won third place.”

Jacob has recently started postsecondary schooling at the state land grant university and has plans of someday earning his Ph.D. in animal science. He stated Ms. Paul’s classes “...showed [him] what [he] wanted to do [his] whole life, be a veterinarian, was not for [him].”

Allie has recently started classes at the local community college and is majoring in animal science. “[She] knows [she] likes the whole ag [thing], but [she] has considered other things, but every time [she] goes back to animals and agriculture.” According to Allie, Ms. Paul’s classes “...kind of narrowed it down to what [she] wanted to do. When [she] was little, [she] always liked flowers and considered the flowers and like now there are no flowers in here, it is just like animal science and hands-on stuff.”

The Path Followed to Successfully Integrate Core-subject Concepts

Ms. Paul is the lead teacher in the department and has 16 years of teaching experience; twelve of those years have been at Carla High School. To begin her path to becoming a successful and progressive agricultural educator, she earned a bachelor of science degree in agricultural science. Ms. Paul has earned her agricultural teaching certificate and her state core certification. Ms. Paul is a driven individual who takes her

job and the responsibility of educating youth seriously. This was evident by her stern facial expressions as she answered the questions within the case study. She was very willing to share information about her program and was enthusiastic when talking about the accomplishments of her students.

When Ms. Paul first began teaching at Carla High School, she was only hired as a part-time teacher. In addition to teaching at the Carla High School, she also worked with the Junior Master Gardner program at the local university. According to Ms. Paul, [she] was able to help out with lessons, and [she] thinks that kind of helped [her] start changing [her] teaching skills, because [she] saw what was starting to develop out there as far as the curriculum. [Ms. Paul] grew up in a program where a lot of [the curriculum] was textbook based and packets. [They] did some hands-on [learning] but not a lot. [Ms. Paul] was not a very good test taker growing up. [She] found out that [she] had testing anxiety when [she] was a junior in college. From learning that made [her] change [her] way of teaching and the way [she] evaluates a student. Because anybody can guess...on certain things, but the actual application [she] felt was a real tool to tell if a kid understood what they were learning.

After her experience of working with the Junior Master Gardner Program, Ms. Paul was then hired on full-time at the Carla High School and has continued taking advantage of numerous professional development opportunities that have been presented to her. A few years back, Ms. Paul "...was selected by the state to go to the biotechnology conference." She has "...also gone to a community college for two

years...” for a veterinary technician program. “[She] was with the first group with the Vet Tech” at the community college and “it was continuing education.” According to Ms. Paul, “[she] always looks for different ways [to teach], [she] sees the kids change over time and the way they learn, so [she] is always on the internet looking for new ways, and if [she] finds something then [she] may utilize it, but change it until [she] feels [her] kids in the classroom can understand it.”

For example: [Ms. Paul] found a lesson that talked about detecting if a human had diabetes. [She] took that same lab and adapted it to where it would be for an animal. Based on the color, you could tell this animal had diabetes, this one had a urinary problem, and so forth. [She] looks at the human aspect and then [she] relates it to ag.

Ms. Paul also found another activity where they “...were learning about dentistry and how the parts of the mouth [work] and things. [The students] made a mouth out of marshmallows and an apple.” The lesson was designed to teach little kids about human dentistry, but when Ms. Paul came across this lesson she thought, “...I can do that for the animals.” She stated she is “...told that [she] is very creative [with] the way that [she] is trying to get things across.” According to Ms. Paul, “I try to put myself in the kids’ shoes and say; How would I learn best and how could I understand it?”

Ms. Paul “...relies on new courses and other teachers, and if [she] has certain questions, [she] goes to [the local] vets and asks them.” When asked about her undergraduate work and how it has assisted her in her teaching, Ms. Paul mentioned, “...from the standpoint of [her] professors that [she] had, for animal science, they would

actually bring the cow into the classroom.” As for “horticulture and floral, [they] were in the labs doing a lot of things and that helped [her] learn.” Through her professors, [Ms. Paul] saw that there were other ways of learning. In [her] high school program, [she] didn’t always have that.”

Tools and Resources Currently Utilized in the Agricultural Education Classroom

According to Ms. Paul, “most of [the agricultural department] funding comes through [their] career technology director.” In the past, she has written a few grants and has “...worked with a science teacher” on writing a grant.

[The Carla High School] had an integrated program when [Ms. Paul] first started...with science and geography and ag. [They] called it the land, the people, and the food. One of the teachers and [Ms. Paul] wrote a grant together, to where [they] were able to obtain some GPS units. [They] took a nature walk with [their] kids, where [the students] were able to use the GPS, but [the students] also did identification of some specimens from the trees and [the teachers] implemented the soil into it and the different terrains to get the geography standpoints.

According to Ms. Paul, “working with those two ladies, really helped out a lot.”

The program existed for three years.

By having that program, the students took on more ag classes and they definitely commented that if they hadn’t taken that class they wouldn’t have taken more ag classes. Some of them have actually gone on to pursue careers in the ag field,

one of them is actually an ag teacher. [Ms. Paul] thinks that program definitely brought life to ag and a different concept to those students of what ag was.

“Due to number, [they] weren’t able to continue that program.” According to Ms. Paul, “the first class had over twenty [students]. Then over the years it kind of dwindled, and they couldn’t justify having the core teachers with so few in a class.” Ms. Paul also stated,

[she] is not scared to ask for donations. The connections [Ms. Paul] has at the university or within the community will donate to us as well. It may be simple things. Whenever [she] taught horticulture, [she] called one of the major companies in [the neighboring community] and was able to obtain plugs, for a penny a plug, and was able to recoup [their] expenses and make a lot of profit off of one sale. The kids definitely had a hands-on experience there and they learned from this early stage of it, what to do. [The students] did all the marketing for it and things of that sort.

The Carla Agricultural Department facilities consists of three classrooms, a small animal room, a teacher office, a storage room, mezzanine storage, a greenhouse, an outside land lab area, and an agricultural mechanics laboratory. Ms. Paul’s room covers approximately 2000 ft² and contains seating for 36 students at four foot high tables with stainless steel tops. The room has a whiteboard located at the front along with a projector and projector screen. There is a teacher station located at the front of the room as well. To the left of the teacher station is a food science work station, which consists of a full size refrigerator, an oven, a sink, and counter space. There is cabinet storage

both above and below the counter space. To the right of the teacher work station there is also counter space that has storage below, and there are two bulletin boards located above the counter space. Located beside the counter space is a storage room that is approximately 48 ft², and the room contains cabinet storage as well as shelving units. Next to the storage room there is a large overhead door. Opposite the storage room, there is a 12' x 16' floral cooler, which sits next to the small animal care room and in between the floral cooler, and the small animal room there is a water faucet. The small animal care room encompasses approximately 360 ft² and contains counter space with cabinet storage above and below. The room also contains a stainless steel dog wash bay, a stainless steel examination table, seven small animal cages, and a washer and dryer. Windows are located between the small animal room and the classroom for easy viewing by the teacher. Ms. Paul's room also has mezzanine storage above the computer lab.

In between Ms. Paul's room and classroom two, there is a small computer lab (300 ft²) that contains twelve computers, two filing cabinets, and access doors into both classrooms. Classroom two has eight foot tables with seating for 30 students. The teacher work station is located at the front of the room and there is a six foot upright storage cabinet located behind the teacher work station. Beside the teacher work station, there is a whiteboard along with a projector and projector screen. On the opposite side of the room from the teacher work station, there is a second six foot upright storage cabinet, and the side wall is lined with counter space with cabinet storage below. At the back of the room, there is more counter space with storage above and below, a sink, an oven, and a full size refrigerator. Next to the refrigerator there is a teacher office that is

approximately 60 ft². On the other side of the office door there are two fish tanks that have cabinet storage below.

The third classroom is located just a short distance down the hall from the other two classrooms and covers approximately 720 ft² with seating for 21 students at six foot tables. Classroom three contains four student computers and a 'computers on wheels' work station. The teacher work station is located at the front of the room next to the whiteboard and the projector. There is counter space lining the one side wall with cabinet storage below. There are five compound microscopes that magnify up to 100x located on top of the counter space. Classroom three is connected to the agricultural mechanics laboratory, which encompasses over 2000 ft². The agricultural mechanics laboratory contains a shelving unit next to the entrance door, which houses the welding helmets, welding gloves, and welding jackets. Beside the shelving unit there was two six foot upright storage cabinets. The lab contains two sinks, restrooms, and a set of lockers. Opposite the lockers, there is a tool storage room that is approximately 160 ft² and contains shelving units and tool cabinets. The lab contains a band saw, table saw, sliding miter saw, drill press, tire changer, metal cutting band saw, chop saw, sand blaster, metal shear, and large grinder. There are seven shielded metal arc welders along the side wall with ventilation located above them. In addition to the seven arc welders, there are two oxy-acetylene rigs, three MIG welders, and a plasma cutter. At the end of the lab, opposite the classroom, there is a large overhead door. Above the classroom there is mezzanine storage.

Located outside of Ms. Paul's classroom are a small land lab area and a polycarbonate greenhouse. The greenhouse is 800 ft² and contains gas heat with circulating fans on the ceiling, when the heat is on. It also contains evaporative cooling pads on one end and two exhaust fans on the opposite end with a temperature controlled heating and cooling system. There are five tables in the greenhouse and two doors, one at each end of the greenhouse. The land lab area consists of raised flower beds, a picnic table, and space to provide hands-on experiences for the students. The land lab area is surrounded by a six foot high chain link fence and covers 4000 ft².

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

According to Ms. Paul, for other teachers to be successful and increase the rigor in their classroom, "...they need to approach their principals or if they have a career technology director and tell them that [core-subject integration] is important to them and start some collaboration there." Ms. Paul believes "if the opportunity is given to attend the different programs that are out there..." the teachers should take advantage of those opportunities." She stated, "...there are scholarships out there to go to different conferences or CEU's; [she] would encourage that." According to Ms. Paul, "that is how [she] got [funding] for [some professional development workshops]."

Ms. Paul believes teachers need to "...stay current with technology." She mentioned the teachers in her department "...are supposed to be getting SMART boards and [she] has already been looking at lessons that dealt with utilizing the SMART boards." Just recently, Ms. Paul and her students were "...talking in vet med about how

some of the things that were actually done by a human being are being done by equipment, such as dictation and x-rays.” According to Ms. Paul,

[agricultural teachers] have to stay current with whatever is going on in society. [She] has gone to a science conference for a few days where [she] learned different things, like how the science teachers teach their kids to learn and that helped out too.

Ms. Paul believes, “...stepping outside of [agricultural education] professional development and seeing if they can attend those core [professional development workshops]” could assist in increasing the rigor in the classroom. Ms. Paul “...even went to the family consumer science, the culinary institute, and [she] thought how can [she] relate this to [her] class. [She] actually found material for [her] food technology classes; [she] learned different ways how to teach.”

Currently, Ms. Paul has “...a former student that works for the USDA and they are putting lesson plans on their Web site.” She believes,

...if [the agricultural education profession] could make some collaboration with [the USDA] or a company like Monsanto, where they are doing some collaboration of lessons to make it easier for the teachers, which have those core classes integrated in there as well. ...That would be very beneficial to where you have that team developed already.

Ms. Paul thinks “...the universities can play a big part...” in helping teachers advance in the area of academic integration. She believes universities should “...take a

day where just labs are done and to where the teachers are maybe from the standpoint of a student.” Ms. Paul went as far to suggest,

no offense to the professors, but I do know that a lot of them have not been in a classroom for a while. To put them into that setting again, as an instructor in a high school setting, might even give the professors a better concept of what they need to be doing to better prepare the teachers.

Summary

In summary, the Carla Agricultural Education Program is a moderately to highly integrated program for the following reasons:

- The Carla Agricultural Program works closely with other core-subject departments within the Carla High School, and the Career and Technical Director encourages collaboration. The Career and Technical Director plans meetings and sets aside time for the agricultural educators to meet and collaborate with core-subject teachers on a regular basis.
- Students enrolled in certain agricultural education courses at Carla High School can earn fine arts credit towards graduation.
- Ms. Paul regularly utilizes inquiry based instruction to teach agricultural concepts in her classroom through inquiry based questioning and experiments.
- Numerous students enrolled in the program participate in the FFA agriscience fair and have earned awards at both the state and national levels. The projects conducted for the agriscience fair are usually highly involved and require the assistance of individuals with a broader knowledge than the agricultural teacher

possesses. Therefore Ms. Paul enlists community members to assist her students in conducting their agriscience fair experiments.

The data from this case study reveals that the Carla Agricultural Education Program can be classified as a temporal coordination agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

In temporal co-ordination, each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines. The timetable is adjusted so that topics within the subjects or disciplines, which are related, are scheduled at the same time. Similar topics are taught on the same day or week while remaining part of a subject-based teaching program. Students study the concepts of the different subjects separately, and are left themselves to uncover the relationships. This approach has been described also as 'parallel' or 'concurrent' teaching. (p. 553)

Ms. Paul stated she meets informally as well as formally with the core-subject teachers at her school. A large part of her interaction and collaboration occurs informally, before or after school hours, following questions that arise while Ms. Paul is teaching or planning lessons. According to Ms. Paul, the CTE at Carla High School takes time every year to analyze the state standardized assessment scores for their students. The CTE department looks at the overall student performance as well as the performance levels of the students who are involved in the CTE courses. After they have analyzed the results of the state standardized assessments, the CTE department then

sets goals for the year about where they can implement things in their classroom to help improve the state standardized assessment scores. “For instance, one year [the Carla School High School] had very low scores in English, so [the CTE department] went to a [state standardized assessment] formatted test” (Paul). According to Ms. Paul, “all of us in our department are mentors of students that have not passed one or more of their sections of their [state standardized assessment].” To assist the teachers in being better mentors and strengthen the assistance they are providing in their classroom, the Carla CTE Department has “...had some of [the core teachers] come to [their] department meetings, and they gave [them] some examples of what they are needing the kids to understand” (Paul).

