

Attitudes of Outstanding Virginia Agricultural Education Teachers Toward Mathematics
Integration

By
Ryan G. Anderson

Dissertation submitted to the faculty of the
Virginia Polytechnic Institute and State University
In partial fulfillment of the requirements for the degree of
Doctor of Philosophy
In
Career and Technical Education

John Hillison, Co-Advisor
Daisy Stewart, Co-Advisor
Penny Burge
Robert Williams

August 10, 2006
Blacksburg, Virginia

Key Words:

Agricultural Education

Mathematics Integration

Agricultural Education Teachers' Attitudes

Agricultural Education Teachers' Needs

Attitudes of Outstanding Virginia Agricultural Education Teachers Toward Mathematics Integration

By Ryan G. Anderson

Abstract

The purpose of this study was to analyze outstanding agricultural education teachers' attitudes toward mathematics integration. The researcher also determined the outstanding agricultural teachers' level of mathematics integration into each course currently taught. An investigation into the collaboration efforts being made between the agricultural education and mathematics department was also included. The researcher identified the outstanding teachers' perceived needs related to mathematics integration and provided baseline data as the agricultural education instructors in Virginia increase their integration of mathematics.

The researcher utilized an electronic questionnaire completed by 25 outstanding agricultural education teachers and follow-up interviews of the 5 teachers who reported integrating mathematics at the highest level. The agricultural teachers reported having favorable attitudes towards the integration of mathematics into the agricultural education curriculum. The results of the data analysis indicated that there was a negative relationship between age and percentage of mathematics integration. All of the agricultural education teachers thought that their efforts to integrate mathematics have helped their students increase their mathematics achievement levels, but they have no concrete evidence.

There were several recommendations for implementation, which included encouraging agricultural education teachers to continue to integrate mathematics and

other academic areas. Textbook manufacturers, state agricultural leaders and state agricultural education curriculum specialists need to continue to develop curriculum and other education materials that emphasize academic integration.

Recommendations for research that emerged from the study included investigating the attitudes of agricultural teachers toward the integration of other academic areas and the mathematics teachers' attitudes toward mathematics integrated into the agricultural education curriculum. Another researcher could investigate the students' attitudes toward receiving academic credits for enrolling in agricultural education courses.

There were several implications that rose from this study. Future research could investigate whether the teachers would increase their rates of mathematic integration if ample materials that integrate mathematics are developed for their use. The research findings related to the percentage of mathematics integration in each course taught give curriculum specialists insight into the courses in which the agricultural education teachers are struggling to integrate mathematics. This researcher also identified that these adopters of mathematics integration into agricultural education fell within the implementation stage of the stages of adoption.

Dedication

I would like to take this time to dedicate this to some individuals who are very close to me who are no longer with us. I would first like to thank Grandpa Dan and Grandma Leona. I am sure that I was not always the easiest kid to deal with growing up, with that I know that your patience must have been tested from time to time. I would like to thank you for your patience and for accepting me for who I was. I would also like to thank you for always having your door open for me when I needed a place to go. Grandpa Dan, I wish your time on earth would have been a little longer... I would have enjoyed the opportunity to get to know you better as I grew older. Grandma Leona, I really enjoyed watching Cubs games with you and eating the occasional pancake.

I would also like to take this time to thank Grandma Gerry and Grandpa Francis, you have instilled in me a sense of pride for the things that I do. You have also instilled in me the desire to approach my “white collar” profession with a “blue collar” work ethic. Grandma Gerry, it was your stubbornness that I inherited, without that I would have listened to the people who have doubted me. Grandpa Francis, I truly enjoyed our trash-night conversations. Those conversations have provided me with an appreciation of those who have come before me.

Each of you has instilled the importance of family, the importance of doing the right thing, and being a better person. You have also taught me to get back on my feet when you get knocked down, no matter what. You have always believed in me even when I didn't, for that I thank you. My time spent with each of you while you were here was special. There is not a day that goes by that I don't think about you and miss you greatly.

Acknowledgements

To Dr. John Hillison, my advisor, your guidance throughout the entire doctoral process has been greatly appreciated. I would also like to thank you for your patience with me; I would also like to thank you for giving me the opportunity to prove myself when others doubted me. I hope that once you get rid of me you can finally enjoy your retirement.

To Dr. Daisy Stewart, my co-advisor, there are no words that could express my appreciation for your dedication to your students and your attention to detail. You are truly one of the professionals who lead by example. I would also like to wish you good luck with your new position. I would also like to know when you are going to retire so I can sell my shares of Bic pens.

To Dr. Penny Burge, your critical analysis of my work has been greatly appreciated. You have always pushed me to try to live up to my potential, for that I am truly grateful. I have also enjoyed each of your courses; they have all been insightful. You are an outstanding asset to Virginia Tech!

To Dr. Bob Williams, I would really like to thank you for always being there when I needed to vent. Your dedication to your students and their individual needs has always been underappreciated by some people; I am not one of those. I have always appreciated our lengthy chats and I look forward to working with you on future endeavors.

To Dr. Pat Sobrero, you are truly a great asset to the students of the Agricultural and Extension Education Department. Your dedication to each and every student is appreciated. I would really like to thank you for all of your advice!

To Dr. Christian Mariger, the time spent together as colleagues as been inspiring. Your willingness to help has been astounding. I have also enjoyed out many conversations. I look forward to working with you again in the future.

To Dr. Tom Broyles and Dr. John Cannon, I would like to thank you for your insight throughout the past three years. Your willingness to help has made the doctoral process a little easier. Good luck with your future endeavors!

To Doris Smith, the agricultural education Mom, your hospitality (and Bobby's too) has been warm and receptive. It has been a blessing to get to know you over the past three years. With Dr. Hillison retiring and my move to Murray State, you can finally say that you have run off all of the troublemakers from Illinois.

To Susan Archer, you will always be my favorite fiscal technician!

To Dr. Rusty Miller, I really appreciate all of the things that you have done for me. You showed me how to be both a professional and enjoy my personal life. You have been a great friend and I will miss our Monday night excursions! Good luck with your new position at A&T.

To Andy Seibel, you are a great asset to the Virginia FFA! You have also been a great asset to me as a doctoral student who was always in need of something, whether that was a summer job or a good laugh. I will really miss our lunch outings; there was never a dull moment around you. You are not only a great colleague but a great friend. It will now be the pleasure of Rusty and me to both pick on you as you work through the dissertation process.

To Marshall Swafford (and Deborah), I enjoyed the short time that we got to work together. I enjoyed our weekend adventures and just hanging out. Good luck with your new job in Oklahoma!

To my agricultural education teacher, Mike Chausee, you have inspired me to enter into the agricultural education profession. You have always been a great teacher, mentor, and friend.

Catherine Byers, there are very few words that could help me describe what you have meant to me throughout this process. I once heard that behind every great man is a great woman. I don't believe that; I think it should say next to every great man is a great woman. You have always stood next to me through the good, the bad, and everything in between! I have always appreciated what you have done for me.

I would like to take this time to thank my family for all of their support all of these years; it would not been an enjoyable experience without your support. I would like to take the time to thank each and each of you individually, but I just finished writing one dissertation...I don't want to write a second one. I have truly missed being away from home, I know I have missed a lot of birthday parties, holidays, football games, basketball games, county fairs, and nights at the cattle barn. I hope that I will get to spend more time at home now that this endeavor has come to an end.

I would like to thank my brother for the countless hours that we have pondered life. I know that I have always set a standard for you to live up to; that's a part of being a big brother. It would be nice if every once in a while you wouldn't make it look so easy to surpass them. I enjoyed the time that we got to spend together when you went to Tech, except for when you tried to light me on fire. I know you're an outstanding agricultural

education teacher and someday I will have to call you Dr. Anderson; until then leave the biggest impact that you can on your students.

Tim and Theresa Anderson, Dad and Mom, thank you for all of your support throughout my entire life. You have instilled the importance of education and hard work in both Shawn and me. I hope that now that this endeavor is completed that we will be able to spend more time together as a family. Your countless hours of encouragement and support over the phone and over the computer have been and always will be appreciated!

I would also like to take this time to acknowledge all of you who have told me that I couldn't do it over the years; I would like to thank you for not believing in me. You have truly inspired me to prove you wrong; I look forward to continuing to do the same!

Table of Contents

Abstract.....	ii
Dedication.....	iv
Acknowledgements.....	v
List of Tables.....	xiv
Chapter 1	
Introduction.....	1
Reshaping Education.....	2
Statement of the Problem.....	6
Justification.....	7
Purpose of Study.....	9
Assumptions.....	10
Limitations.....	10
Significance of the Study.....	11
Theoretical Framework.....	12
Definitions.....	14
Summary.....	15
Chapter 2	
Review of Literature.....	17
Policies Affecting Integration.....	17
The Carl D. Perkins Vocational and Technical Education Act of 1998	17
Virginia Standards of Learning.....	19
Agricultural Instructors' Abilities in Mathematics.....	20
The Need For Academic Integration	22

	Seven Steps to Enhancing.....	31
	Teachers' Attitudes Toward Mathematics Integration.....	33
	Mathematics Integration and Coordination.....	34
	Theoretical Framework.....	37
	Stages of Adoption.....	37
	Knowledge stage.....	37
	Persuasion stage.....	37
	Decision stage.....	38
	Implementation stage.....	39
	Confirmation stage.....	39
	Adopter Categories.....	40
	Innovator.....	40
	Early adopter.....	40
	Early majority.....	41
	Late majority.....	41
	Laggards.....	41
	Summary.....	41
Chapter 3	Methodology.....	44
	Research Design.....	45
	Participants.....	46
	Data Collection.....	47
	Survey Instrument.....	47
	Interviews.....	52

	Field Testing.....	54
	Reliability of Instrument.....	55
	Validity of Instrument.....	56
	Data Collection.....	56
	Data Analysis.....	58
	Summary.....	62
Chapter 4	Results.....	64
	Characteristics of Outstanding Teachers and Their Programs.....	64
	Mathematics Integration.....	68
	Outstanding Teachers' Attitudes Toward Mathematics Integration.....	71
	Outstanding Agricultural Education Teachers' Perceptions Of the School Environment.....	73
	Outstanding Agricultural Education Teachers' Needs.....	73
	Relationship Between Selected Characteristics and Mathematics Integration.....	75
	Emerging Themes Related to Mathematics Integration.....	76
	Mathematics as a Component of Agricultural Education..	77
	Current Issues Regarding Mathematics Integration.....	77
	Cognitive Effort to Emphasize Mathematics.....	78
	Teachers' Perceived Needs to Increase Integration.....	78
	Educational In-service Needs of Teachers.....	79
	Linking the Virginia Standards of Learning to Lessons....	79

	Cognitive Effort to Emphasize the Virginia Standards of Learning.....	80
	Agricultural Teachers Efforts to Collaborate.....	80
	Agricultural Education Lessons Integrated with Mathematics.....	81
	Career Development Events that Utilize Mathematics....	81
	Summary.....	83
Chapter 5	Conclusions, Discussion, and Recommendations.....	84
	Purpose of the Study.....	84
	Summary of the Research Methodology.....	85
	Summary of Findings.....	86
	Conclusions and Discussion.....	92
	Recommendations for Implementation.....	97
	Recommendations for Further Research.....	99
	Summary.....	100
	References.....	102
	Appendix A.....	113
	Appendix B.....	114
	Appendix C.....	115
	Appendix D.....	116
	Appendix E.....	117
	Appendix F.....	118
	Appendix G.....	125

Appendix H.....	126
Appendix I.....	127
Vita.....	129

LIST OF TABLES

Table 3.1 A Comparison of E-mail and Traditional Survey Methods.....	49
Table 3.2 Analysis of Survey Data.....	60
Table 4.1 Summary of Respondents' Years of Teaching Experience.....	65
Table 4.2 Summary of Selected Teacher Characteristics.....	66
Table 4.3 Mathematics Courses Completed by Respondents.....	67
Table 4.4 Summary of Selected Program Characteristics.....	68
Table 4.5 Percentage of Mathematics Integrated per Course.....	70
Table 4.6 Agricultural Education Teachers' Attitudes toward Mathematics Integration..	72
Table 4.7 Agricultural Education Teachers' Perceptions toward School Environment....	73
Table 4.8 Agricultural Education Teachers' Needs Regarding Academic Integration....	74
Table 4.9 Relationships between Selected Variables and Percentage of Mathematics Integration.....	76

Chapter 1

Introduction

Agricultural education has been present in public schools since their development in America. Minnesota was the first state to offer secondary agricultural education with the first school organized in 1888. By 1910, Virginia promoted agricultural education through Congressional district agricultural schools. A total of 30 states had agricultural education courses established in the public schools systems prior to the Smith Hughes Act, which was passed in 1917 (Phipps & Osborne, 1988). The Smith-Hughes Act provided funding to promote and establish agricultural education courses. Phipps and Osborne (1988) outlined the four major instructional components of agricultural education programs:

1. *Classroom instruction* lays out the foundation for students to gain the principles and theories associated with agricultural education.
2. The *laboratory instructional* component allows students to develop psychomotor skills and apply the principles of agriculture. Phipps and Osborne (1988) indicated that “laboratory instruction provides the essential link between classroom instruction and skill development” (p. 8).
3. *Supervised agricultural experience* (SAE) programs provide students with the opportunity to apply the knowledge and skills learned at school to real-world applications.
4. *The National FFA Organization* is an inter-curricular student organization for students enrolled in agricultural education courses.