Ms. Paul has a good working relationship with the science teachers in her school and does not hesitate to stop by their classrooms and ask questions. Ms. Paul believes, “...when the kids are able to utilize different methods of learning; that’s when it definitely helps out.” She mentioned she has heard about students that have commented during science classes “...that they have lots of repetition, they learn it in [agriculture class] and go and learn it in [science class], or they may have heard it in their science classes, but [in agriculture class they] actually do more hands-on components...”

To assist in connecting the curricula between the classrooms, Ms. Paul infuses inquiry based instruction into many lessons she teaches. According to Ms. Paul, inquiry based learning can be recognized in her classroom by observing the experiments that take place in her classroom as well as through the questioning techniques that she employs. Ms. Paul admitted when she incorporated agriscience fair type projects into

her classroom, the level of inquiry based learning was elevated. She said she plans to start incorporating those type projects into more of her curriculum to assist the students even further in developing problem solving skills. Ms. Paul allows students to openly discuss the happenings in the other classrooms so that she can draw from the students' experiences and alter her teaching. Altering her teaching helps to ensure the students truly understand the link between the information taught in other classrooms and the content taught in her classroom. Many times student discussions can change the direction of a lesson within Ms. Paul's classroom.

Students within the Carla Agricultural Education program, who are members of the Carla FFA, are encouraged to develop and conduct an agriscience fair project to be entered in the FFA Agriscience Fair competition. Each year a few Carla FFA members compete in the regional and state FFA Agriscience Fair competitions. The Carla FFA and Ms. Paul have a long history of winning entries at the state FFA Agriscience Fair competition and have represented their state at the national FFA Agriscience Fair competition.

Case Study #6

The Roger Agricultural Program was selected for this case study for the following reasons: the program was recommended by an agricultural educator within the state; students in the Roger Agricultural Education Program can earn science credit for enrollment in certain agricultural education courses; students enrolled in the Roger Agricultural Education program participate in the FFA Agriscience Fair and generally place well at the state, regional, and national competitions; Mr. Bradley, the agricultural

education teacher at Roger High School, regularly utilizes inquiry based instruction in his classroom; and Mr. Bradley works closely with the core-subject teachers in his school in an attempt to assist students in retaining information. The case study was conducted during the first month of the school year, during the school day, and the site visit was conducted in a half of a day. Interviews with Mr. Bradley and former students, teacher developed lesson plans, program budgets, and the facilities available to the agricultural education program served as the data sources for this case study.

Roger High School is located in a community in the Northern U.S. with a population of 270 as of July 2009 (www.city-data.com). According to the U.S. Census Bureau, the community is classified as a rural community. A majority of the population is White (96.6%) with a median age of 33.4 years, an average household income of \$48,991.00, and a median property value of \$56,376.00 (www.city-data.com). The community was very small and the school was surrounded by farmland. The community possessed older construction with very little new housing in progress.

The Roger High School building was located along the main road that connected the town to the highway and possessed a gravel parking lot for faculty, staff, and student parking. The building was small and of older construction with an addition to the building under construction. Roger High School is comprised of approximately 135 students in grades seven through 12 and possesses one agricultural educator. The agricultural education department was located at the back of the school, but the easiest access was through the main entrance at the front of the school.

The Roger Agricultural Education Program has "...kind of a more of traditional composite ag ed one, two, three, four type system and then junior high students"

(Bradley). Mr. Bradley stated in the junior high program

[he] will have the seventh and eighth graders for one quarter each, so half of the eighth graders first and then second quarter, and then the seventh graders [he] has in the spring third and fourth quarters. Then the freshmen are required to take ag for one semester, so basically [he] sees every student seventh grade through freshmen year for a quarter or semester at least. Then sophomore up is elective.

According to Mr. Bradley, "typically about 75% of the students in the school take ag classes."

Mr. Bradley said academic integration "...is something that, from day one, was very deliberate." Mr. Bradley "...incorporates as much as [he] can." According to him ...there is so much application of science in agriculture, [he] is not sure where one starts and one ends. As far as the language arts, [he] has the students write reports, and [the students] give tons of speeches, presentations, formal and informal. [He] certainly tries to work in as much of the English as [he] can.

When talking about mathematics, Mr. Bradley mentioned he incorporates "mathematics, of course, in ag mechanics and animal science. [He] tries to do as much math as [he] can." According to Mr. Bradley,

all of our teachers, the science, the English teachers, the math teachers work really well with [him]. [He] is not afraid to ask questions: What is a better way to teach this term? How do I figure the angle of this rafter?

He stated he is "...not real great at geometry, so [he] is asking [the geometry teacher] all the time for help in geometry.

Mr. Bradley explained that "the first year or two when [the Roger High School] switched from industrial arts to agriculture, there was a lot of: Why are we learning this sort of thing? [and] Why are you grading my paper like you are an English teacher?" In response Mr. Bradley explained to the students that "...you can't leave English class and forget how to structure a sentence." He claims,

now the students are so comfortable with it, they know that [they] are going to be doing article reviews and write a half page summary; they know they are going to stand up in front of the classroom and speak on a particular topic that they were researching.

Mr. Bradley's student, Jenna, "...remembers writing papers..." According to her, "[she] wrote papers on different types of diseases when it came to animals." Jenna also mentioned when Mr. Bradley graded papers, he focused on "proper grammar and making sure [each student] had all the content, just like [each student] would be graded in English, making sure [each student] had what he required they had in information, proper format."

When asked about students receiving academic credit for agricultural classes, Mr. Bradley stated the students can receive a biology credit for his botany/horticulture

class, but there are no other academic credits that can be earned through agricultural education courses. According to Mr. Bradley, “as far as ag, [they] are working on [adding more courses that can be counted for academic credit], but [he] has not seen anything and [they] have a post-secondary school a half hour down the road.” He stated, “[he] has had lots of conversations about dual credit for ag, but it just hasn’t happened.”

When asked about the role that the core-subject teachers play in his curriculum development, Mr. Bradley stated, “...we try to share and make sure we don’t overlap when it comes to planning.” According to him it is important to share with the other teachers,

because when [you] start teaching you walk in and you think there are all these topics, what should I teach, which ones don’t I [teach]. And from year one to two it changes so much and two to three to four and so on. Finally, you kind of feel like you have your little niche marked out.

Mr. Bradley “doesn’t want to do too much of what the biology instructor is covering, so [he] has backed off on genetics. [The biology teacher] does an outstanding job of genetics, so [he] will talk more about the ag application of those genetic concepts.” According to Mr. Bradley,

[Roger High School’s] new geology instructor...is all about soils and geology and all that good stuff. So [Mr. Bradley] has backed off a little bit [on those topics], because [the geology instructor] really covers some of those things.

Mr. Bradley said the “the sophomores come into my ag class and they are like we already did soil triangles, we already did soil profiles, and all those good things, then

that allows [him] to get into something else that [the geology instructor] doesn't cover.” Mr. Bradley continued and said, by doing this it allows “...us to talk about soil fertility, because that is not being covered over in [geology] class.”

As far as the curriculum planning, Mr. Bradley “...thinks it is kind of fun, [we] work together so that we don't overlap too much. We still have some replication, but it allows us to cover more things.” He stated he and the other teachers

...then just bounce ideas, if [he] has a question about botany, for my botany/hort class, the structure of something, cells and plants and whatever else, [he] is not afraid to walk across the hall and ask [the biology teacher]: So wait a minute, when I went to college there were five kingdoms, when did that change?

The meetings and curriculum planning within the Roger High School is “mostly informal.” According to Mr. Bradley,

we have had the curriculum planning as a school system, what was the atlas curriculum mapping that was formal at an in-service. Last year, we went over the state standards for science, math and English, so those kinds of things are kind of formal. [He also] sat in on the science group.

Mr. Bradley's state does not “...have [agricultural education] standards in [his state] yet; they are in the works.” He stated he does not completely follow the national AFNR standards, but “[he] has certainly taken a look at them” and there are future plans for state agricultural education standards in his state.” Mr. Bradley said, “when we develop the [state] standards, we [will] have a copy of [the national AFNR standards], and we [will be] working with them together.” He continued by saying he “...knows the

big discussion too is that if a sophomore at [one school] and their family moves to [another school], and the next year he or she is going to take ag in [the new school], then [the student] should be kind of at the same point.” He mentioned one of the goals of the standards should be “that the freshmen classes in one school look like the freshmen class in the other school.” Mr. Bradley believes “the guidelines [to standards implementation] will probably be fairly loose.”

When asked about resource sharing among teachers within his school, Mr. Bradley explained that his agricultural program “is actually part of a career and tech center...” Mr. Bradley “is employed by the Regional Career and Tech center, not by the [Roger High School].” There are six agriculture programs within the [Regional] Career and Tech center, and the six programs often share resources. According to Mr. Bradley, the Regional Career and Tech center “has a Bobcat skid steer loader. We were the first program in [the state] to offer Bobcat training and skid steer certification.” He also mentioned the Regional Career and Tech center “has a meats trailer. [They] have a 36 foot enclosed low body car trailer [with] tables, meat saw, grinders, stuffers, the whole nine yards. [They] have a mobile meats lab that [they] rotate through the programs.” The center also has “small engines and electrical wiring [kits]. All those kits move.” According to Mr. Bradley, “there is no reason for one program to have 10 Briggs and Stratton engines collect dust for 11 out of 12 months, so this way we move them around. It has been a lot of fun.”

Mr. Bradley then mentioned they “are also part of a high tech consortium that is bigger than the center...” The high tech consortium includes the laser, robotics, and

some things that are not necessarily ag, but more of your high tech stuff [like] CNC milling.” The consortium is comprised of 13 schools. The [educational materials] rotate. [Each school] has six weeks with the materials before it moves on to the next school.” “[The rotation] schedule will come out in late spring for next year, so [each teacher] has some time then to plan.” Mr. Bradley feels he probably does not use the consortium educational materials enough. He stated, “...there are some really nice biotech materials; [the consortium] has got the electrophoresis gels and the centrifuge kit.” Mr. Bradley’s “...philosophy...” is that he “...thinks a lot of [consortium teaching aids] are not necessarily ag related.” He stated, “the lasers are fun and the CNC milling is really cool.” Mr. Bradley’s hang up with the materials is if he is

...going to do three weeks of CNC milling that means [he] has got to take out three weeks of something else. So, if [he] looks at what is ag and what is not ag, yeah there is ton of math application to the lasers and engraving and the robotics and all that stuff; [he] just has a hard time teaching some of those things and not teaching animal science, plant science, economics, and leadership.

Mr. Bradley stated he does

...try to get [the educational materials] to other teachers in the building. There is an embroidery machine that the FCS teacher...uses. Aviation is really cool. The science teacher loves the aviation equipment, but [Mr. Bradley] is not going to teach aviation. So there is a lot of money sitting in tubs in [his] shop.

According to Mr. Bradley, “when [he] first started teaching, [he] did way too much lecture.” He believes lecturing “...was just a crutch...” Mr. Bradley claims “over the course of the years [he] has done a lot better job of adding labs.” He stated,

instead of talking about germination and emergence let us go do it, let us see it, and with the addition of the greenhouse in 2000 that really made those labs come to life. So, in an agronomy lab setting, we are going to do germination and emergence, and we will do a rag doll test just for seed germination. We will take that [data], then [the students] jump on excel and each group will compare their data. There is your math application, and some computers as well. Then with seed germination you talk about the science of cell division and all those kinds of things that go with it. Then after the [plant] comes up, [he] has the students dissect the different plants. [The students] look at the difference between grasses and broad leafs, as far as root structure and where cell division is taking place and those kinds of things.

According to Mr. Bradley, “it gives us a chance to do a lot of different science concepts with one activity, with one lab, that may take us a couple of days then.” The hands-on plant activities were confirmed by Mr. Bradley’s student, Jenna. She stated, “we worked in the greenhouse a lot, transferring plants. We were out front [of the school] building, that little project patio out front, planting in there. We went to the natural resource center and planted over there.” Another student, Mike, mentioned along with the hands-on activities they “...learned about the stamen, pistol, and how the pollen travels down

to the ovary...” According to Mike, “it is basically the same as any other biology class; it is just kind of not so intense.”

When asked about labs that involve chemical usage, Mr. Bradley said he has not done many in the past, but “[he] will be doing some more this year.” He stated his classes “...are going to do some pesticide spraying and then talk about grasses, broad leafs and 2-4-D versus round up...” Mr. Bradley also said his classes have done “...the DNA extraction, not really a lot of chemicals, other than salt and dish soap.” He then mentioned “the one [lab] that is actually dangerous is the electrophoresis [lab], because one of the chemicals is actually a carcinogen.”

Other labs Mr. Bradley’s students recalled were focused on animal reproductive systems, landscape design, and Bobcat driving certification. According to Jenna, “one day [Mr. Bradley] threw out the reproductive system of a gilt on the table, and that is what we learned that day.” She said this lab “...was probably [her] most interesting memory of what [she] learned in [Mr. Bradley’s] class.” Mike mentioned he recalled talking about reproductive systems in the larger animals such as equine and cattle.

When talking about landscape design, Mike said he remembered “...[the students] did a [landscape] design for the superintendent’s new house; [they] did a design on what the property should look like.” He also recalled doing another landscape design lab where the students “...would have a divider in the road...” and they had to figure out “...what kind of landscaping [they] would have.” Jenna also remembered this lab and stated they “...went out to one of the houses here in town that had just been built...” and “...drew up a plan specific to [the homeowner’s] needs.” Jenna continued

to say Mr. Bradley had the students focus on: “How much [the plants] would grow? If they were big plants or smaller plants and whether they would take over each other?”