Students develop essential skills such as leadership, character, and citizenship through participation in individual and team activities (p. 9).

Phipps and Osborne (1988) further acknowledged that agricultural education has developed deep philosophical roots, placing a great deal of emphasis on pragmatism. “The practical application and successful transfer of knowledge, skills, and attitudes into real-world settings is the goal of instruction” (p. 19). Garris (1954) outlined the four-step procedure for teaching agricultural education tasks: (a) preparation, (b) presentation, (c) supervision of practice, and (d) evaluation. Phipps and Osborne (1988) noted that an emphasis has been placed on learning by doing. Agricultural teachers have promoted critical-thinking skills of their students through problem-solving activities. Phipps and Osborne (1988) noted that “agricultural education has been cited as an innovative program model for education, in order to maintain an innovative program, efforts have been made to reshape agricultural education programs to ensure their continued value, relevance, vitality, and quality” (p. 14).

Reshaping Education

The need for educational reform surfaced from the National Commission on Excellence in Education’s (1983) report suggesting that American students are falling behind those in other nations. As a result of the report, titled *A Nation at Risk*, high school graduation requirements for academic subjects increased since 1983 (Barrick, 1992; Campbell, Hombo, & Mazzeo, 2000). The increased academic requirements have come at the expense of career and technical education courses (Cetron & Gayle, 1991). Studies have indicated that the increase in academic coursework has not led to an increase in academic achievement (Clune & White, 1992; Hoffer, 1997). High school

National Assessment of Educational Progress scores for mathematics have been relatively flat for the past 30 years (Castellano, Stringfield, & Stone, 2002).

At the same time, traditional mathematics instruction has experienced a great deal of scrutiny. One of the reoccurring themes suggests that in academic programs, students are lectured to about theories and principles, but are never shown how these theories and principles can be applied to real situations (Bottoms & Sharpe, 1996). Researchers have suggested that mathematics as it is being taught in American schools lacks the real-world “connection” and “context” needed to be learned and applied effectively (Britton, Huntley, Jacobs, & Weinberg, 1999; Hoachlander, 1999; Parnell, 1995; Resnick & Hall, 1998; Von Secker & Lissitz, 1999). Mathematical educators have expressed a need to reform mathematics education; one of the themes that emerged is contextually based learning (Briner, 1999).

Career and technical education courses have also come under scrutiny. Some researchers have expressed concern that skills are taught simply by showing a student how to perform an operation without properly training the student in the theory behind the operation (Parnell, 1996). Warmbrod (1974) stated that “if vocational education assumed its proper role in American education that vocational education must be concerned with the student’s intellectual, social, and cultural development as well as their vocational development” (p. 5). Phipps and Osborne (1988) praised agricultural education; however, they pointed out that one of the image problems associated with agricultural education programs is the emphasis placed on the vocational skills.

Warmbrod (1974) indicated that vocational education should be held accountable for students’ achievement in both academic and vocational skills. Phipps and Osborne

(1988) stated that agricultural education should promote meaningful and practical applications of subject matters, such as mathematics. The National Research Council (1988) indicated that in order for secondary agricultural education courses to remain effective, programs must provide a strong emphasis on traditional academic skills.

The lack of application of the theories and principles taught in the academic classroom and the lack of theories and principles associated with the skills taught in the career and technical education courses have left a gap (Parr, 2004). The lack of connection between subject matter in secondary schools has been widely recognized for a number of years (Glasgow, 1997; NASSP, 1996). This gap between practice and theory must be bridged (Parr, 2004). Warmbrod (1974) indicated that theories and principles must be linked with the application and practice. According to a guide for implementing curriculum integration published by The Ohio State University (Center on Education and Training for Employment, 1998), this bridge could come in the form of contextualized learning.

Contextual learning is rooted in constructivism, which promotes active participation in critical thinking and problem solving regarding an authentic learning activity that students find relevant (Briner, 1999). Contextual learning has the potential to strengthen linkages among the learning environments of school, home, and community and add meaning to mathematics for students (Shinn, et al. 2003). Contextualized learning suggests that neither general nor vocational education is completely capable of standing alone; they must be integrated in order to maximize benefits for students (Prescott, Rinard, Cockerill, & Baker, 1996).

Professionals in mathematics education have embraced the concept of applied or hands-on learning as an effective form of instruction that improves student learning. This approach is not designed to replace content with meaningless activities, but to enhance the student's comprehension of the content (Bailey, 1998; Haury & Rillero, 1994; Kahle, 1998; Prescott, Rinard, Cockerill, & Baker, 1996; Romberg & Kaput, 1999). In hearings before the General Subcommittee on Education in the House of Representatives of the Ninetieth Congress, U.S. Office of Education leaders (Advisory Council on Vocational Education, 1968) proposed developing a curriculum that integrates academic and vocational learning skills to increase that academic performance of students that would otherwise struggle.

Taylor and Muhall (1997) suggested that agriculture as subject matter could add a contextual theme that adds meaning to what students learn. Bailey (1998) suggested specific subjects in which mathematics education may be integrated to establish the contextual-based applications that are meaningful to students. Agricultural education is one of the subjects that Bailey recommended. He stated:

Agriculturally based activities such as 4-H and FFA, have for many years used the farm setting and students' interests in farming to teach a variety of skills. It only takes a little imagination to think of how to use the social, economic, and scientific bases of agriculture to motivate and illustrate skills and knowledge from all of the academic disciplines. (p. 27)

Agricultural education has great potential to deliver relevant curriculum that engages students with hands-on and minds-on learning environments that are rich with real world applications of mathematics (Shinn et al., 2003). Agricultural education, by the very nature of its structure and content, can be used to teach information which may be difficult to teach in other settings (Drawbaugh & Hull, 1971). Phipps and Osborne

(1988) linked academic and vocational education, specifically agricultural education stating that:

Vocational education in agriculture (i.e., agricultural education) is an integral part of public school education and contributes to the general objectives of education. It contributes to the development in students of the ability to think and study and in the ability to solve problems efficiently, which require skill in collecting and interpreting data. (p. 9)

Agricultural education provides that authentic context in which students can apply the concepts and skills grounded mathematic theory (Conroy, Trumbull, & Johnson, 1999). Parr (2004) found that a math-enhanced agricultural curriculum had a positive effect on student math performance, while maintaining the vocational skills associated with the curriculum. According to Bottoms and Sharp (1996), integration of both academic and vocational skills into content areas such as agricultural education holds great potential for enhancing student learning in critical academic, technical, and personal areas.

Statement of the Problem

Drosjack (2003) reported that fewer than one in every three students nationally are able to do math at a proficient level. The Bayer Corporation (2003) found that 9 out of 10 U.S. citizens are concerned that today's students may not have the mathematical skills to produce the excellence required for homeland security and economic leadership in the 21st century. Students today require strong mathematical knowledge and skills in order to pursue a higher education, compete in the technology driven workforce, and be informed citizens (VDOE, 2005). Agricultural education instructors are required by the standards set forth in the Carl D. Perkins Act of 1998 to integrate academics into the agricultural education curriculum.

Miller and Gliem (1993a as cited in Hunnicutt, 1994) found that nearly half of the agricultural education teachers studied in Ohio did not coordinate their efforts to integrate mathematics into the agricultural education curriculum with mathematics teachers. Gliem and Warmbrod (1986, as cited in Shinn, 2003) encouraged agricultural education departments to attempt to integrate practical mathematics applicable to agriculture into the curriculum. Hunnicutt (1994) indicated that agricultural education instructors in Alabama self-reported that they integrated mathematics into 26-50% of the units in the agricultural education curriculum.

Justification

Current literature has shown that there is a need for integration skills due to the 1998 Carl D. Perkins Vocational and Applied Technology Act and the Virginia Standards of Learning. Melodia and Small (2002) indicated that quality agricultural education instructors should actively integrate mathematics into their curriculum to meet the core competencies and standards to which the school and state are being held accountable. Buriak and Shinn (1991) stated that the infusion of mathematics into agricultural education was an essential research activity for curriculum development.

The provisions in section 144 of the Carl D. Perkins Act (1998) are aligned to carry out research for the purpose of developing, improving, and identifying the most successful methods for addressing the education, employment, and training needs of participants in vocational and technical education programs. The integration of academics into the secondary and postsecondary vocational and technical instruction was among several topics included within the research and evaluation section of the Perkins Act.

The Standards of Learning for the State of Virginia's public schools describe the Commonwealth's expectations for student learning and achievement in mathematics. These standards represent a broad consensus of what parents, classroom teachers, school administrators, academics, and business and community leaders believe schools should teach and students should learn (Virginia Department of Education, 2005).

Often teachers think they are integrating mathematics skills into their curriculum and that these skills are essential and provide benefit for the students involved. However, Hunnicutt (1994) found that teachers are not integrating mathematics as much as they believe. Hunnicutt (1994) also found that slightly less than half of the sample of agricultural education teachers in Alabama coordinated efforts with mathematics teachers. It is essential to look at how the teachers integrate mathematics into their curriculum as states begin utilizing agricultural classes to meet graduation credits for math.

In the current study, the researcher determined the present level of mathematics integration for each course as reported by agricultural education teacher and investigated the working relationship the agricultural instructors maintained with the mathematics teachers. The researcher further investigated agricultural education teachers' attitudes toward mathematics integration into the agricultural education curriculum and determined their perceived needs in order to effectively integrate mathematics.

Shinn et al. (2003) stated that the agricultural education discipline can design, develop, deliver, and aggressively promote the adoption of mathematics integration into the secondary agricultural education curriculum that will result in higher student achievement in mathematics. Parr (2004) suggested that research be done on the

collaboration between the mathematics and agricultural education departments in regards to academic integration.

Purpose of the Study

The purpose of this study was to analyze outstanding agricultural education teachers' attitudes towards mathematics integration. The study also determined the outstanding agricultural teachers' level of mathematics integration into each course currently taught. An investigation into the collaboration efforts being made between the agricultural education and mathematics department was also included. The study identified the outstanding teacher perceived needs related to mathematics integration and provided baseline data as the agricultural education instructors in Virginia increase their integration of mathematics. The study will result in proposed actions to increase mathematics integration into agricultural education curriculums. Research questions investigated in this study are:

1. What are the characteristics of outstanding agricultural education instructors who were nominated by Virginia agricultural education leaders and the programs in which these instructors teach?
2. What is the self-reported level of integration of mathematics by each instructor and across instructors for each course taught?
3. What are the attitudes of the outstanding agricultural education instructors toward the integration of mathematics into the agricultural education curriculum?
4. What are the perceptions of the outstanding agricultural education instructors related to the school environment regarding mathematics integration?

5. What are the perceived needs of the outstanding agricultural education instructors regarding the integration of mathematics into their agricultural education curriculum?
6. What are the relationships among selected characteristics of outstanding agricultural education instructors, their programs, and their perceptions of the school environment, level of integration, attitudes, and needs regarding academic integration?
7. What are the primary themes related to integration of mathematics that emerge through interviews with the five outstanding agricultural education instructors who reported the highest percentage of mathematics integration in their courses?

Assumptions

The following assumptions were made regarding this study:

1. The participants possess basic computer skills to access electronic mail and the electronic survey instrument.
2. The participants were accurate in reporting their levels of mathematics integration.

Limitations

The study was limited to the teachers of middle and secondary agricultural education in the Commonwealth of Virginia for the 2005-2006 school year who were identified as outstanding teachers by the Virginia agricultural education leaders. The ability of agricultural education teachers to receive the study may be limited by the school system's e-mail filters. The electronic survey system utilized in this study did not

allow users to save their work, requiring respondents to block off a period of time to complete the survey instrument. An electronic survey system that had a save feature would allow respondents to complete the instrument over several small blocks of time. An additional limitation to the study was the level of accuracy of the teachers in reporting their level of mathematics integration. The study was also limited based on the teachers' varied definitions of mathematics integration.

Significance of the Study

The results of this study will provide insight on how to prepare agricultural education instructors to integrate academics into the agricultural curriculum, specifically mathematics. Parr (2004) recognized agricultural education as a valuable educational resource that already exists in our public schools, but which remains untapped in regard to its potential to increase the academic achievement of our students. Determining the attitudes of the agricultural education instructors toward mathematics integration plays a significant role in the stages of adoption.

Determining the working relationship between the mathematics and agricultural education instructors is essential when developing integrated mathematics curriculum for secondary students. Insight into their working relationships may increase the rate of mathematics integration into the agricultural education curriculum and vice versa. Understanding the perceived needs of agricultural education instructors aids curriculum specialists and teacher education programs when creating and implementing mathematics integrated curriculum.

Increasing the academic rigor of agricultural education may result in increased academic credit offered in the agricultural education curriculum which could meet the

increased academic requirements in America's school systems. Some agricultural education departments in Virginia are experiencing a reduction in student enrollment due to the increased graduation requirements. Offering courses that integrate academics into the agricultural education curriculum may lead to the courses being accepted for academic credit, thus meeting graduation requirements. If students can receive the additional academic credit needed for graduation through courses offered in the agricultural education department, the department might experience a growth in total student enrollment, as well as recruiting more academically inclined students. An increase in academic rigor will also help prepare the agricultural education students to enter the increasing complex agricultural industry.

Theoretical Framework

The theoretical perspective that guided the review of literature and the current study was the Diffusion of Innovations Theory developed by Rogers (1995). Rogers' diffusion theory has been used for many years to describe innovation diffusion and the adoption or rejection of innovations. Rogers described the five stages of the innovation-decision process as knowledge, persuasion, decision, implementation, and re-invention.

- The innovation-decision process begins with the *knowledge stage* in which the potential adopter is exposed to the innovation and begins to understand how it functions.
- The *persuasion stage* includes the individual liking the innovation, discussion about the innovation with others, acceptance of the message about the innovation, formation of a positive image of the message and innovation, and support for innovative behavior from the social system.

- After knowledge is gained and an attitude is formed toward the innovation, the potential adopters enter the *decision stage* in which they are ready to make the decision to adopt or reject the innovation. Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations.
- The *implementation stage* includes the acquisition of additional information about the innovation, as well as regular and continued use of the innovation. An important phase of the implementation stage, when the innovation is applied to uses other than its original intended purpose, is re-invention.
- The *confirmation stage* consists of recognition of the benefits of using the innovation, integration of the innovation's use into routine, and promotion of the innovation to others.

The five stages are all relevant to this study as well as adopter categories. Adult learners, as Russell (1995) proposed, pass through six stages of adoption. He suggested that learners could begin at any stage and progress at their own rates. The stages included awareness, learning the process, understanding the application of the process, familiarity and confidence, adoption to other context, and creative applications to new contexts.

Rogers (1995) categorized adopters based on their innovativeness and reported that over time the distribution of adopters will approach normality. Adopter categories include: innovators (2.5%), early adopters (13.5%), early majority (34%), late majority

(34%) and laggards (16%). Adopter category ideal types characterized the innovators as venturesome, early adopters as having respect within the social system, early majority as deliberate, late majority as skeptical, and laggards as traditional. Typically, opinion leaders are most often found in the early adopter category.

Definitions

For the purpose of this study, the following terms are defined:

Academic skills: Reading, computation, and communication skills related to an occupation or occupational training within agricultural education (Hunnicut, 1994).

Agricultural education: “. . . a systematic program of instruction available to students desiring to learn about the science, business, and technology of plant and animal production and/or about the environmental and natural resources systems” (Team Ag Ed, 2004, p. 1).

Applied academics: A planned series of academic integrated courses which are necessary for occupational competence and which are delivered in applied situations (Hunnicut, 1994).

Applied learning: Instruction in which the academics and theories are made meaningful by real life applications (Hunnicut, 1994).

Career and technical education (CTE): “. . . a planned program of courses and learning experiences that begins with exploration of career options, supports basic academic and life skills, and enables achievement of high academic standards, leadership, preparation for industry-defined work, and advanced and continuing

education” (Washington Office of Superintendent of Public Instruction, 2004, p. 1).

Contextualized learning: The use of a specific environment or “context” to provide practical application to abstract principles (Dworkin, 1959).

Curriculum: The planned interaction of pupils with sequenced instructional content, resources, and processes for the attainment of educational objectives (Hunnicuttt, 1994).

Curriculum integration: The process of combining curriculum for the purpose of increased comprehension (Bottoms & Sharp, 1996).

Extent of integration: The level of integration of mathematics reported by the agricultural instructor, reported as the percentage per course (Hunnicuttt, 1994).

Outstanding agricultural education teacher: The researcher has defined this as one chosen by a panel of statewide agricultural education leaders knowledgeable of the total program in Virginia.

Vocational/academic integration: The integration of academic subject matter into vocational curriculum (Hunnicuttt, 1994).

Summary

Researchers have expressed a great deal of scrutiny of the traditional format of mathematics instruction suggesting that mathematics currently being taught in American schools lacks the real-world “connection” and “context” needed to be learned and applied effectively (Britton, Huntley, Jacobs, & Weinberg, 1999; Hoachlander, 1999; Parnell, 1995; Resnick & Hall, 1998; Von Secker & Lissitz, 1999). Taylor and Muhall (1997) suggested that agriculture as subject matter could add a contextual theme that adds

meaning to what students learn. Parr (2004) recognized agricultural education as a valuable educational resource that already exists in our public schools that remains untapped in regards to its potential to increase the academic achievement of our students. Determining the attitudes of the agricultural education instructors towards mathematics integration plays a significant role in the stages of adoption.

The purpose of this study is to analyze outstanding agricultural education teachers' attitudes toward mathematics integration, the outstanding agricultural teachers' current level of mathematics integration. An investigation into the collaboration efforts being made between the agricultural education and mathematics department will be included. The study will also identify the outstanding teachers' perceived needs regarding mathematics integration. The literature related to the integration of academics into the agricultural education curriculum will be highlighted in Chapter 2. The methodology used to identify the outstanding agricultural education teachers and collect data will be discussed in Chapter 3. The results of the analysis of data will be reported in Chapter 4, and these results will be discussed in Chapter 5.

Chapter 2

Review of Literature

The purpose of this chapter is to present a review of the related literature for the research study. A brief description of the policies that affect the integration of mathematics into the agricultural curriculum will be provided at the beginning of the literature review. The major topics included in this review are the agricultural instructors' abilities in mathematics, the need for academic integration, teachers' attitudes toward mathematics integration, mathematics integration and coordination, and the theoretical framework.

Policies Affecting Integration

The Carl D. Perkins Vocational and Technical Education Act of 1998

The Carl D. Perkins Vocational and Applied Technology Act of 1998 (Perkins Act) called for the expenditure of funds to aid the federal, state, and local levels to address program improvements in vocational education. One of the purposes stated in Title II, Section 204 of this act is—“to support the use of contextual, authentic, and applied teaching and curriculum based on each State's academic, occupational, and employability standards.” (p. 45)

The Perkins Act mandated the integration of vocational and academic education and called for the integration process to include all academic and vocational teachers. The Perkins Act specified academic and employment outcomes of vocational education, including analyses of:

- (A) The number of vocational education students and tech-prep students who meet State academic standards;

(B) The extent and success of integration of academic and vocational education for students participating in vocational education programs; and

(C) The degree to which vocational education is relevant to subsequent employment or participation in postsecondary education. (pp. 45-46)

In response to the passage of the Perkins Act, states developed applied academic programs for vocational education divisions including agricultural education (Miller & Gliem, 1993a, as cited in Hunnicutt, 1994). These applied academic subjects were developed and included lesson plans that incorporated vocational teachers. The lesson plans developed by the teachers must incorporate the following standards from the Perkins Act:

(A) Improve the academic and technical skills of students participating in vocational and technical education programs by strengthening the academic, and vocational and technical components of such programs through the integration of academics with vocational and technical education programs through a coherent sequence of courses to ensure learning in the core academic, and vocational and technical subjects;

(B) Provide students with strong experience in and understanding of all aspects of an industry; and

(C) Ensure that students who participate in such vocational and technical education programs are taught to the same challenging academic proficiencies as are taught for all other students. (p. 46)

The Perkins Act (1998) has placed an emphasis on the integration of academics into the agricultural curriculum. Mathematics is an important function within the

integrated academics in this approach to education (Warmbrod, 1974). It has become increasingly more important to employ teachers who can understand the applicable mathematics concepts and teach them to students to provide a superior workforce and a better educated society (Warnat, 1991).

Virginia Standards of Learning

In 1995, the Virginia State Board of Education took important steps to raise the expectations for all students in Virginia's public schools by adopting Standards of Learning in four core subject areas: mathematics, science, English, and history and social science. These standards represent a broad consensus of what parents, classroom teachers, school administrators, academics, and business and community leaders believe schools should teach and students should learn. The academic standards will let parents and teachers know what is expected of students, and each student's performance and achievement can be measured against the standards. This requirement provides accountability on the part of the public schools and gives the local school boards the flexibility they need to offer programs that best meet the educational needs of students (VDOE, 2006).

Standards of Learning are statements of knowledge and skills that every child is expected to learn and use in solving day-to-day problems and to be a productive citizen. The Standards of Learning for Virginia Public Schools outline the commonwealth's expectations for student learning and achievement in grades K-12 in English, mathematics, science, history/social science, technology, the fine arts, foreign language, health and physical education, and driver education (VDOE, 2006).

The Standards of Learning for mathematics identify academic content for essential components of the mathematics curriculum at different grade levels for Virginia's public schools. Standards are identified for kindergarten through grade eight and for a core set of high school courses. The Standards of Learning progress in complexity at each grade level and throughout the high school courses (VDOE, 2006).

The Standards of Learning are not intended to encompass the entire curriculum for a given grade level or course or to prescribe how the content should be taught. Teachers are encouraged to go beyond the standards and to select instructional strategies and assessment methods appropriate for their students (VDOE, 2006).

Agricultural Instructors' Abilities in Mathematics

The mathematical problem-solving proficiency of agricultural education instructors has received some attention. Most of the studies that reflect mathematics proficiency are the result of measures of student problem-solving while engaged in agricultural activities. Those studies have consistently yielded results indicating that the problem-solving skills of students in high school and college agricultural mechanics courses are low (Gliem & Elliott, 1988; Gliem, Lichtenstieger & Hard, 1987).

Only three studies were found in this review that assessed the mathematics proficiency of agricultural instructors. Agricultural education instructors were found to score below an expected level of competency on a mathematical problem-solving test integrated with an agricultural mechanics context (Gliem & Persinger, 1987 as cited in Shinn, et al. 2003). The secondary agricultural instructors scored lower than the level expected for people teaching secondary students (Miller & Gliem, 1993b as cited in Hunnicutt, 1994). The agricultural education teachers sampled by Miller and Gliem

(1993b, as cited in Hunnicutt, 1994) that had completed more mathematics courses than required by their respective university to earn a degree did not possess a higher problem-solving proficiency than teachers completing fewer mathematics courses. Hunnicutt (1994) revealed that agricultural instructors in Alabama had a mean proficiency level of 66%, with an anticipated acceptable rate of 85%. Both Hunnicutt (1994) and Miller and Gliem (1993b, as cited in Hunnicutt, 1994) further concluded that the agricultural instructors in their respective studies were not proficient in solving mathematics problems related to agriculture.

Some studies have indicated positive relationships between the number of mathematics courses completed and the mathematics proficiency of the individuals (Gliem & Persinger, 1987; Gliem & Warmbrod, 1986; Van Blerkom, 1986 as cited in Shinn, 2003). Miller and Gliem (1993b as cited in Hunnicutt, 1994), however, found that the individuals who had enrolled in more mathematics courses than required by their respective university did not attain a positive correlation with problem-solving proficiency. They also concluded that highly advanced concepts are not required to complete agricultural-related problems; the highest level course needed to solve the agricultural-related problems in their study was algebra.

One strategy for improving the competency of pre-service teachers in mathematics would be to integrate problem-solving as a key component of the agricultural mechanics courses that pre-service teachers are required to complete (Gliem & Warmbrod, 1986 as cited in Shinn, 2003). Gliem, Lichtenstieger, and Hard (1987) indicated that students who successfully completed an applied agricultural mechanics course designed to increase problem-solving capabilities exhibited significantly higher

mathematical proficiency skills after completing the course and retained the skills for a longer period of time. Each of these studies found a positive effect on the mathematical proficiency of students after they had received instruction in mathematics theories and principles applied to vocational education instruction.

The Need for Academic Integration

As a result of the National Commission on Excellence in Education (1983) report, high school graduation requirements for academic subjects increased (Campbell, Hombro, & Mazzeo, 2000). Murnane and Levy (1996) argued that the increased units finally brought high school graduation requirements up to the high-school level abilities. Since 1978, there has been a 14% increase in students enrolled in algebra (Murnane & Levy, 1996). Rosenbaum (2001) stated that today's students are still lacking the basic high-school-level skills needed upon graduation.

Studies have shown that taking more advanced math courses is linked to higher achievement in math as measured on tests conducted through the National Education Longitudinal Study of 1988 (Atanda, 1999), tests from the National Assessment of Educational Progress (NAEP) (Gamoran, Porter, Smithson, & White, 1997), and math course achievement (Smith, 1996). While this may seem obvious to many, the researchers have pointed out that students enrolled in high-risk schools tend to have more limited curricular opportunities (Lee, Burkham, Chow-Hoy, Smerdon, & Geverdt, 1998). Students enrolled in schools with limited curricular opportunities may find it difficult to achieve in math to the extent now required by federal and state policies (Castellano, Stringfield, Stone, & Wayman, 2003).

Studies have indicated that the increase in academic coursework has not led to an increase in academic achievement (Clune & White, 1992; Hoffer 1997). High school NAEP scores for reading, science, and mathematics have been relatively flat for the past 30 years (Castellano, Stringfield, & Stone, 2002). Therefore, despite the many changes in how much mathematics is required and how it is delivered, increasing mathematics achievement levels in the United States remains quite unclear (Castellano et al., 2003).