Mike added, when creating the plans for the landscape design plan, “[they] did scales...” and were required to incorporate “all the aspects of [landscape design] from tiling, to walls, to plant shrubs that we wanted, or other landscaping things if we wanted, like if we wanted rocks in there, or whatever.” Mike also mentioned

one of the things that [Mr. Bradley] stressed was balance. You don’t want to overdo, you don’t want to have a whole bunch of big trees here and then go straight to the little plants. There has to be a flow to the property and to all the landscaping features that there are.

Another lab Jenna recalled was the Bobcat driving certification. According to Jenna, she recalled the “Bobcat certification [lab]...was fun. We learned how to drive a Bobcat.” She said the students

...learned all about [Bobcats] one day and how to drive them. [Mr. Bradley then] got a Bobcat out here, and [the students] would practice using it. [Mr. Bradley] would set up a little course thing, and [the students] would practice it. Then [Mr. Bradley] would watch [the students] do it, and [each student] got certified...

According to Mike, Mr. Bradley’s classes “...give more of a practical spin on the everyday courses that you have to take.” Mike continued by saying,

we take a biology [class], [and] we talk a lot about the terms in biology. We do a lot of critical thinking questions, but we don’t really do anything that applies

what we learn. Like in math classes, we really find out the importance of why you need to learn your fractions, or in biology... it gives a reality kind of check of why it is important that we need to learn the things we do.

Jenna confirmed Mike's point by mentioning she "...didn't take a lot of science classes, because [she] didn't enjoy them. So when [science skills] were [in agriculture] [she] did enjoy them. [She] would say it helped with most of [her] science skills..."

Mike and Jenna also said Mr. Bradley's classes helped enhance their math skills in addition to their science skills. According to Mike,

when we are doing projects with construction, there is a little math that you need to do in your head. So you know we are going to cut this board to $3 \frac{1}{4}$ then you have to measure it twice and take into account the kerf of the blade, $\frac{1}{8}$ ". It all blends together instead of just doing projects on paper; we are doing problems you know to actually make something happen...

Jenna mentioned Mr. Bradley required the students to calculate bills of materials and measure plants. Furthermore, Mr. Bradley taught the students about geometry in floral arranging when he talked about designs being "symmetrical and asymmetrical."

When asked about the techniques that Mr. Bradley uses in his classroom to enhance retention, both students mentioned his hands-on approach to education. Mike said,

we basically do two different types of things. There is the standard classroom learning where we learn all the terms and you learn all the different functions. Then there is also the kind of hands-on type of thing. Like when we are doing

construction projects we will talk about all the different types of wood and why we should use this. We will go over the different measurements that we will have to use and the different tools we will have to use. Then we will also get out there, and we will actually have to apply those things.

For example:

we are going to test different milks for different impurities, I guess you could say, you know we learn all about that stuff, but then going and actually seeing or feeling, tasting whatever that is one way that he definitely helped me learn.

Jenna then mentioned

[Mr. Bradley's] curriculum was very laid out and straightforward. There was information you were expected to learn, and you got it all. If you remembered everything that he presented to you, then you did well. There were no tricks to what he taught you or tricks to his grading scale. He wanted you to do well, and he provided everything you needed to do well. That is how you learned it, because there wasn't anything hidden. ...The classroom style, kind of helped too, having the computers in the classroom and having the tables made it easy to do projects. He is energetic and excited about it. If you didn't want to do something, and he knew you could do it, he would highly encourage you to do it until you decided it was probably a good idea. And then you do it, and you do it well. That was good knowing that someone believed that you could do it, so you thought you could yourself.

Both students classified Mr. Bradley's classroom as student-centered. Jenna said his classroom is "student-centered for sure." She continued by saying his classroom "...works nice for him as a teacher too. He has got cabinet space and computers, and he has got everything he needs to teach well, but it is based on what the students need."

According to Jenna,

[Mr. Bradley] is not going to have a sink and an oven in [his classroom] if it isn't beneficial to the students. We always had everything we needed, and if we didn't there was a way to get it. He would figure something out through the center or through the school; he would use his resources.

Mike stated he "...would have to say definitely student-centered. There is a lot that we do. He will explain things, but then we will be doing a lot more than he did. We will take more time doing things ourselves than him teaching." According to Mike, "we will take notes. Some people learn really well with just taking notes, reading things, you know there are other people that can't learn that way, so we will go out in the shop and do stuff and we will get hands-on. He covers his basis pretty well with that." Mr. Bradley "is pretty nice person; you can get along with him really well" (Mike).

According to Mike, Mr. Bradley "...sets up a good rapport with the students. He knows how to not only teach things to us, but he can capture our attention at the same time."

In addition to the variety of activities that Mr. Bradley utilizes in the classroom, Mr. Bradley also runs a successful Supervised Agricultural Experience (SAE) program and FFA chapter. According to Mr. Bradley, "[he] will start SAEs with freshmen in class, and [he] will take a week at the end of the calendar year and start their proficiency

awards.” He stated they “...don’t do a ton of record books, and [he] has gone back on forth on that and [thinks] maybe [he] should.” According to Mr. Bradley, “the national proficiency award really is a pretty basic record book. If [the students] can keep track of hours and dollars earned and spent, that is really all the record book they need.” Every student has a “...folder, and inside of there they have record pages so they can keep track of their hours. [Mr. Bradley] encourage students to have a calendar.” He even “...had a student this year that kept all of his hours in his cell phone.” In his mind,

whatever it takes [for them to keep records], some of them write it on the calendar and at the end of the month they total them up. [He] encourages students to write it down in whatever system they feel comfortable with. But if you keep track of your hours and your dollars earned and dollars spent and any changes in inventory, that is really about all you need.

According to Mr. Bradley, “with the sophomores and up, what [he] does is [he] takes the first Friday of the month and [the class] runs to the computer lab” to work on their record books. Mr. Bradley mentioned “this month will be cover page and page two, and next month is page three and the next month is whatever.” He then grades those pages over the month in between working on the record books and “then [the students] will make the changes the first Friday of the month and work on the next page, so in the course of nine months [the students] will have their proficiency awards ready to rock and roll for the spring.” “Every student, sophomore and up, has an SAE” and “most of the freshmen [have an SAE], but because they are not all FFA members, [he] is not real strict.”

According to Mr. Bradley, “most of [the SAEs] are going to be in horticulture, turf grass, floral, fruit and vegetable.” He

would say 20%, one out of five maybe [is horticultural related], turf grass is the biggest. There are more students who do that than any, but then you can take your turf and vegetable production and roll it into diversified hort. Hort areas are the biggest ones. After that, probably your grain production, specialty crop, we have got a lot of sugar beets in the area, of course soybeans and corn, the valley is really pretty much corn and beans, it looks kind of like Iowa.

As for the Roger FFA, Mr. Bradley says they “...are a pretty active chapter.”

According to Mr. Bradley, [the chapter] was a national models of innovation finalists in community development in 2007.” He mentioned “there isn’t a month where [they] aren’t running somewhere, doing something, or a day when [they] aren’t planning for the next two things.”

“Last year, [the Roger FFA] had 118 [members], and this year [they] are still working, but [they] will be right in there again 100 to 100 and teens” (Bradley). “Some of [the FFA members] are graduates” (Bradley). Mr. Bradley

thinks [he] had 101 out of 135 in school. With the seventh, eighth, and ninth graders, because they are in a required ag class, [he] doesn’t require FFA membership, because they may not be there by choice. But with sophomores and up, if they are in ag class, they are part of the ag class, and they are FFA members.

Mr. Bradley's "very first year teaching, [he] had 16 FFA members, all of them were boys." During

that one year in between, when [the Roger High School] switched from industrial arts to ag, there was a gentleman here for one year. He was very old fashioned, let us just say. [Mr. Bradley] remembers [his] first day of school when [he] was talking to the students about joining FFA and what this FFA could look like.

[He] had an eighth grade girl raise her hand and ask if she could join FFA. [He] said of course you could, well she said, 'last year girls couldn't join.'

After that comment, Mr. Bradley then understood "...why there were only 16 boys."

Mr. Bradley "...thinks [the Roger FFA's] highest [membership enrollment] was 128, and [they] were two away from getting another delegate at state convention. [He] thinks [they] will be pretty consistent [this year] in the 120s with the school enrollment where it is." According to Mr. Bradley, "that [membership] growth was based on opportunities; students compete in everything, every level at state events." "Last year at state convention, the only teams [the Roger FFA] didn't have were a dairy cattle team and an ag communications [team]. In [their] district leadership events, [the Roger FFA] will have somebody in every category" (Bradley).

According to Mr. Bradley, [the Roger FFA] goes to [the neighboring state]..." each year to compete. The university in the neighboring state, "...has ag activities day, and they put on a bunch of events" (Bradley). "...The events are a little different..." because they are "...across the river now...in [the neighboring state]" (Bradley). Mr. Bradley stated they "...will jump across the river twice [a year] and [they] will do some

[neighboring state] stuff. [The Roger FFA] will take 35-40 students every year” to the ag activities day in the neighboring state. If Mr. Bradley “...doesn’t have a team, [he] rounds up students to try it and they end up doing it.” According to Mr. Bradley, “you find someone who you think [might be interested]...” and encourage them to participate. For example: “You know you are really good at this floral thing, you should give it a shot” or “you know you would be really good at meats judging, I know you butcher a lot, you should try this meats contest.” Mr. Bradley also said,

...it is not that we just go [to the neighboring state] and show up and eat and leave. I mean we have had teams win. We have a lot of teams in the top three, individuals in the top ten, not every event, every day, every year. As long as there is something to write about in [the local] news the next day...

According to Mr. Bradley, “the CDEs, the ones that [the Roger FFA] has been successful in, are the ones that didn’t exist 10 years ago, 15 years ago.” He said, “when [he] was a student it was all about dairy cattle judging and livestock judging, and today [he] doesn’t even have a dairy team and [the Roger FFA] livestock team is coached by the student teacher and that has been successful.” Mr. Bradley stated,

the food science [CDE], ag communications [CDE], we have been to nationals in both of those. We are going to nationals in food science again this year. Ag sales, we have had good ag sales teams. That didn’t exist when I was a student. Wildlife didn’t exist. Equine existed, the hippology part didn’t, but there was horse judging. I don’t know anything about horses, so we have got a gentleman that comes in and works with the horse team.

According to Mr. Bradley, “when you are in [this area], we don’t have range judging really. We don’t have a ton of livestock. [Mr. Bradley] thinks [they] have three livestock producers in the district. There may be two or three students that have livestock. He stated there are tons of horses. “...They are everywhere, so we have a lot of kids that are interested in horse judging and hippology.” So according to Mr. Bradley, “you have to really find the needs of the students, so if it is not in dairy cattle judging, because there are no dairy cows anywhere, well then I guess we will have retool and find what the students are interested in.” In his program, “whatever the students are interested in... [He] finds the time to schedule practices or bring someone in who is good at that event.

As for “community service stuff, [the Roger FFA] does a lot of different community service activities. Some of that is planned as a class” (Bradley). According to Mr. Bradley,

I have never really made that distinction that all FFA activities have to be after school or that all community service projects have to be done by FFA students after school. I think that we should teach leadership in the classroom. So the freshmen handled the Souper Bowl food drive. So we will have different classes do different community service projects. The freshmen, seventh graders in the spring, plant flower beds and do some community service stuff. Our botany hort class, we have got a landscape project north of [the neighboring community] that they do, medicine wheel project. So a lot of those community service projects

are done during the day and as a class, and then of course there is stuff after school and weekends and what not, as well. So it is integrated, the FFA in the classroom. I don't think we go to the point to where I am going to teach FFA contests in the classroom, yes we teach a floral unit and we are going to do some floral identification. My freshmen floral unit, we do 15 or 20 floral ID. We will spend a day on floral arrangements, a day doing corsages and boutonnières. It is not like I am going to teach 126 plant identification in my floral unit, and [the students] are going to be ready to go to the floral contest. So we will give a taste of different things and so that you are at least familiar with what that career looks like, because they should be careers, it is an FFA career development event. But I am not going to spend two months doing crops judging in the classroom...

Mike and Jenna were both heavily involved in the Roger FFA, and both students competed national CDE event. Jenna has competed on numerous CDE teams and represented the state FFA both in the agricultural communications CDE as well as the food science CDE. Whereas Mike has concentrated his efforts on the food science CDE, competing in that CDE since his freshman year, and has represented the state at the national food science CDE (but not on the same team as Jenna).

In addition to the CDEs, Mike has also participated in the FFA Agriscience Fair. Mike's "...agriscience fair project was on pollution. [Mike] tested for different pollutants within different soils along roadways." According to Mike,

[he] first had to decide what roads [he] wanted test. [He] tested three different soils: one at the top, one in the ditch, one farther out into the field; [he] tested

those along an interstate, a highway, and a county road. [He] took different samples. After [he] collected all that stuff, [he] went up to the [state land grant university's] science lab up there, [he] ran it through, [he] thinks a gas chromatography unit. [He] tested for anything and everything that could be in that soil. So [he] tested, [he] mixed it with this organic compound and from there it took everything, it basically spread it all out so [he] could get an accurate reading of what was in that soil.

Mike continued by stating,

the results weren't so favorable, they went totally against [his] hypothesis, there is apparently very minuet levels of anything in the soil. So [he] found out [his] hypothesis was wrong, but [he] would like to go back and test it on. [He] just tested the top soil, but it probably sinks farther down in the soil than just what is on the few first inches on the top. [He] didn't really find anything, but still it was a pretty fun project in the end. It was really fun, and [he] learned a lot.

Jenna is currently a student at the state land grant institute pursuing a degree in marketing. According to Jenna, her involvement in Mr. Bradley's classes definitely influenced her career choice. She mentioned "...when [she] started [her] CDEs, [she] started in food science, and that is where [she] decided [she] enjoyed marketing because of the product [her team] prepared and how [they] marketed it to judges and went through the presentation process." Jenna went on to say, "I would say that [my involvement] has everything to do with why I chose to go into what I am going into."