The integration of mathematics skills into the agricultural curriculum is a relatively new concept that has received only limited amount of study (Hunnicut, 1994). The majority of the research conducted has emphasized the need to integrate science into the agricultural and vocational curriculum. Castellano et al. (2003) examined the early measures of student progress in math course-taking patterns and student progress through graduation in schools with career and technical education (CTE) enhanced whole school reforms.

Castellano et al. (2003) also indicated that students in high schools that have infused their reforms with CTE themes will have increased mathematics outcomes compared with students in high schools that either do not have any reform efforts or have not incorporated career and technical themes into their reform movements. They indicated that students in schools that incorporated CTE into their reforms will take and pass more math courses, take and pass more advanced math courses, and will go further into the math sequence as compared to students enrolled in schools with no reforms.

A limited amount of research has been disseminated regarding the skills agricultural educators must possess in order to implement the integration of mathematics. Miller and Gliem (1993a, as cited by Hunnicutt, 1994) found that agricultural mechanics

teachers in Iowa were deficient in the necessary mathematical skills needed to effectively teach agricultural mechanics.

Students are required to possess mathematical skills in order to succeed in future employment opportunities (Mitchell, 1990 as cited by Hunnicutt, 1994). A limited number of studies have addressed the mathematical skills agricultural instructors should possess. However, federal and state legislation has placed emphasis on the integration of academics.

Mathematics educators have expressed a need to reform mathematics education; one of the themes that emerged is contextually-based learning. Bailey (1998) suggested specific subjects in which mathematics education may be integrated to establish the contextual-based applications that are meaningful to students. Agricultural education is one of the subjects that Bailey recommended. He stated:

Agriculturally based activities such as 4-H and FFA, have for many years used the farm setting and students' interests in farming to teach a variety of skills. It only takes a little imagination to think of how to use the social, economic, and scientific bases of agriculture to motivate and illustrate skills and knowledge from all of the academic disciplines. (p 27)

Due to the results of the Perkins Act, several states have developed or are in the process of developing applied courses for integration of academics into the agricultural education curriculum. Illinois has courses in physical and biological science applied to agriculture. In Virginia, a pilot course in biological and biotechnology applications in agriculture was introduced to selected agricultural education programs for the 2005-2006 school year (Virginia CTE Resource Center, 2006). Ohio planned to have applied

academics in all secondary occupational programs by 1994 (Ohio Department of Education, Division of Vocational and Career Education, 1990). Texas and Illinois conducted pilot courses in mathematics applied to agriculture during the 2005-2006 school year (Facilitating Coordinators in Agricultural Education, 2006).

As early as 1974, Warmbrod stated that the need for integration of academics into the vocational curriculum was a vital move in order for the discipline to survive the reform taking place in education. He also stated that present and prospective vocational teachers must be equipped with skills in order for them to see and understand that academic courses are important to their interests and goals.

In 1984, Hokanson (as cited by Hunnicutt, 1994) found that students knew how mathematics works, but not how to apply it to practical situations. Hokanson advocated an approach to mathematical skills that utilized story problems because most students performed poorly on mathematical reading problems. Hokanson indicated that it was important for students to apply the information and skills in correct, appropriate, and practical situations as compared to rote memorization for the sake of knowledge. He suggested that students should be taught mathematics through applied “real life” situations in order to make them proficient at problem solving. Hokanson stated that the future of vocational education, and education in general, would be one of cooperative efforts to apply basic skills knowledge to life skills and practical situations.

The National Commission on Secondary Vocational Education (1984) made two important recommendations for changes in the curriculum. The first recommendation proposed that vocational courses should provide instruction and practice in the basic skills including mathematics. The second recommendation proposed that students should

receive credit for basic skills courses with the successful completion of selected vocational education courses.

The National Research Council (1988) recommended that all students needed a basic understanding of mathematics and science concepts and that teaching math and science through agriculture was an effective approach to student learning. The American Association for the Advancement of Science (AAAS) recommended that students learn better through real world connections such as work-related activities and problem solving (1992). According to the AAAS, effective mathematics and science teaching and learning occur through the integration of concepts and principles that are problem- and real-world based.

D'Augustine (1989, as cited by Hunnicutt, 1994) concluded that in order for students to be proficient in English, mathematics, science, history and geography, it is necessary for all subjects to be interrelated. It was also noted that rapidly changing requirements are placing new demands on mathematics skills needed for students entering majors in business and vocational programs. According to D'Augustine, those students who are not able to successfully use mathematics in practical working situations cannot succeed in the ever-changing, highly-technical world of work in the future. Phipps and Osborne (1988) indicated that most educators agree that information gathered because it is integrated into the solution of a problem is learned more permanently. These problems can be presented to the student through the use of agriculture as a context in which the learning occurs.

Mitchell (1990, as cited by Hunnicutt, 1994) found that employment situations required mathematics skills that were not being addressed in the traditional mathematics

setting. Vocational mathematics skills would benefit students for future work situations, and students could benefit the most from skills in statistics, probability, logic, reasoning, percentage, measurement, geometry, and algebra. These skills were seen as those most often used in real world situations.

Brown (1991) identified a need for teaching mathematics by giving students real-life problem situations in which they apply skills learned. She indicated that students need to learn how mathematics skills are used to solve everyday problems and enable students to see how mathematics is related to most practical situations. Lieberman and Hoody (1998) found that students who learned mathematics through an environmental context outperformed students who did not. They further indicated that: "Learning in the context of their local community fosters deeper understanding of math and enables students to more readily master crucial skills" (p. 5).

Another indication of the need for integration of academic skills into vocational curriculums was presented by Wasley (1991). He found that one of the drawbacks to traditional education was the isolation of individual subject teachers. Through integration, teachers work together contributing to the overall good of the students. This approach also provided for a new understanding for other professional disciplines and resulted in positive networking within the school system.

Newcomb, McCracken, and Warmbrod (1993) supported this claim; they found that students were much more inclined to learn things that they could put into practice immediately. Newcomb et al. defended the use of real-life problems as teaching tools by making the argument that the natural process by which students learn should be identified and harnessed for use in the classroom.

Bickmore-Brand (1993) concluded that a contextual mathematics approach to teaching and learning produces enhanced thinking about and use of mathematic concepts that leads to greater transfer of learning. Learning strategies that can be applied to enhance the learning of mathematics include:

- Creating a meaningful and relevant context for knowledge, skills, and values.
- Realizing the starting point of interest in mathematics is the knowledge base of the student.
- Providing opportunities for the learner to see the skills, process and values of mathematics by the teacher's modeling.
- Continuing to build on the knowledgebase and challenging the students.
- Facilitating the metacognition of the student by helping by identifying the learning processes.
- Assisting the learner to accept the responsibility for the construction of knowledge.
- Building a community of learners in a risk-free learning environment.

Hunnicutt (1994) found that agricultural instructors in Alabama self-reported a range of 26-50% integration of mathematics in all units taught. He also encouraged state departments of education to develop material relating mathematics to agriculture including workshops, workbook manuals, and acceptable lesson plans.

Research performed within the Hodgson Vocational Technical High School in Delaware revealed that providing a context for learning mathematics not only improved student achievement but also provided math teachers with familiar examples that could be used in the course of teaching their subject matter (Ancess, 2001). Ancess further

stated, “Math teachers visited shop [vocational] classrooms and while there they taught math that corresponded to shop units so that students learned math when they needed to know it for their shop projects” (p. 74). The author also concluded, “In their own classrooms, math teachers began to use shop references to teach math . . .” (p. 74). According to the New Castle, Delaware County Vocational Technical District, the following year saw an increase of 13% on the Delaware math assessment for students involved in the integration movement over the previous year’s students (Ancess, 2001).

Agricultural education has the potential with a relevant curriculum to engage students with active, hands-on, minds-on learning environments that provide the opportunity to learn mathematics (Conroy, Trumbull, & Johnson, 1999; Darling-Hammond & Falk, 1997). Melodia and Small (2002) indicated that a quality agriculture program should provide experiential opportunities, leadership development programs, and laboratory experiences along with classroom instruction. Math and science learning objectives should be integrated throughout. Johnson, Wardlow, and Franklin (1997) found, that students’ attitudes about the subject matter were more positive when learning took place utilizing hands-on activities when compared to the worksheet instruction. These authors even went as far as to claim that the increase of motivation achieved through curriculum integration could possibly decrease high school drop-out rates.

Melodia and Small (2002) stated that the FFA component of an agricultural education program addresses math and science in the career development event areas and proficiency award areas. The Supervised Agricultural Experience (SAE) component addresses integration by having students apply science and mathematics skills to their

specific programs. Cheek, Arrington, Carter, and Randell (1994) indicated that “SAE gives students the chance to utilize the principles learned in class and apply them in real life situations” (p. 1) and SAEs provide “contextually rich opportunities for mathematical applications.” Agricultural teachers already integrate science and mathematics in a variety of ways in their lessons; the next step is to be intentional about integration.

The National Research Council for Agricultural Education (The Council, 2003), a national partnership for excellence in agriculture and education, analyzed the current literature available on student mathematical achievement and identified 12 emerging themes that are considered promising practices to improve student’s abilities in mathematics. The Council (2003, p. 2) recommended the following practices:

1. Provide students with an opportunity to learn criterion materials;
2. Provide students with time on task;
3. Use the community as an informal learning laboratory;
4. Connect knowledge with the personal life of the learner;
5. Provide students with the opportunity to practice with corrected feedback;
6. Engage parents in the student’s learning;
7. Focus on what is “right” about student performance, not what is “wrong;”
8. Use a variety of teaching strategies to accommodate diverse learning styles;
9. Make students feel important and invited as members of the learning group;
10. Deal with needed change or criticism in a positive way;
11. Visit students where they live and get to know the students personally; and
12. Demonstrate a sense of humor.

Thompson, Jansen and Enochs (2005) indicated that agricultural teachers can play a major role in helping students make connections between what they are learning in the agricultural education curriculum and ways to apply that knowledge in the real world. They have modified seven steps to increase mathematics skills in agricultural education using contextual learning. The Seven Steps to Enhancing Mathematics were designed from the elements of the pedagogy and classroom learning strategies identified by Bickmore-Brand (1993). Teachers indicated that the Seven Step Enhancement process was an effective teaching method to help students understand and apply mathematical concepts in agriculture as well as in applying those concepts in other contexts.

Seven Steps to Enhancing Math in Your Curriculum

1. Teacher recognizes math with the class by “pulling out” and “pointing out” the math.
 - When teacher comes to the part of the lesson where predetermined math exists, verbally recognize the math...show students by “pulling out” and “pointing out” in the lesson, activity, and/or project of the day.
2. Teacher assesses students’ math awareness.
 - Teacher asks questions to find out what the students already know. What can you tell me about? Why does this work? What would happen if ___? Does ___ mean anything to you? Where have you used this before?
3. Teacher demonstrates steps/processes needed to complete the example.
 - Walk students through the steps/processes needed to complete the example. Depending on level of understanding, ask students to take the lead.

4. Teacher enhances mathematics in the lesson.

- Explain mathematical concept(s)/principle(s), and show the students how it applies using the terminology of math. Use math language.

5. Teacher reinforces by having students try similar examples.

- Demonstrate similar math examples from similar agriculture scenarios and generic math examples similar to those they might see in math class or on a math test.

6. Teacher checks for understanding.

- Students explain or demonstrate understanding. Ask them to explain the math steps or concepts that we used today. How would you explain these math steps/concepts to someone else?

7. Teacher expands the enhancement.

- Students create new agriculture and math examples or provide students with another agricultural scenario that addresses the same math concept.

Johnson, Charner, and White (2003) stated that curriculum integration appears to be more difficult in settings that are focused on multiple pathways. Curriculum integration can be especially difficult for vocational schools that have students who enroll from multiple schools. A prominent barrier to integration of academics arises from the traditional segregation of academics and career and technical education tracks (Kruse, Seashore, & Bryk, 1994; Newman, et al., 1996; & Nickolas, 2000). Curriculum integration requires flexibility not only by the participating teachers and students, but the entire school. Another problem identified with applied curriculum courses involves a tendency to involve very basic skills rather than higher order thinking skills (Bottoms &

Sharpe, 1996; Stasz, Kaganoff, & Eden, 1994). However, curriculum integration appears to be a powerful tool for both academic and vocational teachers. Johnson et al. (2003) found that curriculum integration allows teachers to move from traditional teaching models, in which teachers are isolated, to more of a collaborative one.

Johnson et al. (2003) reported that an investment of resources is needed to develop support, sustain, and expand curriculum integration efforts. However, they found that agricultural teachers at Johnson County High School located in Mountain City, Tennessee had initially incorporated academic lessons into the agricultural education curriculum in an effort to more fully prepare the students for future endeavors. The agricultural instructors continued to progressively add sophisticated academic material into the curriculum and teamed with academic instructors to deliver the content. After working with the agricultural instructors and witnessing the students becoming engaged and enthusiastic about the real-world application of the academic content, academic teachers frequently approach vocational teachers seeking additional opportunities to collaborate (Johnson et al., 2003).