Mike will begin his post-secondary schooling at a state institution and plans to pursue a degree in history education. According to Mike, Mr. Bradley's "...style of teaching..." really helped influence him. Not necessarily on his decision to become a teacher, because Mike "...has known [he] wanted to be a teacher for a long time", but more on what he wants "...to aim to be like..." Mike believes "...that if [he] can apply how [Mr. Bradley] teaches things to a history course or any social studies course, [that] would definitely increase the learning power of students."

The Path Followed to Successfully Integrate Core-subject Concepts

Mr. Bradley has 15 years of teaching experience and has been teaching at Roger High School for all fifteen years. To begin his path to becoming a successful and progressive agricultural educator, he earned a bachelor of science degree in agricultural education with a minor in biology and then went on to earn a master of science degree in agricultural education. Mr. Bradley possesses an agricultural teaching certificate and a science teaching certification, which allows him to offer a biology credit for his botany/horticulture class. Mr. Bradley is a humorous individual who relates well with his students. He injects humor into his classroom constantly in order to keep the students entertained. He has a true passion for teaching, and this is evident by the rapport he has with his students and the enthusiasm he possessed when answering the questions within the case study. Mr. Bradley was constantly smiling throughout the duration of the case study and thoroughly enjoyed informing me about his program and his students' accomplishments.

“Trial and error” has been one of most prominent ways that Mr. Bradley has prepared himself to increase the rigor in his classroom. According to Mr. Bradley, in order for teachers to add rigor into their classroom and become more progressive in academic integration, “the biggest thing is that [agricultural educators] just have to be open minded and [they] have to be willing to do some things and change and try stuff.” Mr. Bradley admits, “it would be really easy for [him] to do ag and not even think about writing reports and doing speeches or to integrate mathematics. Some of it is so inherent, math in agriculture is just there, and science the same.” According to Mr. Bradley, agricultural educators cannot “...be afraid to talk to the teachers in the building, and find out, maybe [their] sentence structure isn’t perfect and the way [they] do bibliographies or the way [they] cite materials” is not the proper format. Mr. Bradley mentioned “[Roger High School] had an outstanding speech teacher for a long time and she retired now a couple of years ago. She was awesome and very talented and very willing to help answer questions and what not.” Mr. Bradley admits

[he] has learned a ton from the students, because they came from the speech program and they get involved in FFA and do extemporaneous and memorize and whatever else. [He] picked up a ton from the students when it came to presentations and things like that...

When referencing his formal training in the area of academic integration, Mr. Bradley mentioned “...there may be some in-services every once in a while...” on this topic. He stated his school has conducted “...some in-services on writing...” Mr. Bradley then continued on and mentioned the numerous “...sessions on the ag teacher

side...” According to Mr. Bradley, the agricultural education profession has “...lots of in-services on different science labs, food science labs, biotech, those kinds of things...”

Mr. Bradley elaborated on the professional development sessions within the profession and stated that “we have our summer conference for our ag teacher association. There is also a summer class. It is a five day course. They tend to be ag mechanics, but we have had other things as well.”

When it comes to professional development outside of the agricultural realm, Mr. Bradley said he is “...not a member of the science teachers group at all.” He

...is a member of his state’s nursery greenhouse association; [he] was a member of that for a number of years (The [State] Nursery Greenhouse Management Association). [He] went to a couple of their meetings, and they talked more about landscaping and those types of issues and the horticulture and what not.

Mr. Bradley’s attendance at professional development workshops is funded “through the center.” According to Mr. Bradley, “[the Regional Career and Tech center] has been very supportive...” He is not sure “...how aggressive...” of a budget the center has, but he is sure they have “...a pretty decent budget as far as attending workshops and what not, a lot of Perkins money.” Mr. Bradley mentioned “the career and tech center director is very positive about increasing [teachers’] education. The career and tech center pays for masters credits; [they] started that a couple years ago.” Mr. Bradley is not sure “how many schools reimburse their teachers to go to grad school.” He believes “some of that is an indication about how positive they are about getting out and learning...”

Tools and Resources Currently Utilized in the Agricultural Education Classroom

The Roger Agricultural Department operates on a budget of over \$6000.00 a year. This budget includes repairs and maintenance, telephone, travel, and supplies. The facilities consists of a classroom, a small storage room attached to the classroom, an office connecting the classroom to the agricultural mechanics laboratory, an agricultural mechanics laboratory, a tool room in the agricultural mechanics laboratory, a storage area in the agricultural mechanics laboratory, mezzanine storage, and a greenhouse attached to the school. The classroom encompasses over 750 ft² and consists of seating for 27 students at six foot tables with chairs. At the back of the room, there is seven student computer stations with a shelf located above the computers to store SAE record books. Along the one side wall there is a stove, a small refrigerator, a sink, and counter space that has cabinet storage above and below. There is also a six foot cabinet located beside the counter space. There is a teacher work station located at the front of the room in addition to a white board, two bulletin boards, and a SMART board. A small storage room (~ 96 ft²) is attached to the classroom and contains a full size refrigerator, shelving units, and a six foot storage cabinet. Located beside the storage room is an office (~ 96 ft²) that has counter space as a desk with cabinet storage below and shelving above. Behind the teacher desk, there are more shelving units and a six foot storage cabinet. The office is a connection between the classroom and the agricultural mechanics laboratory.

The agricultural mechanics laboratory encompasses approximately 2000 ft² and contains four welding booths with arc welders and ventilation above. Beside the

welding booths, there is an oxy-acetylene station with a manifold system. The agricultural mechanics laboratory contains six work stations, two sinks, lockers, and an overhead door. There is a band saw, table saw, drill press, two sliding compound miter saws, scroll saw, and a metal band saw located in the lab. There is also a six foot tool cabinet, tool room, wood storage area, and mezzanine storage. The tool room (~ 96 ft²) contains shelving units and a six foot upright cabinet. The wood storage area (~ 96 ft²), has a wood storage rack and the flammables cabinet.

Attached to the agricultural mechanics laboratory is a greenhouse that encompasses over 375 ft² and has an electronic temperature control system with two heaters and two fans. The greenhouse also contains an irrigation system, five metal tables, and three shelving units.

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

According to Mr. Bradley, the number one thing that teachers need "...is that [academic integration] has to be an atmosphere in your school." A teacher needs "...those academic teachers that are willing to work with [them]." Unfortunately, Mr. Bradley believes "...there are those teachers in other schools who are territorial; I am the science teacher and you are not, kind of deal." So in the end, those agricultural teachers who want to advance "...get no help from their science teachers..." According to Mr. Bradley, "you have got to have the partnership in your school."

In addition to the assistance from other teachers, Mr. Bradley stated you have to "...be willing to try, be willing to be creative." According to him,

I fail all the time. You do something in the greenhouse, because it will be really cool, this will be a really awesome lab, and then it completely flops. What you thought you will be able to demonstrate, nothing works, so you throw it away. At least that is a teaching tool, so what didn't work, so next time what if we did this? That is half of science is just trying stuff. It is same thing when you are teaching math, then I make myself look like a fool because the kids in the back are like wait a minute that isn't the right answer, so what did I do wrong. I don't know if that is a skill, but it is an attitude.

A good budget is another tool or resource Mr. Bradley feels is very important. According to Mr. Bradley, "if you are going to have test tubes and beakers and a digital scale and electrophoresis equipment, you have got to have some budget for it." He mentioned "early on, we steal as much as we can from the other teachers." Mr. Bradley stated, "[he] is not going to buy microscopes, because [he] has got them 50 feet from [his classroom]."

When asked about curriculum materials that may be of assistance to teachers, Mr. Bradley said as long as "...teachers are willing to attend the national ag teachers conferences, there is some good stuff there." He also alluded to industry as a resource as well. According to Mr. Bradley, companies such as Hummert International have "...an outstanding program in the summer, ...it is a 3 or 4 day program and that was really cool." Mr. Bradley also mentioned the "...state in-service conferences. If they have sessions that deal with science and math integration and those kinds of issues, those are all good."

According to Mr. Bradley, “as far as curriculum, ...some of the textbooks that [he] has in the back of the classroom are pretty elementary.” He believes “other than going to college level and bringing those textbooks in, which you can certainly pull bits and pieces, ...[he] has not seen a lot of great textbooks.” Mr. Bradley stated “you can use them as a reference, pull some stuff out every once in a while, but not as a sit down let us do chapter one. [He] doesn’t think students like sitting down and doing chapter one questions and chapter two questions quiz.”

Summary

In summary, the Roger Agricultural Education Program is a moderately to highly integrated program for the following reasons:

- Students enrolled in the botany/horticulture class at Roger High School can earn science credit towards graduation.
- Mr. Bradley frequently collaborates, mostly informally, with core-subject teachers to help better teach his students and to help his teaching remain consistent with the core-subject classrooms.
- Mr. Bradley regularly utilizes inquiry based instruction to teach agricultural concepts in his classroom through inquiry based questioning and experiments.
- Numerous students enrolled in the program participate in the FFA Agriscience Fair and have earned awards at the state and national level.

The data from this case study reveals that the Roger Agricultural Education Program can be classified as a temporal co-ordination agricultural education program,

when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

In temporal co-ordination, each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines. The timetable is adjusted so that topics within the subjects or disciplines, which are related, are scheduled at the same time. Similar topics are taught on the same day or week while remaining part of a subject-based teaching program. Students study the concepts of the different subjects separately, and are left themselves to uncover the relationships. This approach has been described also as ‘parallel’ or ‘concurrent’ teaching. (p. 553)

Mr. Bradley stated he meets informally as well as formally with the core-subject teachers at his school. A large part of his interaction and collaboration occurs informally, before or after school hours. The collaboration usually occurs following questions that arise while Mr. Bradley is teaching or planning lessons. According to Mr. Bradley, the school system has conducted in-service trainings for curriculum mapping, and last year they reviewed the science, math, and English standards. During this in-service time, Mr. Bradley attended the session in regards to the science standards. Mr. Bradley has a good working relationship with the core-subject teachers in his school and does not hesitate to stop by their classrooms and ask questions. He enjoys working together with the science teachers when planning curriculum “...so that [he and the science teachers] do not overlap too much, we still have some replication, but it allows us to cover more things” (Bradley). Mr. Bradley also encourages his students to discuss

what they learned in the core-subject classrooms during his class, because then he is able to make stronger links between the material being presented in the core-subject classrooms and the concepts being taught in his classroom. He mentioned he does a lot of trial and error, and when those experiments do not work, that is when he will enlist the help of the core-subject teachers to solve the problem. Mr. Bradley also stated he learns a lot from listening to the students about what they have learned in other classes.

To assist in connecting the curricula between the classrooms, Mr. Bradley infuses inquiry based instruction into many lessons he teaches. According to Mr. Bradley, inquiry based learning can be recognized in his classroom by observing the experiments that take place in his classroom as well as through the questioning techniques that he employs. Mr. Bradley claims he infuses core-subject concepts into his classroom whenever they naturally occur in his curricula.

Students within the Roger Agricultural Education program, who are members of the Roger FFA, are encouraged to develop and conduct an agriscience fair project to be entered in the FFA Agriscience Fair competition. Each year a few Roger FFA members compete in the regional and state FFA Agriscience Fair competitions. The Roger FFA and Mr. Bradley have a long history of winning entries at the state FFA Agriscience Fair competition and have represented their state at the national FFA Agriscience Fair competition. Additionally, Mr. Bradley has received the National FFA Agriscience Teacher award in the past and was recognized at the National FFA Convention.

Variable-Oriented Cross-Case Analysis

The variable-oriented cross-case analysis summarized the findings of this study by identifying common themes and categories that existed among the case studies. The cross-case analysis examined each section (The Path Followed to Successfully Integrate Core-subject Concepts, Tools and Resources Currently Utilized in the Agricultural Education Classroom, Tools and Resources Needed for Other Agricultural Educators to Successful in Core-subject Integration) of the individual case studies. The common themes and categories were reported below.

The participant group represents a diverse background of teaching experience; overall, the group has taught 79 years. Two of the communities where the schools were located were classified as rural communities based on the United States' Census Bureau community classification. The remaining four communities were classified as urban clusters. The average household income of the communities was \$42,650.00. Two of the teachers were employed by schools that included the seventh and eighth grade classes in their high school building and the remaining four, only contained grades nine through 12. The student body of the schools ranged from 135 to over 2800. Over 25% of the students, enrolled at the six schools participate in activities and/or classes provided by the Agriculture Education Department (See Table 4.1).

The Agriculture Programs employ between 1 to 4 teachers. Among the participants, three had earned a bachelor of science in a field other than Agriculture Education (i.e. animal science or integrated crop management). Five out of the six teachers have earned a master's degree in either animal science or agricultural education,

and one teacher is currently in a doctoral program focusing on administrative leadership. All of the teachers are agricultural teaching certified. Three of the teachers possess a science teaching certificate, and three teachers possess an additional teaching certification beyond agriculture or science (see Table 4.1).