Teachers' Attitudes Toward Mathematics Integration

In the majority of the studies in this review, teachers were positive toward the concept that mathematics and science should be included and integrated into the agricultural education curriculum. Miller and Vogelzang (1983) found that agricultural instructors in Iowa supported the inclusion of mathematics concepts in agricultural education. Miller and Gliem (1993a as cited in Hunnicutt, 1994) found that all teachers in their Ohio study had positive attitudes toward the integration of mathematics in their curriculum. Both studies revealed that the individuals sampled believed that the students

would benefit both vocationally and academically when mathematics is integrated into the curriculum.

Miller and Gliem (1993a as cited in Hunnicutt, 1994) reported that 47% of all the Ohio agriculture teachers stated they integrated mathematics into their curriculum. A check of the state department records indicated that only 6% of the teachers were involved in the Ohio applied academic program for mathematics (Ohio Department of Education, Division of Vocational and Career Education, 1991).

Applied academics, as a planned program provided by state departments of education and/or consultants, reached very few agricultural education programs in Ohio (Miller & Gliem, 1993a as cited in Hunnicutt, 1994). These teachers who did not participate in the applied academic program still believed the integration of mathematics was important enough to include in their program without a guide or a planned program. Forty-seven percent of the teachers were apparently using their own methods for integration of mathematics concepts into their curriculum without a planned program.

Miller and Gliem (1993b as cited in Hunnicutt, 1994) also stated that research is needed in this area to determine the capability of agricultural education instructors in applying mathematics concepts to agricultural-related problems. They thought that determining the best methods for the integration of mathematics into the agricultural curriculum was vital for the academic success of the students enrolled in agricultural courses.

Mathematics Integration and Coordination

The primary effort to integrate academic and vocational subjects has come from the vocational educators (Miller & Gliem, 1993a as cited in Hunnicutt, 1994). The

Perkins Act (1998) mandated that integration work within both vocational and academic disciplines. According to the Perkins Act, it is necessary for academic teachers to integrate related vocational concepts into the curriculum, as well as for vocational teachers to integrate academics into the vocational curriculum.

There is evidence that mathematical concepts are being integrated into agricultural education programs. Loadman (1986) and Dayberry (1991) investigated to find the extent of incorporation of mathematics into the agricultural education curriculum. Dayberry (1991) found that mathematical concepts and skills were being integrated throughout the curriculum. Loadman (1986) found that it was indispensable to teach certain mathematical concepts as they correlated with the specific areas within agriculture.

Johnson (1991) indicated that students who were more proficient in mathematical skills achieved higher scores in a state agricultural mechanics career development event. He suggested that it may be essential to redesign instructional programs to improve the mathematics skills of agricultural education students. Johnson indicated a need for additional research into improving the mathematical abilities of both students and instructors.

Miller and Gliem (1993a as cited in Hunnicutt, 1994) indicated that education can be improved if there is coordination between vocational and academic teachers. They found that only 27% of the agricultural instructors in Ohio were asked by mathematics instructors for examples of agricultural-related problems to be incorporated into their mathematics curriculum. Forty-seven percent of the agricultural instructors stated that they had asked mathematics instructors for ways to integrate mathematics into their

agricultural instructional program. They concluded that almost twice the amount of mathematical coordination is being done by the agricultural instructor as compared to the mathematics instructors (Miller & Gliem, 1993b as cited in Hunnicutt, 1994).

Dormondy (1992) found that a majority of agricultural instructors were sharing resources with academic teachers. The secondary instructors of agriculture were actively interacting with other programs at their respective schools. On the other hand, the integration was initiated by the agricultural instructors in a majority of the cases.

Butler and Lee (1993) suggested that instructors participating in a new agriscience program in Mississippi used particular mathematics concepts, skills, and applications in teaching this course. The study also stated the need for efforts in using team teaching and instructional planning by both mathematics and agricultural instructors. While this study did not bring to light the extent to which instructors interact with one another, the recommendations called for the planning of suitable instruction by instructors from both mathematics and agricultural content areas.

Effective collaborative curriculum integration has been found to succeed under conditions in which schools provide opportunities to collaborate across disciplines, foster a shared sense of purpose, and provide programmatic supports and flexible structures (Betances, 1999; Hernandez & Brendefur, 2003; Locke, 1999; Peterson, McCarthy, & Elmore, 1996; Schmidt, Finch, Faulkner, & Kandies, 1995). Interdisciplinary collaboration is a time-consuming activity with important implications for school and administrative support. Collaborative teams with supportive school environments and structural supports to collaborate were able to stay focused and progressively refined the design of the teaching and learning activities. Highly authentic, integrated, and standards-

based curriculum units could be produced if teams collaborated under favorable conditions (Hernandez & Brendefur, 2003; Loucks-Horseley, Stiles, & Hewson, 1996; Peterson et al., 1996).

Theoretical Framework

The theoretical perspective that guided the review of literature and the current study was the Diffusion of Innovations Theory developed by Rogers (1995). Rogers' diffusion theory has been used for many years to describe innovation diffusion and the adoption or rejection of innovations. Rogers described the five stages of the innovation-decision process as knowledge, persuasion, decision, implementation, and confirmation.

Stages of Adoption

Knowledge stage. The innovation-decision process begins with the knowledge stage where the potential adopter is exposed to the innovation and begins to understand how it functions (Rogers, 1995). At this stage the individual needs to know what the innovation is and how and why it works. Teachers are exposed to this information principally through the different communication channels in which one individual communicates a new idea to one or several others. Parr (2004, p. 116) found that in-service education for teachers concerning contextualized teaching and learning did help instructors recognize opportunities, as well as the knowledge and skills needed, to increase the math performance of their students.

Persuasion stage. In the persuasion stage, the potential adopter forms a favorable or unfavorable attitude toward the innovation (Rogers, 1995). The potential adopter cannot begin to form this attitude until knowledge is gained about the innovation in the first stage of adoption. The persuasion stage incurs as affective (feeling) mental activity

as opposed to the cognitive (or knowing) activity in the knowledge stage (Rogers, 1995). Hunnicutt (1994) found that all 55 agricultural education teachers sampled in Alabama indicated that they believed that mathematics were necessary part of the agricultural education curriculum. Miller and Vogelzang (1983) found that agricultural instructors in Iowa supported the inclusion of mathematics concepts in agricultural education. Miller and Gliem (1993a as cited in Hunnicutt, 1994) found that all teachers in their Ohio study had positive attitudes toward the integration of mathematics in their curriculum. Anderson (2003) indicated that there was a negative relationship between the Agriscience teachers of Texas attitudes toward an innovation and age and years teaching. Frazee, Frazee, Baker and Kieth (2002) found a similar negative relationship between level of education and attitude toward an innovation.

Decision stage. After knowledge is gained and an attitude is formed toward the innovation the potential adopter is ready to make the decision to adopt or reject the innovation. According to Rogers (1995), the innovation-decision process leads to a decision to make full use of the innovation (adoption) or a decision not to adopt an innovation (rejection). Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations. These five qualities are the most important characteristics of an innovation. Any decision may be reversed at a later point in time if the innovation becomes obsolete or replaced by another innovation. Miller and Gliem (1993a as cited in Hunnicutt, 1994) reported that 47% of all the Ohio agriculture teachers stated they integrated mathematics into their curriculum.

Implementation stage. Implementation occurs when the potential adopter puts the innovation into use (Rogers, 1995). Until this stage, the innovation-decision process has been strictly a mental exercise, but now a change in behavior must take place. The implementation stage includes the acquisition of additional information about the innovation, as well as regular and continued use of the innovation. An important phase of the implementation stage, when the innovation is applied to uses other than its original intended purpose, is re-invention.

Hunnicut (1994, p, 65) utilized a descriptive design to determine the self-report level of mathematics integration among 55 agricultural education teachers in Alabama. The percentage of integration was reported on a scale of 1= 0-25%, 2= 26-50%, 3= 51-75%, and 4= 76-100% of units receive integration. The mean for percentage of integration was 2.15.

Parr (2004) found mathematically enhanced agricultural power and technology courses in Oklahoma had a positive effect on student math performance. Student achievement in mathematics is a serious matter facing public education. The math achievement scores agricultural education student in at least one state have been examined and found to be below the state average as well as below the level of other career and technical education concentrators (Woglom, Parr, & Morgan, in press).

Confirmation stage. The decision to adopt or reject is often not the terminal stage in the innovation decision process because individuals may seek out information before they and after they decide to adopt an innovation. At the confirmation stage, the adopter seeks reinforcement of the innovation-decision and if conflicting messages about the innovation are obtained, the previous decision may be reversed (Rogers, 1995). A

decision to adopt or reject an innovation may be reversed or reinforced, depending on the information gathered by the adopter. The increase in mathematics achievement among student enrolled in the agricultural power and technology courses in Oklahoma may empower mathematics teachers who have been searching for a way to make their subject matter more meaningful to students (Parr, 2004; Romberg & Kaput, 1999; & Parnell, 1998).

Adopter Categories

Rogers (1995) categorized adopters based on their innovativeness and reported that over time the distribution of adopters will approach normality. Adopter categories include: innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%). Adopter category ideal types characterized the innovators as venturesome, early adopters as having respect within the social system, early majority as deliberate, late majority as skeptical, and laggards as traditional.

Innovator. The innovators typically have an obsession with being venturesome. They also have the desire to obtain new ideas that tend to lead them outside of their local peer network. Being an innovator has several risks involved; they must be willing to accept the occasional setback. The innovator tends to be rash, daring and risky; they must be able to cope with a high degree of uncertainty about an innovation at the time of adoption. The innovator may not be accepted by their local peers; however they play an important role in introducing new ideas into the system (Rogers, 1995; pp. 263-264).

Early Adopter. The early adopters are more accepted within the local peer network than the Innovators. This category is comprised of the majority of opinion leaders with the peer network. The early adopters tend to serve as role models for other

members of the social system and are often the individuals that serve as consultants for the adoption of innovations. The early adopters tend to be respected by their peers and seen as successful.

Early Majority. The early majority tend to adopt innovations before the average member adopts the new idea. The innovation-decision period for the early majority is relatively longer than that of the innovator and the early adopter. The early majority tends to be deliberate for a period of time before adopting the new idea.

Late Majority. The late majority adopt innovations shortly after the average member of a social network. The adoption process for the late majority may be an economic necessity and/or the peer pressure. The late majority approach new ideas skeptically and cautiously, adopting innovations after the majority of the social network has already done so.

Laggards. The laggards tend to be isolates in the social network and are often considered traditionalists. The laggards tend to make decisions based on what has happened in the past. Laggards tend to be suspicious of innovations and change agents. Their innovation-decision process is relatively lengthy, with adoption and use lagging far behind their peers in the social network.

Summary

The Perkins Act of 1998 mandated the integration of vocational and academic education and called for the integration process to include all academic and vocational teachers. The Virginia Standards of learning set fourth academic standards I mathematics, science, English, and history and social studies. This requirement provides

accountability for public schools and gives the local schools the flexibility to offer programs that best meet the educational needs of students.

Three studies conducted regarding agricultural teachers mathematical abilities have lead researchers to conclude that they teachers have sub-par mathematical problem-solving proficiency. The researchers have suggested that additional mathematics be integrated into agricultural mechanics courses at teacher education institutions.

As a result of the National Commission on Excellence in Education (1983), Campbell, Hombo, and Mazzeo (2000) reported that high school graduation requirements for academic subjects increased. Additional studies have indicated that the extra core courses students are required to take have not lead to an increase in academic proficiency. Mathematical educators have expressed a need to reform mathematics education; one of the themes that emerged is contextually-based learning. Bailey (1998) suggested specific subjects in which mathematics education may be integrated to establish the contextual based applications that are meaningful to students; agricultural education was one of the subjects recommended.

Several studies have indicated that agricultural education teachers support the inclusion of mathematics into the agricultural education curriculum. The teachers had positive attitudes towards the integration of mathematics and had begun integrating mathematics. Previous research has indicated that agricultural education teachers need to make the initial effort to collaborate with academic teachers regarding integration.

Rogers' diffusion of innovations served as the theoretical framework for this study. Rogers' outline five stages of the innovation-decision process to determine the adoption or rejection of innovations. Several studies have indicated that agricultural

teachers in various regions throughout the United States have entered into the innovation-decision process.

The purpose of this study was to analyze outstanding agricultural education teachers' attitudes toward mathematics integration and their current level of mathematics integration. An investigation into the collaboration efforts being made between the agricultural education and mathematics department was also included. The study also identified the outstanding teacher's perceived needs related to mathematics integration.

Chapter 3

Methodology

Agricultural education instructors are required by the standards set forth in the Carl D. Perkins Vocational and Technical Education Act of 1998 to integrate academics into the agricultural education curriculum. The formal integration of mathematics into the agricultural education curriculum on the state level in Virginia is minimal. However, applied science courses such as biology application in agriculture have recently been added to the state approved curriculum (Virginia Office of Career and Technical Education Services, 2006).