Table 4.1

Matrix of Agricultural Education Program and Teacher Statistics

Profile	CS110	CS210	CS310	CS410	CS510	CS610
Type of Community	Urban Cluster	Rural	Urban Cluster	Urban Cluster	Urban Cluster	Rural
Population	15706	683	8173	3827	86679	270
Median Income	41841	56302	44074	28224	36463	48991
# Students (9-12)	1051	x	1250	315	2800	x
(7-12)	x	400	x	x	x	135
# of students in ag	585	210 (includes 7th & 8 th grade)	135	85	400	100 (includes 7th & 8th grade)
# Teachers	4	2	1.5	1	4	1
Years of Experience	26	9	3	9	16	16
Bachelors	an sci and ag ed	ag ed	an sc	int. crop mgt	ag ed	ag ed
Masters	an sci	ag ed	ag ed	ag ed	x	ag ed
Doctorate	in progress - Admin Leadership	x	x	x	x	x
Ag Cert.	yes	yes	yes	yes	yes	yes
Science Cert.	no	yes	in progress	yes	x	yes
Other Cert.	no	biology	x	AEST	state core	x

When examining the curriculum the participants were teaching, the data revealed that most of the programs were teaching courses that could be classified as non-

traditional when compared to agricultural education programs 10 to 20 years ago. For example: two teachers offered a veterinary medicine course, two offered a floral design course, three were teaching natural resource/environmental science courses, three were teaching food science courses, and one teacher offered an applied biology course. Other courses such as animal science, plant and soil science, agricultural mechanics, agricultural business, and the traditional leveled agricultural education courses (i.e. Agriculture 1, 2, 3, and 4) were offered as well. Students enrolled in five of the six agricultural education programs can earn science or biology credit towards graduation through certain courses, and students in one program can earn a fine arts credit towards graduation (see Table 4.2).

In one of the programs, the core curriculum standards serve as a structure and framework for the curriculum planning of the agricultural education courses. Among the other programs, two of the teachers incorporate core curriculum standards and concepts as much as possible to assist in increasing state required test scores. The remaining three teachers incorporate core concepts when they naturally occur within the curriculum. Core curriculum teachers assist both formally and informally with the planning of agricultural curriculum. According to the participants, two of the schools conduct scheduled meetings between the agricultural teachers and the core curriculum teachers; two of the teachers meet informally with the core teachers, but do schedule meetings from time to time to discuss integration; one of the teachers mainly receives informal assistance from the core-subject teachers in his school; and one teacher receives very little assistance from the core-subject teachers in their school. Every teacher stated they

utilize inquiry based instruction in their classrooms often, but one of the teachers believes that she could utilize inquiry based instruction more often than she currently does. In addition to inquiry based instruction, all of the teachers regularly teach by utilizing hands-on, experiential based methods and attempt to facilitate a self-directed atmosphere in their classrooms (see Table 4.2).

In reference to the other two circles, of the three circle model of a complete agricultural education program, three of the teachers conduct a strong SAE program, two programs conduct a moderately strong SAE program, and one teacher does not place much emphasis on SAE projects within his program. Five of the six programs possess a highly involved FFA chapter and one program has an FFA chapter that is involved, but not nearly as extensively as the other five programs. The average FFA membership exceeds over 100 members between the six participating programs. Students in the participating schools have won state CDE competitions in Food Science, Floriculture, Ag. Communications, Ag. Sales & Marketing, Livestock Judging, and others. Even though one participating school does not have a highly involved FFA chapter, students in that program regularly conduct FFA Agriscience Fair projects, and generally these projects earn high rankings at the state and national FFA competitions. Of the remaining five programs, two participants conduct agriscience fair-type projects within the school district. The other three programs regularly participate in the FFA Agriscience Fair, and their students generally win awards at the state and national competitions (see Table 4.2).

Table 4.2

Matrix of Curriculum, Role of Core-subjects, and FFA per Program

Curriculum	CS110	CS210	CS310	CS410	CS510	CS610
Animal science	x	x	x			
Vet Med/Science		x			x	
Plant and Soil Science	x		x	x		
Ag Mechanics		x	x	x		
Horticulture						x
Floral Design			x		x	
Landscape Management			x			
Natural Resource	x		x	x		
Food Science	x		x		x	
Applied Bio			x			
Ag Business				x		
Ag 1,2,3,4						x
Core Credit	science	biology	biology	science	arts	biology
Role of Core	Structure	When it naturally occurs - as much as possible	When it naturally occurs - as much as possible	When it naturally occurs - as much as possible	As much as possible to assist	As much as possible to assist
Core Teacher Role	Formal assistance - scheduling	Informal assistance - very willing to assist	Professional learning community each week	Not very willing to assist	Mostly informal, but a few formal mtgs	Mostly informal, but a few formal mtgs
Inquiry Based Instruction	often	often	not as often as she would like	often	often	often
Chemicals	regularly	a few	not very often	often	often	a few
Hands-on	yes	yes	yes	yes	yes	yes
Self-directed	yes	yes	yes, but Could do better	yes	yes	yes
Agriscience Fair	yes	yes	Within the school	Within the school	yes	yes
SAE	weak	moderate	strong	strong	strong	moderate

Curriculum	CS110	CS210	CS310	CS410	CS510	CS610
FFA	Moderately involved chapter	Heavily involved chapter	Heavily involved chapter	Heavily involved chapter	heavily involved chapter	heavily involved chapter
National CDE	Food Science	x	Ag Sales	Floriculture	Food Science	Food Science, Ag comm, Ag sales
FFA Members	?	110	135	52	120-150	100-120

The Pathway Followed to Successfully Integrate Core-subject Concepts

When asked about the pathway followed to become progressive in the area of academic integration, all of the participants eluded to their high level of personal motivation to advance themselves in the area of core-subject integration. Through their personal motivation, the teachers seek out and attend numerous professional development workshops and conferences to assist in advancing their knowledge. All of the participants participate in professional development offered by their state post-secondary institutions as well as participate in the state and national agricultural teacher associations' annual conferences and workshops. Four of the five participants attend professional development activities conducted by state teacher associations outside of agricultural education (i.e. science teacher associations), and one attended national professional development activities hosted by the National Science Teachers Association. Five of the participants spent countless hours questioning core-subject teachers about how to teach core-subject concepts, and four out of the six mentioned they rely on "trial and error" in their programs to increase their knowledge base. During the "trial and error," the teachers capitalize on the teachable moments that occur when

new ideas do not go as planned. Three of the participants write grants to obtain teaching materials for the programs, and three teachers seek out community support to not only learn new information but also for financial assistance. Standardized curriculum can be found in two of the participating programs, and two of the teachers have been or are currently involved in the Dupont National Agriscience Teacher Ambassador Academy and the National Agriscience Integration Institute (see Table 4.3).

Table 4.3

Matrix of Pathway Teachers Followed Beyond Post-Secondary Schooling

Pathway	CS110	CS210	CS310	CS410	CS510	CS610
Personal Motivation	yes	yes	yes	yes	yes	yes
School In-service	x	yes-works with science department	yes	x	yes - works with science department	yes
University	ALS Summer	yes	yes	AEST	yes	yes
State Ag Teacher	x	yes	yes	yes	yes	yes
National Ag Teacher	x	yes	yes	yes	yes	yes
State Other	x	yes	yes	x	yes	yes
National Other	x	yes	x	x	x	x
Questioning	yes	yes	yes	x	yes	yes
Trial and Error	yes	x	yes	x	yes	yes
Dupont	x	yes	yes	x	x	x
Grants	many	many	x	a few	x	x
Community	yes	x	x	x	yes	yes
Standardized Curriculum	ALS	x	x	AEST	x	x

Tools and Resources Currently Utilized in the Agricultural Education Classroom

When observing the facilities available to the participants, all six programs had classroom space, an agricultural mechanics laboratory, a greenhouse, and access to computers for students to use. The classrooms available to the participants ranged in size from 600 ft² to 2000 ft² and contained seating for 16 to 36 students. All of the classrooms were equipped with movable tables and chairs and either a SMART board or a white board. Two of the classrooms were fully equipped to teach food science courses (containing a conventional oven, at least one sink, and at least one refrigerator). Two other classrooms had a refrigerator, but no oven. Three classrooms contained either five or six lab stations, which included a sink at each lab station. Five classrooms had mounted projectors, and the sixth classroom had a computer lab with a mounted projector next door that is only used by the agricultural department. All six programs possessed or have direct access to compound microscopes to conduct inquiry based learning activities. There was a floral cooler located in two of the classrooms; one was a 4' x 6' cooler, and the other was a 12' x 16' cooler. All of the classrooms and the programs possessed numerous cabinets for storage, and five of the programs had storage rooms in addition to the cabinet space (see Table 4.4).

The agricultural mechanics laboratories averaged over 2000 ft², and all of the laboratories contained welding booths (ranged from four to eight booths). All of the agricultural mechanics laboratories were equipped with shielded metal arc welders. Three of the laboratories contained MIG welders. Five of the laboratories possessed oxy-acetylene rigs. One program owned a plasma cutter and one program contained a

TIG welder. Lockers were located in three agricultural mechanics laboratories and two programs possessed mezzanine storage. Five of the agricultural mechanics laboratories included tool rooms and four of the laboratories contained tool cabinets in addition to the tool rooms. For ease of project construction, all of the agricultural mechanics laboratories included an overhead garage door and one of the programs had two overhead garage doors on opposite sides of the laboratory to allow for movable projects to be pulled in one door and out the other door (see Table 4.4).

Each of the participating programs had access to a greenhouse to allow for plant soil science lab activities to be conducted. The greenhouses ranged in size from 375 ft² to 1200 ft². Five of the greenhouses were constructed of poly carbonate material and one greenhouse was constructed with a combination of polycarbonate material, and polyethylene. Four of the greenhouses contained an electronic temperature control system, two contained an aquaponics unit, an irrigation system was installed in one greenhouse, and one greenhouse had a head house attached (see Table 4.4).

Five of the six programs had individual teacher offices. Other facilities available for teaching included an ornamental garden, a land lab, and a livestock show arena. To assist in the maintenance of the numerous facilities, two programs also included an outside storage shed (see Table 4.4).

Table 4.4

Matrix of Available Resources

Available Resources	CS110	CS210	CS310	CS410	CS510	CS610
Operating Budget	18000	no prescribed budget	5000 + lab fees	legislature funded	provided by CATE director	6000
<i>Classrooms</i>						
Number	4	2	2	1	3	1
Sq. Footage	750	600	1600	2000	2000	750
# of Seats	26	25	34	16	36	27
Tables	yes	yes	yes	yes	yes	yes
Computers	access to COWS	13	computer lab - 25	10	computer lab - 12	7
Stove	x	x	x	x	1	1
Sink	6	5	x	5	2	1
Refrigerator	x	1	x	1	1	1
Floral cooler	4 x 6	x	x	x	12 x 16	x
SMART board	3	1	x	x	x	1
White board	x	1	1	1	1	1
Projector	1	1	x	1	1	1
Lab stations	6	5	x	5	x	x
Microscopes	numerous	6	10	3	5	borrows
Tall cabinets	x	2	1	x	x	1
<i>Ag Mech Lab</i>						
Sq. Ft.	2000	1500	3200	1500	2000	2000
# of Welding Booths	8	6	5	5	6	4
Arc Welders	8	6	6	3	7	4

Table 4.4 continued

Available Resources	CS110	CS210	CS310	CS410	CS510	CS610
MIG Welders	8	x	12	x	3	x
TIG Welder	x	x	1	x	x	x
Plasma Cutter	x	x	x	x	1	x
OA Rigs/Stations	8	1	x	2	2	1
Lockers	x	x	1	x	1	1
Work Tables	6	3	8	x	1	6
Metal Storage	x	yes	x	x	x	yes
Wood Storage	x	x	x	x	x	yes
Mezzanine Storage	x	x	x	x	yes	yes
Tool Room	x	1	2	1	1	1
Cabinets	yes	x	yes	x	yes	yes
Compressed Air	yes	x	x	x	yes	x
Table Saw	x	x	x	x	1	1
Band Saw	1	x	1	x	1	1
Metal Band Saw	x	1	x	x	1	1
Drill Press	x	x	1	x	1	1
Cut-Off Saw	x	x	x	x	2	x
Miter Saw	x	x	x	x	1	2
Metal Shear	1	x	1	x	x	x
Radial Arm Saw	1	x	x	x	x	x
Overhead Door	1	1	2	1	1	1
Tire Changer	x	x	x	x	1	x

Table 4.4 continued

Available Resources	CS110	CS210	CS310	CS410	CS510	CS610
Sand Blaster	x	x	x	x	1	x
<i>Greenhouse</i>						
Material	poly carbonate	poly carbonate	poly carbonate	polyethylene / poly carbonate	poly carbonate	poly carbonate
Sq. Ft.	375	500	960	1200	800	375
Tables	x	8	6	9	5	5
Electronic Temp Control	x	yes	x	yes	yes	yes
Irrigation	x	x	x	x	x	yes
Head House	x	yes	x	x	x	x
Aquaponics Unit	x	yes	x	yes	x	x
Storage Room	2	x	1	1	2	1
Other Facilities	outside ornamental garden	x	show arena - 2400 sq. ft.	x	land lab area	x
Storage Shed	x	on order	8x16	x	x	x
Office	x	yes	yes	yes	yes	yes

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

When discussing the tools and resources other teachers need to increase rigor in their classrooms, the participants discussed: teacher's personal attitudes; longer, more in-depth professional development workshops; agricultural educator resource sharing; and changes in pre-service curriculum. One of the most prominently discussed topics

involved a change in teacher attitudes. Most of the participants brought light to the fact that many of the teachers in the agricultural education profession possess a mentality that it is not their responsibility to teach students the core-subjects. Some of the participants believe before any major changes will take place in classrooms, personal attitudes and mentalities need to change. The participants believe that the attitude change needs to start at the pre-service teacher level. If teachers are taught from the beginning that they, along with the entire school community, are responsible for the students' performance, then rigor in the agricultural classrooms will elevate. Furthermore, according to the participants, pre-service teachers need to be taught how to actually integrate core-subjects into their curriculum and should be shown through modeling (See Table 4.5).

Current professional development workshops were discussed and the participants believe they are not long enough, thus not in-depth enough to truly assist teachers with core-subject integration. A few of the participants mentioned that a teacher cannot thoroughly learn enough in a single one hour session to feel comfortable implementing the new concept in their classroom. Therefore, strong professional development should be multiple hours long or consist of multiple sessions to assist with the attitude and mentality change (see Table 4.5).

The participants also mentioned that one of the best ways they learn new methods of teaching and gain new insight into core-subject integration is by talking with other agricultural teachers and sharing ideas and materials. One of the participants stated that she greatly increased her knowledge by assisting with the development of the standardized curriculum in her state, because she was able to sit around and talk to other

teachers about what they have done to teach different lessons. Furthermore, two of the participants mentioned the idea of a resource sharing website, one that is potentially done in conjunction with agricultural industries, to provide an outlet for teachers to share and discuss what they have done in their classroom. The participants also mentioned talking with core-subject teachers and bouncing ideas off one another is a great way for teachers to become more informed in the core-subject areas. This leads into the next point, which is collaboration with core-subject teachers. According to the participants, working with the core-subject teachers in the school is one of the best ways to help increase rigor in your classroom. One participant mentioned that teachers cannot be afraid to admit when they do not know something and must be willing to ask for help especially if it is in relation to core-subject concepts. Of course, for this to be possible, one also needs the support of the core-subject teachers or otherwise the collaboration and questioning cannot take place (see Table 4.5).

A few other tools or resources mentioned were standardized curriculum, administrative support, community assistance, and a justifiable budget. One of the participant's states has a standardized curriculum and she feels that standardized curriculum has definitely helped to increase the rigor in the agricultural education classrooms across her state. One of the other participants works in a state that has a few classes that can be counted for dual credit, and there is a standardized curriculum that teachers are required to teach to retain dual credit status. According to a few of the participants, administrative support is crucial for teachers to be able to increase the rigor in their classroom. If administrative support is not present and the culture within the

school does not promote integration and collaboration, then it will be difficult for teachers to change their attitude and advance their classroom (see Table 4.5).

Table 4.5

Matrix of Tools and Resources Needed by Other Teachers

Tools/Resources	CS110	CS210	CS310	CS410	CS510	CS610
Standardized Curriculum	yes	x	x	yes	x	x
Other Teacher Support	yes	yes	x	x	x	yes
Collaboration	yes	yes	x	x	yes	yes
Personal Attitude	yes	yes	yes	x	x	yes
Administrative Support	x	x	x	x	yes	yes
Pre-Service Change	yes	yes	yes	x	yes	x
Community	yes	x	x	x	yes	x
Longer Professional Development	x	yes	yes	yes	yes	yes
Resource Sharing	x	yes	yes	yes	yes	x
Budget	yes	yes	x	x	x	yes

Summary

All of the programs are “at or above” a Level 4: Nesting on The Integration Ladder as proposed by Harden (2000). Two of the programs are a Level 4: Nesting, which means the teachers in the programs “...target, within a subject-based course, skills relating to other subjects. Content drawn from different subjects in the curriculum may be used to enrich the teaching of one subject” (Harden, 2000, p. 552). Three of the

programs are classified as a Level 5: Temporal Co-ordination, which means “...each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines” (Harden, 2000, p. 553) and one of the programs is classified as a Level 8: Complementary program (see Table 4.6).

The complementary approach has both subject-based and integrated teaching. The integrated sessions now represent a major feature of the curriculum. These sessions are recognized to be, in terms of time, allocated resources and assessment as important, if not more important, than the subject-based teaching. The focus for the teaching may be a theme or topic to which the disciplines can contribute. (Harden, 2000, p. 554)

Table 4.6

Matrix of Levels of Integration

Summary	CS110	CS210	CS310	CS410	CS510	CS610
	Level 8	Level 4	Level 5	Level 4	Level 5	Level 5
	Complementary	Nesting	Temporal Co-ordination	Nesting	Temporal Co-ordination	Temporal Co-ordination

CHAPTER V

CONCLUSIONS, IMPLICATIONS, AND RECCOMENDATIONS

Chapter 5 outlines the purpose, objectives, procedures, and findings of this study and states the conclusions found from the data analysis. Recommendations for teachers, administrators, and state agricultural education staff members are presented, as well as future studies pertaining to academic integration are presented.

Purpose and Objectives

The purpose of this study was two-fold: 1) Identify the path that progressive agricultural educators, who were successful in integrating core-subject concepts, particularly STEM, in their classroom followed, and 2) To determine the tools and resources progressive agricultural educators believe other agricultural educators need in order to follow a similar path (see Figure 1.1). Thus, the following research questions were developed:

5. What path did progressive agricultural educators follow to successfully integrate core-subject concepts into their curriculum?
6. What tools and resources were currently utilized in agricultural education classrooms that were identified as successfully accomplishing core-subject integration?
7. What tools and resources are needed for other agricultural educators to implement core-subject integration within their classroom?

Summary of Procedures

The population of this study consisted of six agricultural educators, one from each region outlined by the National Association of Agricultural Educators (NAAE). Participants for each case study were initially identified by professionals within their state. These professionals are directly involved with the agricultural education teachers (i.e. agricultural teacher educators, state agricultural education staff, and/or state FFA coordinators/directors). The teachers were then contacted via email to establish their interest or willingness to participate. Once initial contact via email was made, each teacher participated in a screening process to determine which teachers met the operational criteria outlined by the researcher: 1) are science and/or math credits offered for the courses they teach; 2) are inquiry based learning methods being employed; 3) do agricultural educators collaborate with core-subject teachers; 4) do agricultural educators encourage students to participate in the FFA Agriscience Fair; and 5) is the teacher a member of the National Association of Agricultural Education (NAAE).

A comparative embedded multiple-case study research design was employed to answer the research questions. For this study the researcher utilized the multiple-case study design for literal replication purposes. The researcher traveled to each of the participants' schools to conduct the case studies. Prior to traveling to the participants' schools, the participants were asked to identify former students who would be willing to participate in the study and arrange for them to be present during the case study. The students had to meet the following operational criteria: 1) the students will have previously graduated from high school; 2) the students were enrolled in the agricultural

education program all four years of their high school career; and 3) the students will have taken at least two courses that were instructed by the participant.

Each case study consisted of two separate, semi-structured interviews: 1) the teacher and 2) the former students. In addition to the semi-structured interviews, a content analysis of multiple lesson plans was conducted, classroom operating budgets were examined, and observations and an inventory of the facilities took place.

Data collected from both the teacher interviews and the student interviews were transcribed, and a within-case analysis was conducted. Data was unitized, categorized, and coded. The constant comparative method (Glaser & Strauss, 1967) was employed to categorize the data. The categories of data were sorted into emergent themes, and theme titles were developed to distinguish each theme from the others (Erlandson, Harris, Skipper, & Allen, 1993). Two professionals within the field of agricultural education served as coders (reviewing the researcher's themes and suggesting revisions). After all data were analyzed, the within-case analysis continued, consisting of the interview data being triangulated with the additional data collected through facility observations, equipment and supplies inventory, budgetary information, and lesson plan content to establish converging lines of inquiry (Yin, 2006). Following the within-case analysis, a variable-oriented cross-case analysis was performed to compare the results of the within-case analyses and establish converging lines of inquiry.

Summary of Findings

Overall the participants in the study followed similar paths to become progressive in academic integration. All participants appeared to be highly self-

motivated individuals, because they seek out professional development opportunities in order to continuously improve the teaching in their classrooms and increase rigor within their curriculum. Collaboration between agricultural educators and core-subject educators is crucial to increasing rigor in the agricultural education classroom (Myers & Thompson, 2008).

Tools and resources currently utilized by teachers that are progressive in the area of academic integration include: administrative support, adequate facilities, and a budget that allows for the purchasing of equipment and supplies to conduct inquiry based instructional activities. Administrators at the participating schools were supportive of the idea of academic integration in the agricultural science classroom. The participants mentioned it is difficult for agricultural educators to be successful in the integration process if administrative support is not present. Additionally, the participants all possess adequate facilities to conduct academic integration and believe available facilities and budgets affect the success of academic integration. Without proper facilities and supplies it is difficult for teachers to incorporate inquiry based instruction.

Other teachers need numerous tools and resources to be successful in academic integration. According to the participants, longer professional development workshops are needed for teachers to successfully advance in the area of academic integration along with resource sharing opportunities between other agricultural educators and potentially core-subject teachers. According to the participants, budgets also are a constraint for teachers when attempting to advance. The participants believe if a teacher does not have the financial support needed to purchase supplies or equipment necessary for proper

core-subject integration, then the teachers will become discouraged and not place much emphasis on core-subject integration. Although, if the teacher's budget does not allow for extra purchases, then the teacher should take it upon themselves to seek out additional fiscal support to assist in classroom instruction by writing grants or asking the local community for support.

Cross-Case Analysis Conclusions, Implications, and Recommendations

The Path Followed to Successfully Integrate Core-subject Concepts

The paths followed by the participants to become progressive in academic integration were similar. All the teachers in this study are highly educated and continuously seek out new opportunities to improve their teaching and increase their core-subject and agricultural content knowledge. Five of six participants have earned a master of science degree; four were obtained in the field of agricultural education, and one was obtained in the area of animal science. Besides a master of science degree and an agricultural teaching certification, all of the participating teachers, except one, have earned an additional teaching certificate in a subject outside of agricultural education.

Neither the size of the agricultural education program (number of teachers or number of students enrolled), nor the educational pathway followed to reach the agricultural education certification appeared to hinder the participants from becoming progressive in the area of academic integration. Furthermore, neither the years of teaching experience, nor the overall size of the school appeared to affect the pathway the teachers followed to become progressive in the area of academic integration. Overall, the participants possessed moderately high to highly integrated programs that challenged

students. According to the students, the challenging curriculum assisted them in learning core-subject material at a higher level.

According to the students interviewed in this study, they experienced higher retention rates and possessed a genuine interest in the subject matter being taught because their teachers utilized a constructivist approach to teaching by infusing hands-on learning and engaged them in their own learning. In the participants' classrooms, the constructivist approach was evident as each teacher relied upon their students previous knowledge learned in other classes to assist in teaching lessons in their classroom. By incorporating previous knowledge, teachers are better able to create learning experiences that best suit the students and are applicable to the students' lives. According to Brooks and Brooks (1999), when utilizing a constructivist approach in their classroom, teachers focus on connections between facts and assist the students in developing a new understanding. The participants adjust their teaching methodologies according to student responses to questions, and students are encouraged to analyze, interpret and predict information. In a classroom where the constructivist philosophy is evident, teachers utilize more open-ended questions in an attempt to promote discussion among students (Brooks & Brooks, 1999) and rely heavily on hands-on, experiential learning activities in a self-directed classroom. As a result of the teaching methods utilized by the participants, their students enjoy learning new information and retain information at a higher level.

The participants in the study who placed a great deal of emphasis on the FFA Agriscience Fair tended to incorporate agriscience fair-type activities in their

classrooms, teaching their students through the use of inquiry based instruction on a more frequent basis. When agriscience fair projects are conducted as part of classroom curriculum, more students benefit from and more students participate in the FFA Agriscience Fair.

Tools and Resources Currently Utilized in the Agricultural Education Classroom

According to participants, if agricultural education teachers want to conduct highly integrated programs where students have strong understanding of the scientific method and enjoy learning about science, then a close working relationship and high levels of collaboration with core-subject teachers is crucial. Previous research (Chiasson & Burnett, 2001; Dormody, 1993a, Dormody, 1993b; Myers & Thompson, 2008; Pavelock, Woolery, Ullrich, & Kelley, 2009; Thompson & Balschweid, 2000, Whent, 1994) supports this recommendation. Dormody states collaboration between agricultural education teachers and science teachers "...improves science knowledge and skill..." of the agricultural teachers and "...should be encouraged," and "...agriculture teachers should work closely with science departments when developing, implementing, and evaluating agriscience courses" (Dormody, 1993a, p. 58). Pavelock et al. (2009) support the idea of collaboration and state

Agriscience instructors should take the initiative to work with secondary science teachers. CTE teachers should provide science teachers with information regarding objectives covered in agriscience courses that connect science principles to real-life applications and utilize science teachers' knowledge to further integrate core objectives into agriscience. (p. 11)

According to the participants, budgets influence the level of integration within an agricultural education program. The participating programs possess budgets that provide subsequent funding to ensure that materials and supplies are in stock for laboratory activities to take place. A majority of funding is provided by the school districts or the legislature, but a portion of a few of the budgets was obtained through writing grants. Consequently, the participants who engaged in grant writing possessed more advanced technology and equipment specific in its purpose and provided more opportunities to the students when conducting science experiments or inquiry based activities.

Agricultural education facilities also appeared to affect the level of integration within an agricultural education program. Participating agricultural education program facilities are of ample size and provide adequate space for the participants to conduct a variety of classroom activities and employ inquiry based instructional strategies. The participants in the study all possessed instructional laboratories as well as classrooms that supplied space for computers and other teaching materials. Furthermore, the participant facilities contained adequate storage for all materials required to conduct appropriate activities while still allowing storage of materials for other activities.

According to the participants, if teachers do not have the proper facilities to provide for hands-on laboratory experiments, teachers cannot successfully conduct inquiry based instruction to better improve student retention and understanding of science. The proper facilities and materials may include, but are not limited to: a classroom that provides additional space beyond tables, a greenhouse, an agricultural mechanics laboratory, and a storage room for materials and equipment.

Tools and Resources Needed for Other Agricultural Educators to be Successful in Core-subject Integration

Possessing a constructivistic philosophy, teachers can increase rigor in their classroom while integrating core-subjects at a higher level. The constructivist approach to teaching needs to be modeled for pre-service teachers. Additionally, professional development workshops should be conducted for current agricultural educators to ensure that current agricultural educators understand the justification for the concept behind constructivism. Discussing and sharing ideas is crucial to the advancement of integration within the agricultural education classroom, and more opportunities for teachers to share ideas should be provided.

Self-motivation is a key characteristic of progressive agricultural educators. Participants in the study claim they are self-motivated and possess a strong intention to continually improve their teaching and increase the rigor in their classrooms to better serve the students. According to Ajzen (1991), intention

...is a central factor in the theory of planned behavior.... Intentions are assumed to capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior. As a general rule, the stronger the intention to engage in a behavior, the more likely should be its performance.