The purpose of this study was to analyze outstanding agricultural education teachers' attitudes toward mathematics integration. The researcher also identified the outstanding agricultural teachers' self-reported level of mathematics integration into each course. An investigation into the collaboration efforts being made between the agricultural education instructors and mathematics instructors is also included. The researcher further identified the outstanding teachers' perceived needs to increase mathematics integration. An analysis of the emerging themes associated with the outstanding agricultural education instructors who integrate mathematics at the highest level was also conducted by the researcher. The study resulted in proposed actions to increase mathematics integration into the agricultural education curriculum. Research questions investigated in this study are:

1. What are the characteristics of outstanding agricultural education instructors who were nominated by Virginia agricultural education leaders and the programs in which these instructors teach?

2. What is the self-reported level of integration of mathematics by each instructor and across instructors for each course taught?
3. What are the attitudes of the outstanding agricultural education instructors toward the integration of mathematics into the agricultural education curriculum?
4. What are the perceptions of the outstanding agricultural education instructors related to the school environment regarding mathematics integration?
5. What are the perceived needs of the outstanding agricultural education instructors regarding the integration of mathematics into their agricultural education curriculum?
6. What are the relationships among selected characteristics of outstanding agricultural education instructors, their programs, and their perceptions of the school environment, level of integration, attitudes, and needs regarding academic integration?
7. What are the primary themes related to integration of mathematics that emerge through interviews with the five outstanding agricultural education instructors who reported the highest percentage of mathematics integration in their courses?

Research Design

The research design for this study included both qualitative and quantitative research methodologies. The goal of the researcher was to maximize the strengths of qualitative and quantitative research and minimize the weaknesses of both. This allowed the researcher to collect data using different strategies and methods. The mixed-methods

design allows the researcher to tap into the participants' perspective and discuss the issues under investigation through the follow-up interviews while the questionnaire systematically measures factors associated with purpose of the study (Johnson & Onwuegbuzie, 2004).

The mixed-methods design possesses its own strengths and weaknesses. One of the strengths outlined by Johnson and Onwuegbuzie (2004) is that a mixed-methods strategy can answer a broader and more complete range of research questions; some of the weaknesses included time and money. Johnson and Onwuegbuzie (2004) suggested that mixed-methodology is the best approach to utilize when attempting to accurately answer complex research questions. The use of both methodologies in this mixed-design study was utilized to enhance the value of the study.

Participants

The participants of this study were selected by a panel of experts who frequently visit agricultural education teachers and observe them teaching. The panel was composed of two agricultural education teacher educators at Virginia Tech, the Director of Agricultural Education in the Virginia Department of Education, and two Virginia agricultural education curriculum specialists. An email message was sent to the panel of experts requesting nominations of 10 outstanding agricultural education classroom teachers using the following criteria:

- Knowledgeable of the agricultural education curriculum in Virginia;
- Willing to accept change;
- Provide an in-depth analysis of the questions;
- Willing to complete the study thoroughly; and

- Able to communicate effectively through email.

After compiling the responses from the panel of experts, a list of nominees was created based on those who were identified by the expert panel. The nomination list was then submitted to the panel of experts for final approval. The panel reached a consensus on 26 outstanding agricultural education teachers. An email was then sent to all prospective participants to inform them of their nomination.

Data Collection

A two-phase process was used to collect data; the first phase utilized an Internet-based survey instrument. The second phase consisted of follow-up interviews with the five outstanding teachers who integrated mathematics at the highest level.

Survey Instrument

Internet-based surveys present some distinct advantages over other types of evaluation instrumentation processes (Dillman, 2000). Several researchers have noted advantages of the Internet-based survey design, which include:

1. Internet-based survey instruments can access large number of potential participants (Lazar & Preece, 1999).
2. Electronic survey instruments can be delivered instantly, thus reducing the data collection period time (Truell, Bartlett, & Alexander, 2002; Watt, 1997).
3. Cost to produce Internet-based survey instruments and distribute using electronic mail is minimal as compared to other data collection tools (Duffy, 2002; Lazar & Preece, 1999; Watt, 1997).
4. Human error associated with data entry is eliminated (Duffy, 2002; Lazar & Preece, 1999).

5. The data collection process has been reduced to transferring data from one program to another, eliminating the time spent entering data (Duffy, 2002; Lazar & Preece, 1999).
6. Participants answer more freely than in other research process due to a greater sense of anonymity (Harris & Dersch, 1999).

Although electronic surveys provide several advantages, they present disadvantages as well. The most glaring disadvantage of electronic surveys is the utilization of electronic mail filters. It is possible that the e-mails sent by the researcher could have been filtered into the recipients' junk mail folders. Therefore it is uncertain how many people received the survey, thus placing uncertainty on the return rate (Goree & Marszalek, 1995). Simsek (1999) compared electronic surveys to traditional survey methodology (see Table 3.1):

Table 3.1
A Comparison of E-mail and Traditional Survey Methods

Factor	Survey Type			
	Personal interviews	Telephone interviews	Mail questionnaire	E-mail questionnaire
Cost	Very high	High	Moderate	Lowest
Data collection speed	Moderate to low	Very fast	Moderate	Fast
Response rate	Very high	Moderate	Low	Moderate to high
Geographic flexibility	Limited	High	Very high	Highest
Time flexibility	Limited	Moderate	High	Highest
Diversity of questions	High	Moderate to low	Moderate	Moderate
Questionnaire length	Long	Moderate to short	Moderate to long	Moderate to short
Use of visual aids	Highest	None	Usually high	Low
Item non-response	Low	Moderate	Moderate to high	Moderate to low
Ease of prior-contact	Difficult	Easy	Easy	Easiest
Ease of follow-up	Difficult	Easy	Easy	Easiest
Respondent anonymity	Lowest	Moderate	High	High
Potential interviewer bias	High	Moderate	None	None
Respondent convenience	Low	Moderate	High	High
Eliciting sensitive data	Low	Moderate to high	High	High
Control of field force	Low	Moderate	High	High
Sample control	High	Moderate to high	Low	Moderate
Difficulty of carrying out	Very difficult	Difficult	Easy	Easy to medium

With the lack of existing instruments that address all of the goals of the study and with consideration of the advantages associated with the utilization of Internet-based survey instruments, an electronic survey instrument was developed by the researcher. The survey instrument was created based on the review of the literature regarding academic integration into the career and technical education and agricultural education curricula. Consultation with faculty and doctoral students of the Agricultural and Extension Education Department at Virginia Tech and a mathematics curriculum specialist provided feedback to determine face validity and readability of the instrument.

Principles of electronic survey design from Dillman's (2000) tailored design method were consulted when constructing the instrument. The survey instrument was constructed with the assumption that the participants possess only basic computer skills; therefore, the survey was simple to complete and provided clear explanations. Dillman also recommended keeping all questions on one continuous Internet webpage and utilizing the traditional question format. Virginia Tech's SurveyMaker program was designed to work with all web browser programs, thus eliminating any potential errors created by the different browser setups. The contact information of the researcher was provided to assist the participants with any technical problems that they might experience.

The survey instrument was composed of seven major parts, and the complete survey appears in Appendix A:

- I. Teacher characteristics (questions 1-10): This section of the questionnaire was developed to align with research question one to investigate general teacher characteristics associated with outstanding teachers. This section

included age, level of education, gender, years teaching, areas of endorsement, grade level taught, mathematics courses completed, licensure, and ethnicity.

- II. Program characteristics (questions 11-15): This section of the questionnaire was developed to align with research question one, which investigates general program characteristics associated with teachers who integrate mathematics. This section included the number of teachers in the agricultural education department, student enrollment in agricultural education, type of school schedule, size of community and academic credits offered in agricultural education.
- III. Mathematics integration (question 16): This section assesses research question two by asking teachers to self-report the courses taught, the number of students enrolled in each course, and the level of mathematics integration in each course.
- IV. Teacher opinions (questions 16-35): This section relates to research question three, exploring the teachers' attitudes toward mathematics integration utilizing a 5-point Likert scale. Possible responses included: 1= Strongly Disagree, 2= Disagree, 3= Uncertain, 4= Agree, 5= Strongly Agree. This section probed attitudes toward how students learn, how mathematics should be taught, academic integration, academic rigor of agricultural education, and perceptions of the agricultural education curriculum. In the construction of the survey instrument, several statements were constructed positively while others were worded

negatively. This was done to check for consistency in the teachers' responses.

- V. Teacher collaboration (questions 36-40): This section aligns with research question four, which provided the researcher with the teachers' opinions of the school environment. A five-point Likert scale was used to collect data. Possible responses included: 1= Strongly Disagree, 2= Disagree, 3= Uncertain, 4= Agree, 5= Strongly Agree. This section probed the teachers' views regarding their efforts to integrate mathematics and the mathematics instructors and other faculty and administrators' efforts towards integration.
- VI. Teacher needs (questions 41-50): This section aligned with research question five, which assessed the perceived needs of the outstanding agricultural education instructors regarding the integration of mathematics into their agricultural education curriculum.
- VII. Question number 51 asked participants to identify the name of the school where they teach. The purpose of this question is to allow the researcher to contact non-respondents, and then it will be omitted from the data to be analyzed. No information will be linked to specific respondents or their schools in reporting the results.

Interviews

Follow-up interviews were used by the researcher to collect more in-depth information regarding mathematics integration into the agricultural education curriculum. This section of the study utilized qualitative methodology to collect data. Qualitative

research, broadly defined, means "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (Strauss & Corbin, 1990, p. 17). While quantitative researchers seek causal determination, prediction, and generalization of findings, qualitative researchers seek instead illumination, understanding, and extrapolation to similar situations. Qualitative analysis results in a different type of knowledge than does quantitative inquiry. There are several considerations when deciding to adopt a qualitative research methodology. Strauss and Corbin (1990) claimed that qualitative methods can be used to better understand any phenomenon about which little is yet known.

The researcher developed an interview guide (Appendix G) based on the results of research questions 1 through 6, which were determined using the survey instrument. An interview guide is a list of questions or general topics that the researcher wants to explore during each interview. Although it is prepared to collect similar information from each person, there are no predetermined responses.

In semi-structured interviews, the interviewer is free to probe and explore within these predetermined inquiry areas. Interview guides ensure good use of limited interview time. They make interviewing multiple subjects more systematic and comprehensive. They also help to keep interactions focused. In keeping with the flexible nature of qualitative research designs, interview guides can be modified over time to focus attention on areas of particular importance or to exclude questions the researcher has found to be unproductive for the goals of the research (Lofland & Lofland, 1988).

Field Testing

Prior to conducting the field test, the survey was submitted to faculty and doctoral students in the Agricultural and Extension Education Department at Virginia Tech to evaluate the instrument for any potential errors and determine face validity. Based on this review, revisions were made in terms of grouping questions, adding questions, and adding answering options.

Fink (1995) indicated that 10 people are typically needed to field test an instrument. A group of 10 Agricultural and Extension Education pre-service teachers at Virginia Tech completed the instrument while they were student teaching during the spring semester of 2006. Upon completion of the field-tested instrument, the pre-service teachers were given the opportunity to provide additional suggestions for improvement of the instrument and report any technical problems to establish face validity. Reviews of responses indicated that only minor revisions were needed and these changes were made prior to data collection. The data collected from the field test allowed the researcher to analyze the reliability of the instrument which is described in the reliability section of this chapter.

Field testing was conducted for the follow-up interviews as well. Two participants were selected from the group of outstanding teachers who were not selected to participate in the follow-up interviews. The purpose for field testing was to fine tune the interview guide in order to determine if the guide followed a logical flow. Field testing was also used to draft the open-ended questions in order to determine if they are aligned with the purpose of the study. Field testing the follow-up interview guide also allowed the researcher the opportunity to refine interviewing skills.

Reliability of Instrument

Bott (1996) suggested that reliability is the “degree of accuracy in which a test measures consistently” (p. 27). Internal consistency reliability (Pedhazur & Schmelkin, 1991) is determined by checking the components of a questionnaire against each other. Internal consistency reliabilities have a range of 0 (lowest) to 1.0 (highest) (DeVellis, 1991). The following guidelines have been proposed by DeVellis (p. 85) regarding acceptable reliabilities for research instrument scales:

below .60	unacceptable
between .60 and .65	undesirable
between .65 and .70	minimally acceptable
between .70 and .80	respectable
between .80 and .90	very good
above .90	consider shortening the scale

The Cronbach’s alpha and Spearman-Brown reliability coefficient was calculated for the items reported from the field study of the researcher-constructed instrument used in this study. The analysis yielded a Cronbach’s alpha coefficient of $\alpha = 0.868$ and a Spearman-Brown coefficient of $\alpha = 0.874$ with an $n = 10$. DeVellis (1991) classified a coefficient of this range as indicating very good internal consistency reliability.

The Cronbach’s alpha and Spearman-Brown reliability coefficient was calculated for the items reported from this study. The analysis yielded a Cronbach’s alpha coefficient of $\alpha = 0.638$ and a Spearman-Brown coefficient of $\alpha = 0.656$ with an $n = 25$. DeVellis (1991) classified a coefficient of this range as indicating undesirable and minimally acceptable.

Validity of Instrument

The validity of a measurement instrument is the extent to which the instrument measures what it is supposed to measure (Bott, 1996). The only validity measure for this instrument was based upon its review during field testing. Litwin (1995) promoted the utilization of a panel of experts in order to establish content validity. The selected faculty members in Agricultural and Extension Education and Career and Technical Education along with the mathematics curriculum specialist for Montgomery County, Virginia public schools served as a panel of experts who reviewed the instrument in order to assess content validity.