(Ajzen, 1991, p. 181)

The participants seek out professional development opportunities related to their weaknesses in order to become more proficient in core-subject knowledge. According to

Myers and Thompson (2008), “professional development is paramount to moving the profession forward in integrating academics into agricultural education programs” (p. 219). The participants are willing to admit when they do not understand information and regularly ask core-subject teachers for assistance. According to the participants, agricultural education teachers need to be willing to admit when they lack knowledge in certain subjects and ask for assistance where necessary. If teachers do not ask for assistance, there is a much smaller chance that their knowledge base will grow and opportunity for core-subject teachers to learn about the agricultural education curriculum is limited. The participants believe if core-subject teachers are well-informed about the agricultural education curriculum, there is a greater chance they will be advocates of student participation in agricultural education and the FFA. In turn, support the agricultural education program in times of budgetary shortages.

The participants believe for teachers to become progressive in the area of academic integration, professional development needs to be extended and more detailed (demonstrating new methods and ideas that educators can take back to their classrooms). If teachers feel uncomfortable teaching or talking about core-subject ideas, they are less likely to incorporate core-subject principles into their curriculum (Ajzen, 1991). A few of the participants believe there is an effectual language gap between the core-subject teachers and the agricultural education teachers, and once that gap is bridged, more agricultural educators will feel more comfortable talking about core-subject concepts. One way this gap can be bridged is through collaboration with core-subject teachers. In addition to collaboration among teachers, administrative support is also crucial to the

success of academic integration. If the administration does not support the concept and does not provide opportunities for teachers to collaborate, it is difficult for the agricultural educator to stay motivated to incorporate academic integration into their classroom. Whereas, if the school atmosphere promotes academic integration, agricultural educators more easily stay motivated, and their personal attitudes will remain more favorable to the idea.

Teachers need to seek out alternative funding sources if sufficient funds are not provided by a school district or legislature. Additional sources of funding may be in the form of grants, community donations, or additional creative fundraisers (i.e. plant sales, engine tune-ups, woodcraft sales, metal furniture sales, etc.). If additional funding is not obtained, it could be difficult for teachers to secure the proper equipment and supplies necessary to increase rigor in their classrooms.

It is recommended if integration initiatives are not currently in place, agricultural teachers should take it upon themselves to talk to administration about the idea of providing in-service time for teachers to meet and discuss integration. If, however, administration is not willing to assist in the matter, it is recommended the agricultural educators should communicate directly with core-subject teachers about their interest in integration and develop a working relationship with the core-subject teachers.

According to Wicklein and Schell (1995), “three primary factors... significantly affect the success or failure of the multidisciplinary curriculum: 1) teacher and administration commitment to the integration approach, 2) innovation and effort in curriculum re-design, and 3) administration and teachers’ coordination of integration plan” (p. 70).

Case Study #1 Conclusions

The Larry Agricultural Education Program is a highly integrated program and unique for the following reasons:

- Mr. Bates and the other agricultural education teachers work closely with the core-subject teachers within the high school to plan out the agricultural education curricula each year in an attempt to horizontally integrate the programs. Regularly scheduled meetings are held between the agricultural educators and the science educators to ensure curriculum alignment between classes.
- Students enrolled in three different agricultural education courses at Larry High School can earn science credit towards graduation
- Mr. Bates regularly utilizes inquiry based instruction to teach agricultural concepts in his classroom through the use of experiments that stem from current problems in the agricultural industry.
- Numerous students enrolled in the program participate in the FFA Agriscience Fair and conduct experiments that are highly scientific. A few of the students have worked very closely with a local agricultural business and have conducted agriscience fair projects that help to solve a problem that the local business is experiencing.

The data from this case study reveals the Larry Agricultural Education Program can be classified as a complementary agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

the complementary approach has both subject-based and integrated teaching. The integrated sessions now represent a major feature of the curriculum. These sessions are recognized to be, in terms of time, allocated resources and assessment as important, if not more important, than the subject-based teaching. The focus for the teaching may be a theme or topic to which the disciplines can contribute. (p. 554)

The Larry Agricultural Education Program was established on the basis of being an applied science curriculum, and the state science standards serve as a framework for the agricultural education curriculum. Students in agricultural classes at Larry High School are exposed to constant repetition of core-subject concepts, but in different contexts. Mr. Bates believes, if agricultural education departments want to gain support for their program from core-subject teachers and administration, they must develop more rigorous programs that offer science credit towards graduation. Previous research supports agricultural education programs offering science credit towards graduation (Brister & Swortzel, 2007; Chiasson & Burnett, 2001; Dormody, 1993a; Dormody, 1993b; Johnson, 1996; Pavelock et al, 2009; Thompson & Balschweid, 2000).

Case study # 1 differed from the other case studies because the teacher met with the school's core-subject teachers on a regularly scheduled basis to plan curriculum, and the teacher utilized the core-subject standards as a framework for curriculum planning. In doing so, this teacher had a close working relationship with the core-subject teachers, who in turn have recognized the benefits of participation in agricultural courses have provided their students. One way that core-subject teachers have realized the benefits is

through the collection and analysis of data to see if a student's participation in the agricultural concepts course affected student performance on the state science standardized assessment. At the time of the case study, only one year of data had been analyzed, but a positive difference was already detected. The teacher reported he had skimmed over the most recent results, and from initial glance the teacher believes the students enrolled in the agricultural concepts course out-performed their constituent group for the second year in a row. As a result, according to the agricultural teacher, science educators in the school would like the agricultural concepts course to serve as a prerequisite to the biology one course. This necessitates future comparison of similar data to serve as a means for agricultural education programs to show the true benefits of student enrollment in agricultural education programs.

Administrative support is a crucial element when developing a highly integrated program. The Larry High School administration has been accommodating to Mr. Bates, and the superintendent served as a change agent (Rogers, 2003) for the Larry High School by hiring Mr. Bates to serve as the lead teacher of the program. With a supportive administration and a motivated team of teachers, Mr. Bates has been able to uphold those high standards to greatly benefit the students in his program. If administrative support or if a positive attitude towards academic integration does not exist within the school, then agricultural educators should take it upon themselves to schedule meetings with the principal and core-subject teachers to demonstrate the benefits of academic integration. Previous research states administrative support is

necessary for teachers to be successful in conducting an integrated program (Brister & Swortzel, 2007; Chiasson & Burnett, 2001; Dormody, 1993a; Thompson, 2001).

Mr. Bates believes before the agricultural education profession can advance in the area of academic integration, there needs to be a mindset change among many teachers within the profession. This mind-set change could be brought about by the implementation of some form of standardized agricultural curriculum. Standardized curriculum would assist in increasing the rigor in agricultural classrooms, because it would provide new and beginning teacher with a strong resource to assist them. Efforts to improve the agricultural education profession should be focused on the new and beginning teachers and not on the experienced teachers, because the experienced teachers are set in their ways and will have a higher refusal rate when asked to change.

Case Study #2 Conclusions

The Gavin Agricultural Education Program is a moderately integrated program for the following reasons:

- The Gavin Agricultural Program is part of the science department within the Gavin High School which allows Mr. Chris and his teaching partner an open line of communication with the science educators within his school. Being part of the science department promotes collaboration with other teachers outside of agricultural education.
- Students enrolled in certain agricultural education courses at Gavin High School can earn science credit towards graduation.

- Mr. Chris regularly utilizes inquiry based instruction to teach agricultural concepts in his classroom through the use of inquiry based questioning as well as experiments based on the agricultural concepts taught in his classroom.
- Numerous students enrolled in the program participate in the FFA Agriscience Fair and have earned awards at the state and national levels. The students agriscience fair experiments have enlisted the help of the science teachers within the school to conduct the experiment properly.

The data from this case study reveals that the Gavin Agricultural Education Program can be classified as a nesting agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

Nesting occurs when a teacher targets, within a subject-based course, skills relating to other subjects. Content drawn from different subjects in the curriculum may be used to enrich the teaching of one subject. The term ‘infusion’ has also been applied to this stage of integration where teachers ‘analyze the separate subject’s goals and identify ways in which these generic skills can be refined into existing subjects.’ (pp. 552-553)

The Gavin Agricultural Education program is part of the Gavin High School science department, so Mr. Chris has the opportunity to converse with science teachers on a regular basis during departmental meetings. According to Dormody (1993a), “by teaching in the science department, teachers of agriculture may be increasing knowledge of and access to both science department and agricultural program resources” (p. 58).

Dormody (1993a) goes on to say, “agriculture teachers should be encouraged to form partnerships with science teachers. Isolation can lead to wasteful duplication of effort and resources, and lost opportunities” (p. 58).

Collaboration is a key element to successful integration. Mr. Chris has a friendly personality that enables him to make connections with not only his students but also with other faculty members within his school. His ability to connect with other people enables him to easily collaborate with the core-subject teachers and enlist their assistance whenever necessary. His collaborative efforts benefit the students, because he is abreast on the happenings in other classrooms and utilizes that knowledge to structure his lectures and lessons. Mr. Chris believes the largest barrier to teachers improving in the area of academic integration is communication between the core-subject teachers and the agricultural teachers. Mr. Chris believes agricultural teachers and core-subject teachers are not conversing enough, and agricultural teachers should take an active role in their school’s science departments in order to promote more collaboration. If agricultural educators want to integrate their program, they must collaborate with core-subject teachers on a regular basis (Chiasson & Burnett, 2001; Dormody, 1993a, Dormody, 1993b; Myers & Thompson, 2008; Pavelock, Woolery, Ullrich, & Kelley, 2009; Thompson & Balschweid, 2000, Whent, 1994).

According to Mr. Chris, agricultural education programs need to be constantly changing to meet the needs of the students and the agricultural industry (NRC, 2009). Mr. Chris is a flexible teacher who thrives on teachable moments that appear in his classroom. He develops lesson plans and always has a plan of action in mind but he is

not afraid to deviate from that plan if teachable moments appear. Flexibility is a key factor when attempting to integrate a program (Johnson, Charner, & White, 2003).

Agricultural educators must be willing to adapt and change on a regular basis in order to accommodate their students' and the agricultural industry's needs.

According to Rogers' diffusion of innovation model (2003), Mr. Chris would be classified as an early adopter and an opinion leader within the agricultural education profession. If teachers want to become an opinion leader within education they must attend agricultural education professional development workshops regularly and start attending professional development activities outside of agricultural education. He is dedicated to improving, not only the Gavin Agricultural Education Program, but agricultural education as a profession. Mr. Chris has become a member of the National Science Teachers Association and has begun to conduct professional development workshops for their organization. Mr. Chris believes agricultural teachers are teaching the core-subject concepts, but they are failing to utilize the proper terminology and vocabulary for the students to make the strong connection between the core-subject classroom and the agricultural classroom. The solution to this problem is longer and more in-depth professional development workshops as well as the infusion of academic integration into the pre-service curriculum (Chiasson & Burnett, 2001; Dormody, 1993a, Dormody, 1993b; Myers & Thompson, 2008; Pavelock, Woolery, Ullrich, & Kelley, 2009; Thompson & Balschweid, 2000).

Case Study #3 Conclusions

The Becky Agricultural Education Program is a moderately to highly integrated program for the following reasons:

- Ms. Gates is part of a professional learning community within her school and has cross walked the state agricultural standards with the state biology standards. Ms. Gates and the biology teacher work closely and establish the same deadlines for research proposals for science fair projects.
- Students enrolled in Ms. Gates' applied biology course can earn a science credit towards graduation
- Ms. Gates frequently collaborates, mostly informally, with core-subject teachers to help better teach her students and to help her teaching remain consistent with the core-subject classrooms
- Every student enrolled in the applied biology course is required to conduct a science fair project to exhibit at the school science fair
- Ms. Gates utilizes inquiry based instruction in her class often through structured questioning and experiments.

The data from this case study reveals that the Becky Agricultural Education Program can be classified as a temporal coordination agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

In temporal co-ordination, each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines. The timetable is adjusted so that topics within the subjects or disciplines, which are related, are scheduled at the same time. Similar topics are taught on the same day or week while remaining part of a subject-based teaching program. Students study the concepts of the different subjects separately, and are left themselves to uncover the relationships. This approach has been described also as ‘parallel’ or ‘concurrent’ teaching. (p. 553)

According to Fullan (1993) and Senge (2000), organizations, like schools, who are challenged with the problem of change among their members should consider developing personal learning communities to assist in addressing the future success of the organization. Every teacher at the Becky High School is required to be part of a professional learning community. Professional learning communities meet every Wednesday and discuss issues related to their students (i.e. curriculum challenges, personal issues, events in the community that affect their students, etc.). According to Ms. Gates, meeting in the professional learning communities allows her to collaborate with core-subject teachers more frequently and the learning communities demonstrate that her administration supports integrated programming. Agricultural educators should suggest the idea of professional learning communities to their administration in an attempt to promote collaboration among the teachers within their school. According to Myers & Thompson (2008), “collaboration with other academic teachers through cross-

curricular projects will help students better understand the academic, as well as technical concepts and principles” (p. 219).

The students enrolled in Becky High School agricultural courses can earn biology credit toward graduation by enrolling in an applied biology course taught by Ms. Gates. Moreover, agricultural educators and science teachers need to coordinate efforts to ensure that their course content aligns in order to promote consistency between classes. Previous research supports agricultural programs offering science credit towards graduation (Brister & Swortzel, 2007; Chiasson & Burnett, 2001; Dormody, 1993a; Dormody, 1993b; Johnson, 1996; Pavelock et al, 2009; Thompson & Balschweid, 2000).

According to Rogers’ diffusion of innovation model (2003), Ms. Gates would be classified as an early adopter and an opinion leader within the agricultural education profession. If teachers want to become an opinion leader within the agricultural education profession, they must attend agricultural education professional development workshops at the national level and start attending professional development activities outside of agricultural education. Ms. Gates is only a third year teacher, and she has a passion for improving her teaching and assisting others to do the same. Ms. Gates is a self-proclaimed “conference workshop junkie” who is continuously seeking out new opportunities to improve her teaching. Ms. Gates attended the Dupont Agriscience Integration Institute this past year and learned new and interesting teaching methods to employ in her classroom.

Case Study #4 Conclusions

The Harriet Agricultural Education Program is a moderately integrated program for the following reasons:

- The standardized curriculum utilized in Ms. Cale's classroom is correlated with the National Science Standards.
- Students enrolled in Ms. Cale's program can earn science credit towards graduation, up to two credits, as long as they take classes necessary to be considered completers of the program.
- Ms. Cale regularly utilizes inquiry based instruction to teach agricultural concepts in her classroom through inquiry based questioning and experiments.
- Ms. Cale encourages participation in the FFA Agriscience Fair competition.

The data from this case study reveals that the Harriet Agricultural Education Program can be classified as a nesting agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

Nesting occurs when a teacher targets, within a subject-based course, skills relating to other subjects. Content drawn from different subjects in the curriculum may be used to enrich the teaching of one subject. The term 'infusion' has also been applied to this stage of integration where teachers 'analyze the separate subject's goals and identify ways in which these generic skills can be refined into existing subjects.' (pp. 552-553)

The development of a standardized curriculum for agricultural education would assist teachers with increasing rigor in their classrooms. Ms. Cale is highly involved in the development and revision of her state's standardized curriculum. She believes this work has assisted her greatly in increasing the rigor in her classroom. She claimed by creating a standardized curriculum, more teachers in her state began implementing inquiry based instruction, especially after worksheets and lab sheets were included. The standardized curriculum in her state is cross-referenced with the state science standards as well as other core-subject standards. Previously, research supported the development of standards based teaching resources for agricultural educators (Myers & Thompson, 2008; Pavelock et al., 2009; Dormody, 1993b).

According to Rogers' diffusion of innovation model (2003), Ms. Cale would be classified as an early adopter and an opinion leader within the agricultural education profession. If teachers want to become an opinion leader within the agricultural education profession, they must attend agricultural education professional development workshops at the national level and partake in idea sharing sessions with other agricultural educators. Ms. Cale serves in numerous leadership roles within her state agricultural education profession and is continuously seeking out new opportunities to improve her teaching. She credits her involvement with the groups that revised the standard curriculum to be one of her most informative venues for professional development. Ms. Cale enjoys conversing with other agricultural educators at state and national meetings and believes that there needs to be more time built into professional development workshops for round table discussions and idea sharing. Longer and more

in-depth professional development workshops related to academic integration are required for the agricultural education profession to advance forward (Chiasson & Burnett, 2001; Dormody, 1993a, Dormody, 1993b; Myers & Thompson, 2008; Pavelock, Woolery, Ullrich, & Kelley, 2009; Thompson & Balschweid, 2000).

Case Study #5 Conclusions

The Carla Agricultural Education Program is a moderately to highly integrated program for the following reasons:

- The Carla Agricultural Program works closely with other core-subject departments within the Carla High School, and the Career and Technical Director encourages collaboration. The Career and Technical Director plans meetings and sets aside time for the agricultural educators to meet and collaborate with core-subject teachers on a regular basis.
- Students enrolled in certain agricultural education courses at Carla High School can earn arts credit towards graduation.
- Ms. Paul regularly utilizes inquiry based instruction to teach agricultural concepts in her classroom through inquiry based questioning and experiments.
- Numerous students enrolled in the program participate in the FFA agriscience fair and have earned awards at both the state and national levels. The projects conducted for the agriscience fair are usually highly involved and require the assistance of individuals with a broader knowledge than the agricultural teacher possesses. Therefore Ms. Paul enlists community members to assist her students in conducting their agriscience fair experiments.

The data from this case study reveals that the Carla Agricultural Education Program can be classified as a temporal coordination agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

In temporal co-ordination, each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines. The timetable is adjusted so that topics within the subjects or disciplines, which are related, are scheduled at the same time. Similar topics are taught on the same day or week while remaining part of a subject-based teaching program. Students study the concepts of the different subjects separately, and are left themselves to uncover the relationships. This approach has been described also as 'parallel' or 'concurrent' teaching. (p. 553)

Ms. Paul is proactive when collaborating with the core-subject teachers in her school and regularly attends science department functions to help improve her teaching and ensure that she is staying consistent with the lessons they are teaching. Her collaborative efforts benefit the students, because she is abreast on the activities that are taking place in other classrooms and utilizes that knowledge to adjust her lessons. Ms. Paul and the other teachers in the Carla Agricultural Education Department are cognizant of the weaknesses of their students in relation the state standardized assessments. As part of the CTE department at Carla High School, Ms. Paul and the other CTE teachers review the state standardized test results each summer and determine where they need to focus their efforts to assist in increasing the scores. After setting

goals, the CTE department will enlist academic departments to help develop a plan of action to assist in increasing standardized assessment scores in the weak areas. If agricultural educators want to integrate their program, they must collaborate with core-subject teachers on a regular basis (Chiasson & Burnett, 2001; Dormody, 1993a, Dormody, 1993b; Myers & Thompson, 2008; Pavelock, Woolery, Ullrich, & Kelley, 2009; Thompson & Balschweid, 2000, Whent, 1994).

Administrative support is a crucial element when developing a highly integrated program. The Carla High School administration accommodates Ms. Paul and the other CTE teachers by scheduling time for the CTE teachers to collaborate amongst themselves or time to meet with core-subject teachers. If administrative support or if a positive attitude towards academic integration does not exist within the school, then agricultural educators should take it upon themselves to schedule meetings with the principal and core-subject teachers to demonstrate the benefits of academic integration. Previous research states that administrative support is necessary for teachers to be successful in conducting an integrated program (Brister & Swortzel, 2007; Chiasson & Burnett, 2001; Dormody, 1993a; Thompson, 2001).

Ms. Paul spends many hours attending professional growth workshops and searching for new ideas (via the internet and talking with other teachers, to help improve her program). According to her students, Ms. Paul is constantly altering her teaching methods to accommodate her students' learning styles, and she facilitates an interactive, hands-on, and self-directed classroom (Jacob & Allie). Johnson et al. (2003) stated flexibility is a key factor when attempting to integrate a program. Agricultural educators

must be willing to adapt and change on a regular basis in order to accommodate their students' and the agricultural industry's needs.

According to Rogers' diffusion of innovation model (2003), Ms. Paul would be classified as an early adopter and an opinion leader within the agricultural education profession. If teachers want to become an opinion leader within the agricultural education profession, they must attend agricultural education professional development workshops and be willing share ideas with other agricultural educators. Ms. Paul enjoys conversing with other agricultural educators and believes that there needs to be a system developed to share curriculum ideas. In addition, Ms. Paul believes to change the agricultural education profession, changes at the pre-service level must take place first. According to Balschweid (2002), agricultural education is facing a shortage of qualified teachers... (p. 66). Furthermore, Dormody (1993b) stated "...teacher educators in agricultural education should consider addressing [integration] during pre-service....education.

Case Study #6 Conclusions

The Roger Agricultural Education Program is a moderately to highly integrated program for the following reasons:

- Students enrolled in the botany/horticulture class at Roger High School can earn science credit towards graduation.
- Mr. Bradley frequently collaborates, mostly informally, with core-subject teachers to help better teach his students and to help his teaching remain consistent with the core-subject classrooms.

- Mr. Bradley regularly utilizes inquiry based instruction to teach agricultural concepts in his classroom through inquiry based questioning and experiments.
- Numerous students enrolled in the program participate in the FFA Agriscience Fair and have earned awards at the state and national level.

The data from this case study reveals that the Roger Agricultural Education Program can be classified as a temporal co-ordination agricultural education program, when cross-referencing the data gathered with the integration ladder as proposed by Ronald Harden (2000). According to Harden (2000),

In temporal co-ordination, each subject remains responsible for its own teaching program. The timing of the teaching topics within a subject, however, is done in consultation with other disciplines. The timetable is adjusted so that topics within the subjects or disciplines, which are related, are scheduled at the same time. Similar topics are taught on the same day or week while remaining part of a subject-based teaching program. Students study the concepts of the different subjects separately, and are left themselves to uncover the relationships. This approach has been described also as 'parallel' or 'concurrent' teaching. (p. 553)

The students enrolled in Roger High School agricultural courses can earn biology credit toward graduation by enrolling in a botany/horticulture course taught by Mr. Bradley. Moreover, agricultural educators and science teachers need to coordinate efforts to ensure that their course content aligns in order to promote consistency between classes. Mr. Bradley spends countless hours asking questions of the core-subject teachers as well as the students in his school to ensure that he is not duplicating too

much information. Previous research supports agricultural programs offering science credit towards graduation (Brister & Swortzel, 2007; Chiasson & Burnett, 2001; Dormody, 1993a; Dormody, 1993b; Johnson, 1996; Pavelock et al, 2009; Thompson & Balschweid, 2000).

Mr. Bradley is proactive when collaborating with the core-subject teachers in his school and is not afraid to ask other teachers questions when he does not know something. He regularly attends science department functions to help improve his teaching and to ensure that he stays consistent with the lessons the other teachers are teaching. His collaborative efforts benefit the students because he is abreast on the activities that are taking place in other classrooms and utilizes that knowledge to adjust his lessons. If agricultural educators want to integrate their program, they must collaborate with core-subject teachers on a regular basis (Chiasson & Burnett, 2001; Dormody, 1993a, Dormody, 1993b; Myers & Thompson, 2008; Pavelock, Woolery, Ullrich, & Kelley, 2009; Thompson & Balschweid, 2000, Whent, 1994).

Agricultural education programs need to be constantly changing to meet the needs of the students and the agricultural industry. Mr. Bradley is a flexible teacher who thrives on teachable moments that appear in his classroom. He develops lesson plans and always has a plan of action in mind, but he teaches a lot based on trial and error. Flexibility is a key factor when attempting to integrate a program (Johnson, Charner, & White, 2003). Agricultural educators must be willing to adapt and change on a regular basis in order to accommodate their students' and the agricultural industry's needs.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are made:

Recommendations for Agricultural Education Teachers

Current agricultural education teachers need to be self-motivated and proactive to be successful in the area of academic integration. Agricultural teachers should seek out professional development opportunities within and outside of agricultural education to learn more knowledge about core-subject concepts and integration. They should collaborate with core-subject teachers and share resources and space. Programs that do not possess ample space will likely face challenges when increasing the rigor in their classroom, because this restriction will prevent storage for resources and materials to conduct inquiry based instruction. In addition to sharing resources, agricultural teachers should take the time to cross-reference the material they teach with core-subject standards. According to Dormody (1993a), “agricultural competencies should be clearly cross-referenced with science competencies to show how agriscience courses reinforce science competencies” (p.58). If core-subject credit is not currently offered for agricultural classes, agricultural education teachers should confer with their administration about the possibilities of offering core-subject credit for agricultural courses.

Once cross-referencing is completed and core-subject credit towards graduation is offered for agricultural classes, agricultural education programs should track their students’ progress on standardized assessments and compare the results to their

counterparts that are not enrolled in agricultural education courses. If academic integration is not regularly implemented or talked about in their schools, agricultural teachers should be proactive and serve as change agents by talking with administration about scheduled opportunities to collaborate with core-subject teachers during in-service time.

Budgets are a determining factor in the success of academic integration, and therefore, agricultural education teachers should seek out grant opportunities to supplement their budgets and purchase new and up to date equipment and supplies in order to conduct inquiry based activities in their classroom. Furthermore, agricultural education teachers should frequently converse with current leaders in the agricultural industry and keep abreast on the current trends within the agricultural industry. Their curriculum should be adjusted to mirror those trends.

Recommendations for Administrators

One of the barriers hindering academic integration is administrative support. Administrators should set aside time to allow teachers within their school to collaborate. Administrators should also encourage agricultural education teachers to incorporate academic integration in their classroom and collaborate with core-subject teachers. Finally, administrators should provide financial support for agricultural education teachers to attend professional development workshops that focus on academic integration.

Recommendations for State Agricultural Education Staff and Teacher Educators

The job of agricultural educators involves many long hours inside and outside the classroom. To be successful in academic integration agricultural educators need support from state agricultural education staff and teacher educators. State agricultural education staff and teacher educators should create longer, more in-depth professional development programs that focus on academic integration and provide teachers with the resources needed to successfully integrate core-subject concepts in the agricultural education classroom. Furthermore, standards or a standardized curriculum should be created for agricultural education in each state to reduce lesson planning time for agricultural education teachers and provide examples of academic integration within agricultural education. State agricultural education staff and/or university teacher educators should also take the time to evaluate agricultural education programs to determine levels of integration taking place, based on Harden's (2000) Integration Ladder.

Teacher educators should evaluate their program's curriculum to determine whether it incorporates lessons on academic integration, teacher collaboration, and inquiry based instruction. Additionally, pre-service teacher programs should infuse instruction about academic integration into their teacher education curriculum and provide multiple examples of how academic integration is done in the agricultural education classroom.

Recommendations for Further Research

This research study served as a foundation for further studies in the area of academic integration in agricultural education. The researcher proposes that a research study should be conducted to determine desirable characteristics of professional development workshops that appeal to teachers. A needs assessment study should be conducted to explore the needs of agricultural education teachers with respect to the implementation of academic integration in the classroom. Observations of agricultural educators identified as progressive in the area of academic integration should be conducted to identify both activities and teaching methods that increase rigor in the agricultural education classroom. Students taught by teachers identified as progressive in academic integration should be assessed to determine whether or not the implementation of academic integration in the agricultural education classroom affects the students' core-subject knowledge.

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