Data Collection

The responses from the online survey were automatically downloaded into a Microsoft Excel worksheet. The time allotted for data collection was three weeks as recommended by Dillman (2000) and Truell, Bartlett, and Alexander (2002).

The data collection process followed a combination of the Dillman (2000) and Truell, Bartlett, and Alexander (2002) models that utilized a five-step process which included:

Step I: A notification email (See Appendix C) was distributed alerting the participants that they had been identified by an expert panel as outstanding agricultural education teachers. The letter included a brief overview of the purpose of the study, the human rights of the participants as set forth by the Virginia Tech Institutional Review Board, and general directions needed to complete the survey.

Step II: The second email, sent three days after the notification message,

provided the specific directions to successfully access and complete the survey and included a specific deadline. The email also reminded the participants that their participation was voluntary and of their rights covered under Virginia Tech's Institutional Review Board. A contact telephone number for the researcher was provided in case of any technical difficulties accessing the survey.

Step III: The third email was sent one week after the second email, thanking those who had completed the survey and serving as a reminder to those individuals who had not completed the instrument. The email also included the researcher's contact information for participants who were experiencing technical difficulties completing the survey instrument and/or those who felt more comfortable completing the survey instrument via telephone.

Step IV: The fourth email was sent out one week after the third email requesting those who had not completed the survey to please do so immediately and thanking those who had already completed the survey. Information was provided to contact the researcher via telephone if they were experiencing any technical difficulties.

Step V: The fifth email was sent one week after the fourth email. This message indicated the completion of the data collection period, provided contact information for the results of the study, and included a note of appreciation for their participation.

Step VI. All participants in the follow-up interviews for this study were contacted

via e-mail (Appendix D) and asked to participate in an interview. The researcher introduced himself and explained the purpose of the interview and determined a location and time to meet. The participants were informed about the nature of the interview and their participation was voluntary. Consent was granted through an e-mail response from each participant.

Data Analysis

The survey data were analyzed using the Statistical Package for the Social Sciences (SPSS) 13.0 Student Version for Windows. A complete listing of the data analysis methods utilized for each of the questions on the survey instrument and the relationship of items with each research question can be found in Table 3.2. Specifically, analyses were reported using the following methods for each question.

1. Data related to research question one were analyzed using descriptive statistics. Frequencies, percentages, means, ranges, and standard deviations were calculated for the characteristics of the outstanding agricultural education instructors and their programs. Survey instrument questions 1-15 were used to collect the data associated with research question one.
2. Data associated with research question two were analyzed using descriptive statistics. Frequencies, percentages, means, and ranges were calculated for each outstanding agricultural education instructors' overall integration of mathematics and for each course taught by outstanding agricultural education instructors. Survey instrument question 16 was used to collect the data associated with research question two.

3. Data relative to research question three were analyzed using descriptive statistics. Frequencies, percentages, means, and standard deviations were calculated for the items that measured attitudes. Survey instrument questions 17-35 were used to collect the data associated with research question three.
4. Data related to research question four were analyzed using descriptive statistics. Frequencies, percentages, means, and standard deviations were calculated for the outstanding agricultural education instructors' perceptions in their school's environment regarding mathematics integration. Survey instrument questions 35-40 were used to collect the data associated with research question four.
5. Data related to research question five were analyzed using descriptive statistics. Frequencies, percentages, means, and standard deviations were calculated for the outstanding agricultural education instructors' perceived needs regarding the integration of mathematics into their agricultural education curriculum. Survey instrument questions 40-50 were used to collect the data associated with research question five.

Table 3.2

Analysis of Survey Data

Instrument question	Theme	Research Question	Measurement Scale	Data Analysis
1	Years taught	1,6	Ratio	Frequency, Mean, Standard Deviation, Range, Correlation (16-50)
2	Level of education	1,6	Nominal	Frequency, Cross-Tabulation (16-50)
3	Age	1	Ratio	Mean, Standard Deviation, Range
4	Gender	1,6	Nominal	Frequency
5	Ethnicity	1,6	Nominal	Frequency
6	Grade level taught	1	Nominal	Frequency
7	VAAE member	1	Nominal	Frequency
8	Endorsements	1,6	Nominal	Frequency, Cross-Tabulation (16-50)
9	Math courses completed	1,6	Ratio	Frequency, Correlation & Cross-Tabulation (16-50)
10	Teaching licensure	1,6	Nominal	Frequency, Cross-Tabulation (16-50)
11	Location of school	1,6	Interval	Frequency
12	Number of agricultural education teachers	1,6	Ratio	Frequency
13	Student enrollment	1,6	Ratio	Mean, Range, Standard Deviation, Correlation
14	Academic credit	1,6	Nominal	Frequency, Cross-Tabulation (16-50)
15	School schedule design	1	Nominal	Frequency
16	Courses taught, percent of mathematics integration, number of students per class	2,6	Interval	Range and Mean for each class Mean for each teacher will be used for Correlation and Cross-Tab Mean for each course will be used for Correlation and Cross-Tab
17	Traditional learning style	3,6	Interval	Mean & Standard Deviation
18	Applied learning style	3,6	Interval	Mean & Standard Deviation
19	Integral component of ag. ed.	3,6	Interval	Mean & Standard Deviation
20	Math instructors view of ag.	3,6	Interval	Mean & Standard Deviation
21	Belief in math integration	3,6	Interval	Mean & Standard Deviation
22	Ag. ed. as a context for math	3,6	Interval	Mean & Standard Deviation
23	Effort to integrate math	3,6	Interval	Mean & Standard Deviation
Instrument	Theme	Research	Measurement	Data Analysis

question		Question	Scale	
24	Ag. as a math content area	3,6	Interval	Mean & Standard Deviation
25	Attitude towards integration	3,6	Interval	Mean & Standard Deviation
26	Ag. ed. as a context to teach	3,6	Interval	Mean & Standard Deviation
27	Ag. ed. an aid to the SOLs	3,6	Interval	Mean & Standard Deviation
28	Student achievement	3,6	Interval	Mean & Standard Deviation
29	Increased effort	3,6	Interval	Mean & Standard Deviation
30	Curriculum available	3,6	Interval	Mean & Standard Deviation
31	Ag as a context for math	3,6	Interval	Mean & Standard Deviation
32	SOL role in enrollment	3,6	Interval	Mean & Standard Deviation
33	Student attitudes	3,6	Interval	Mean & Standard Deviation
34	Student attitudes	3,6	Interval	Mean & Standard Deviation
35	Student capability	3,6	Interval	Mean & Standard Deviation
36	Desire of ag. teacher	4,6	Interval	Mean & Standard Deviation
37	Math instructor's effort	4,6	Interval	Mean & Standard Deviation
38	Ag. instructor's effort	4,6	Interval	Mean & Standard Deviation
39	Outside efforts	4,6	Interval	Mean & Standard Deviation
40	Administrator's effort	4,6	Interval	Mean & Standard Deviation
41	Professional development	5,6	Interval	Mean & Standard Deviation
42	Desire to participate	5,6	Interval	Mean & Standard Deviation
43	How others integrate	5,6	Interval	Mean & Standard Deviation
44	Enroll in a course	5,6	Interval	Mean & Standard Deviation
45	How to teach applied math	5,6	Interval	Mean & Standard Deviation
46	Desire to teach applied math	5,6	Interval	Mean & Standard Deviation
47	Review a curriculum	5,6	Interval	Mean & Standard Deviation
48	Develop a curriculum	5,6	Interval	Mean & Standard Deviation
49	In-service with math teacher	5,6	Interval	Mean & Standard Deviation
50	Provided with curriculum	5,6	Interval	Mean & Standard Deviation
51	School taught at	NONE	N/A	Used to track non-respondents

6. Data relative to research question six were analyzed using correlation analysis with selected teacher and program characteristics and their perceptions of the school environment, level of integration, attitudes, and needs regarding mathematics integration. A cross-tabulation was also conducted for selected teacher and program characteristics and their perceptions of the school environment, level of integration, attitudes, and needs regarding mathematics integration.
7. All follow-up interviews were audio-taped and transcribed by the researcher. Incorporating the participants' own words gives the study credibility. Interviews were then coded by the researcher, in order to develop the themes and patterns observed. The themes were established through units of information consisting of phrases, sentences, and segments of text. Both within and across-case analyses were conducted, which added to the trustworthiness of the results. In addition, the researcher kept a notebook containing individual reflections and analyses of the research process and data, increasing the confirmability of the process (Anfara, Brown, & Mangione, 2002).

Summary

The purpose of Chapter 3 was to describe the methodology used in the study. A panel of experts identified 26 outstanding agricultural education teachers based on specified criteria. An electronic instrument was developed; student teachers field tested the instrument after it had been analyzed by agricultural and extension education professionals and a local public school secondary mathematics curriculum specialist.

Reliability and face validity issues were examined through the field study. The reliability of the instrument was found to be “very good” according to Devallis (1991), with both the Cronbach’s alpha and Spearman-Brown alpha coefficients scores falling between .80 and .90. However, the analysis from this study yielded a Cronbach’s alpha in the range of undesirable and minimally acceptable.

The data collection process utilized a combination of the Dillman (2000) and Truell, Bartlett, and Alexander (2002) models to distribute the instrument and collect the data. A five-step model was designed to contact the participants and alert them of the survey, deliver conduct the survey and the follow-up procedures. The data collected were analyzed using SPSS 13.0 Student Version. The data collected from the follow-up interviews were analyzed using both within and across-case analyses.

Chapter 4

Results

The purpose of this study was to analyze outstanding agricultural education teachers' attitudes towards mathematics integration. The researcher also determined the outstanding agricultural teachers' level of mathematics integration into each course currently taught. An investigation into the collaboration efforts being made between the agricultural education and mathematics teachers was also included. The researcher identified the outstanding teachers' perceived needs related to mathematics integration and provided baseline data as the agricultural education instructors in Virginia increase their integration of mathematics. The study resulted in proposed actions to increase mathematics integration into agricultural education curricula.

Survey instruments were sent electronically to all of the agricultural education instructors who were identified as outstanding teachers by state leaders in agricultural education (N=26). The number of instruments that were completed was 25, resulting in a 96% return rate. The results related to each research question will be presented in this section.

Characteristics of Outstanding Teachers and Their Programs

Question 1: *What are the characteristics of outstanding agricultural education instructors who were nominated by Virginia agricultural education leaders and the programs in which these instructors teach?*

The outstanding agricultural education teachers had range of 5 to 34 years of teaching experience, with a mean of 17 years. However, 44% of the respondents had 5-

10 years of teaching experience and 44% of the respondents had 20 or more years of experience. The respondents' teaching experience is summarized in Table 4.1.

Table 4.1
Summary of Respondents' Years of Teaching Experience (n=25)

	Years	<i>f</i>	%	M	SD
Years Taught	5	1	4	17.04	9.25
	7	1	4		
	8	6	24		
	9	2	8		
	10	1	4		
	13	1	4		
	18	2	8		
	20	2	8		
	24	2	8		
	25	1	4		
	27	2	8		
	28	1	4		
	29	1	4		
	31	1	4		
	34	1	4		

The mean age of the 25 outstanding agricultural education teachers was 40 (SD = 9.08) with a range of 29 to 59. Caucasians accounted for 96% of the respondents, while there was only one African American. Fifty-six percent of the respondents were males and 44% were females.

A bachelor's degree and master's degree were the only two levels of education indicated by the outstanding agricultural education teachers. The findings indicated that 52% had master's degrees, while 48% had bachelor's degrees. All 25 outstanding agricultural teachers had an endorsement in agricultural education, while three had an endorsement in science and one had an endorsement in both mathematics and business. Seventeen (68%) of the respondents indicated holding a Collegiate Professional License while respondents with a Postgraduate Professional License accounted for the other eight

(32%). The majority of the respondents (76%) taught at the high school level and 24% taught at the middle school level. Ninety-two percent of respondents indicated membership in the Virginia Association of Agricultural Educators (VAAE), the state professional association for agricultural education teachers. The frequencies and percentages for selected teacher characteristics are listed in Table 4.2.

Table 4.2
Summary of Selected Teacher Characteristics (n=25)

		<i>f</i>	%
Level of Education	Bachelor's Degree	12	48
	Master's Degree	13	52
Gender	Male	14	56
	Female	11	44
Ethnicity	African American	1	4
	Caucasian	24	96
Grade Level Taught	Middle School	6	24
	High School	19	76
Member of VAAE	Yes	23	92
	No	2	8

A majority (68%) of the respondents completed 4-5 mathematics courses in high school. A majority (56%) of the respondents did not complete a mathematics course at a two-year college and/or community college, but a range of 1-4 courses at this level was reported by 34% of the agricultural education teachers. Forty-eight percent of the respondents completed 2 to 3 mathematics courses at a four-year college or university. The number of courses completed by the outstanding agricultural teachers is indicated in Table 4.3.

Table 4.3

Mathematics Courses Completed by Respondents (n=25)

		<i>f</i>	%
Mathematics Courses Completed in High School	1	1	4
	3	2	8
	4	11	44
	5	1	4
	6	4	16
Mathematics Courses Completed in Community College	0	14	56
	1	4	16
	2	2	8
	3	2	8
	4	1	4
Mathematics Courses Completed at University	0	5	20
	1	2	8
	2	6	24
	3	6	24
	4	3	12
	6	2	8

Note: Totals do not equal 100% due to non-respondents.

Sixty percent of the respondents taught in an urban school, while 40% of the respondents taught in a rural school. The largest number of departments (n=10, 40%) had two teachers as indicated by the respondents. Departments with only one agricultural education teacher made up 28% and three teacher departments were reported by 24%. The respondents (n=25) reported a range of 62 to 440 students enrolled in their agricultural education programs with a mean of 188 students (SD= 76.67). Only three agricultural education teachers indicated that students receive academic credit outside of agricultural education for courses completed in that department. Two teachers said that students received a science elective credit for completing an agricultural education course while one indicated students receive a forestry credit. A majority (22) indicated that students did not receive any academic credit for courses taught in their department. Forty percent of the respondents' schools utilized the A/B block scheduling system. Schools that used the 4x4 block system made up 28%, and the seven-period system was reported

by 24% of the respondents. The frequencies and percentages for selected program characteristics are listed in Table 4.4.

Table 4.4
Summary of Selected Program Characteristics (n=25)

		<i>f</i>	%
Location of School	Urban	15	60
	Rural	10	40
Agricultural Education Teachers on Campus	1	7	28
	2	10	40
	3	6	24
	4	2	8
Type of School Schedule	7 Period	6	24
	8 Period	2	8
	A/B Block	10	40
	4x4 Block	7	28

Mathematics Integration

Question 2: *What is the self-reported level of integration of mathematics by each instructor and across instructors for each course taught?*

The agricultural education teachers (n=24) reported a mean of 21.63% of course content that utilizes mathematics in their curriculum, with a standard deviation of 11.34. The respondents indicated a range of 4 to 47% of mathematics integrated per teacher.

The teachers reported integrating mathematics in a range of 2 to 75% in individual agricultural education courses. The 24 teachers reported teaching 29 different courses. There were seven courses that were taught by only one teacher and six courses by only two teachers. There were seven courses that were taught by at least five teachers, with agricultural mechanics and basic plant science I being taught by the most teachers (10). The seven courses taught by at least five different teachers had a range of 8.60 to 26.43 mean percentage of mathematics integration.

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. The teachers of the five agricultural mechanics reported integrating mathematics at the second highest level ranging from 18.33 to 26.43%. The floriculture, floral design, and horticulture courses yielded the lowest percentages of integration, ranging from 5 to 8.6%. However, landscaping yielded 20% of mathematics integration and greenhouse management yielded 75% integration. The agricultural mechanics and basic plant science I course that was taught by the most agriculture teachers yielded 22.9% mathematics integration. Information for each course taught is presented in Table 4.5.

Table 4.5

Percentage of Mathematics Integrated per Course (n=25)

Course Number	Title	n	Minimum	Maximum	Mean	SD
8035	Greenhouse plant production and management	1	75	75	75.00	0.00
8024	Agricultural business operations IV	2	45	50	47.50	3.54
8022	Agricultural business fundamentals III	3	40	50	45.00	5.00
8026	Agricultural business operations V	1	45	45	45.00	0.00
8073	Applied agricultural concepts	1	40	40	40.00	0.00
8014	Operating the farm business IV	4	25	50	33.75	11.09
8042	Forestry, wildlife, and soil management IV	3	20	40	28.33	10.41
8010	Agricultural production technology III	3	15	45	26.67	16.07
8008	Agricultural mechanics and basic animal science II	7	10	50	26.43	12.33
8004	Agriscience and technology	6	15	50	25.00	13.04
8082	Small engine repair	3	25	25	25.00	0.00
8016	Introduction to power, structural, and technical systems	7	20	35	23.57	5.56
8006	Agricultural mechanics and basic plant science I	10	10	50	22.90	12.33
8012	Agricultural production management IV	3	15	30	21.67	7.64
8036	Landscaping	2	15	25	20.00	7.07
8003	Agriscience exploration	8	15	20	18.75	2.312
8018	Agricultural power systems	3	10	35	18.33	14.43
8040	Introduction to natural resources III	4	0	40	17.50	16.58
8084	Small animal care II	2	5	20	12.50	10.61
8088	Veterinary science	2	5	20	12.50	10.61
8080	Equine management production	3	5	20	11.67	7.64
8002	Introduction to agriscience	6	5	15	9.17	3.76
8034	Horticulture science	5	3	15	8.60	4.72
8038	Floriculture	2	5	12	8.50	4.95
8065	Exploratory agriculture	1	8	8	8.00	0.00
8000	Floral design I	1	5	5	5.00	0.00
90916	Leadership and communication	2	0	5	2.50	3.54
8083	Small animal care I	1	2	2	2.00	0.00

Outstanding Teachers' Attitudes Towards Mathematics Integration

Data were examined to address research question 3: *What are the attitudes of the outstanding agricultural education instructors toward the integration of mathematics into the agricultural education curriculum?*

The maximum range of attitude scores was 1 to 5, with 1 indicating the least favorable attitude and 5 representing the most favorable attitude, as shown in Table 4.6. The researcher classified all mean scores above 3.00 as positive and all scores below 3.00 as negative. The statement that “agricultural education provides an excellent avenue to teach mathematics” yielded the highest mean score of 4.44 (SD = 0.51) and “mathematics is an integral component of agricultural education” was second with a mean score of 4.36 (SD = 0.76). At the other extreme, the statement “mathematics integration is not important to the agricultural education curriculum” yielded the lowest mean of 1.72 (SD = 0.84) and “mathematics should be taught in the mathematics department not in the agricultural education department” had a mean of 1.76 (SD = 0.72). Note that disagreement with a negative statement indicates a favorable attitude. As indicated in Table 4.6, the six negatively worded items (shown in italics) had six of the seven lowest mean scores, indicating that the teachers disagreed with these negative perceptions of mathematics integration.

Table 4.6

Agricultural Education Teachers' Attitudes toward Mathematics Integration (n=25)

Statements	M	SD
Agricultural education provides an excellent avenue to teach mathematics in an applied context.	4.44	0.51
Mathematics is an integral component of agricultural education.	4.36	0.76
Students learn mathematics best in applied learning environments.	4.28	1.14
The curriculum I teach can aid the students with the mathematics section of the Virginia Standards of Learning.	4.16	0.62
I believe I should integrate mathematics into my curriculum.	4.12	0.60
I can integrate more mathematics skills into my agricultural education curriculum than what I am currently integrating.	4.04	0.54
Agricultural education is a mathematics-rich content area.	4.00	0.71
I purposely integrate mathematical concepts into my lessons.	3.92	0.76
I enjoy linking mathematical concepts to agricultural settings.	3.79	0.83
Student achievement increases with the integration of mathematics into the agricultural education curriculum.	3.75	0.85
The Standards of Learning have played a role in the decreasing number of students enrolled in the agricultural education department.	3.60	1.00
There are adequate curriculum materials available to integrate mathematics into my curriculum.	3.08	0.91
<i>Students do not want to learn about mathematics in my courses.</i>	2.88	1.04
<i>If I increase the academic rigor of my courses, the students will elect to not enroll in my courses.</i>	2.76	0.97
Mathematics teachers in my school recognize the value agricultural education has for teaching mathematics.	2.72	1.02
<i>Students learn mathematics best in a traditional mathematics course.</i>	2.56	1.00
<i>My students are not capable of understanding difficult mathematics concepts used in the agricultural industry.</i>	2.24	0.72
<i>Mathematics should be taught in the mathematics department not in the agricultural education department.</i>	1.76	0.72
<i>Mathematics integration is not important to the agricultural education curriculum.</i>	1.72	0.84

Note. Strongly Disagree = 1, Disagree = 2, Uncertain = 3, Agree = 4, Strongly Agree = 5. Negatively worded items are in italics.

Outstanding Agricultural Education Teachers Perceptions of the School Environment

Data were examined to address research question 4: *What are the perceptions of the outstanding agricultural education instructors related to the school environment regarding mathematics integration?*

Encouragement from administrators to collaborate had the highest mean score of 3.46 (SD = 0.84), followed closely by the desire to collaborate with the mathematics teacher (M = 3.4; SD = 0.82). The statement about the mathematics teacher making an effort to collaborate yielded the lowest mean score of 2.29, with a standard deviation of 1.12. The agricultural education teachers' attitudes toward school environment can be found in Table 4.7.

Table 4.7
Agricultural Education Teachers' Perceptions toward School Environment (n=25)

Statements	M	SD
My school administrators encourage academic integration through collaboration.	3.46	0.84
I want to collaborate with the mathematics teachers in my school.	3.40	0.82
I make an effort to collaborate with the mathematics instructor(s) at my school.	3.00	0.91
My colleague(s) outside of the mathematics department and I regularly share ideas and materials related to mathematics instruction.	2.36	0.70
The mathematics instructor(s) make an effort to collaborate with me.	2.29	1.12

Note. Strongly Disagree = 1, Disagree = 2, Uncertain = 3, Agree = 4, Strongly Agree = 5

Outstanding Agricultural Education Teachers' Needs

Data were examined to address research question 5: *What are the perceived needs of the outstanding agricultural education instructors regarding the integration of mathematics into their agricultural education curriculum?*

The respondents indicated favorable attitudes toward professional development regarding mathematics integration. The desire to see how other agricultural education teachers have integrated mathematics yielded the highest mean score of 3.84, with a standard deviation of 0.55.

The statement about reviewing a curriculum that integrates mathematics into agricultural education yielded the second highest mean score of 3.80 with a standard deviation of 0.82. The lowest mean scores were for items related to the desire to develop a curriculum integrating mathematics (3.00), teaching an applied mathematics course (3.16), and participating in classes (3.24) and workshops (3.36) related to mathematics integration. Responses to items on the needs regarding mathematics integration are summarized in Table 4.8.

Table 4.8
Agricultural Education Teachers' Needs Regarding Academic Integration (n=25)

Statements	M	SD
I am interested in how teachers have integrated mathematics into their agricultural curricula.	3.84	0.55
I would be interested in reviewing a curriculum for a mathematics course that is applied to agricultural education.	3.80	0.82
I have participated in professional development activities related to academic integration.	3.68	0.90
I am interested in learning how to teach mathematics in applied contexts.	3.68	0.85
I would increase my integration of mathematics if the curriculum specialists develop more teaching materials that integrate mathematics into the agricultural education curriculum.	3.68	0.90
I would like to participate in additional workshops related to mathematics integration.	3.40	0.82
I would be interested in an in-service workshop on mathematics integration that would include the mathematics instructors from my school.	3.36	0.70
I am interested in taking courses on mathematics integration in agricultural education.	3.24	0.83
I would teach a course focusing on “mathematics applied to agriculture” if students could receive mathematics credit for the course.	3.16	1.18
I would be interested in developing a curriculum for a mathematics course applied to agricultural education.	3.00	1.04

Note. Strongly Disagree = 1, Disagree = 2, Uncertain = 3, Agree = 4, Strongly Agree = 5

Relationship Between Selected Characteristics and Mathematics Integration

Data were examined to address research question 6: *What are the relationships among selected characteristics of outstanding agricultural education instructors, their programs, and their perceptions of the school environment, needs regarding academic integration, attitudes, and level of integration?*

There were two teacher characteristics that had a significant relationship with the percentage of mathematics integration reported by the teachers. Years teaching and age both had significant negative relationships at the .05 level. The results of the data analysis yielded no significant relationships between percentage of mathematics integration and program variables or attitudes toward mathematics integration. The analysis did yield a significant positive relationship at the .05 level between the percentage of integration and the respondents' desire to collaborate with mathematics teachers. The data analysis yielded a significant positive relationship at the .05 level between the percentage of mathematics integrated and the desire to enroll in an agricultural education course that has an emphasis on mathematics integration. The analysis also yielded a significant positive relationship at the .01 level between the percentage of mathematics integrated and the desire to participate in a workshop with their mathematics teachers on mathematics integration. The relationships are presented in Table 4.9. It should be noted that with the small sample size the generalizations that can be drawn from these findings are limited.

Table 4.9

Relationships between Selected Variables and Percentage of Mathematics Integration (n=25)

Teacher Characteristic	r
Participate in an in-service workshop with the mathematics instructors	.52**
Desire to collaborate with mathematics teachers	.45*
Enroll in mathematics integration course	.44*
Age	-.45*
Years teaching	-.45*

* p<.05. ** p<.01.

Emerging Themes Related to Mathematics Integration

Data were examined to address research question 7: *What are the primary themes related to integration of mathematics that emerge through interviews with the five outstanding agricultural education instructors who reported the highest percentage of mathematics integration in their courses?* The four of the five agricultural teachers that reported the highest percentage of mathematics integration were between the ages of 28 and 35; while three of the five were male. Ten themes related to mathematics integration emerged from the data analysis. The themes included mathematics as a component of agricultural education, current issues regarding mathematics integration, cognitive effort to emphasize mathematics, teachers' perceived needs to increase integration, educational in-service needs of teachers, linking the Virginia Standards of Learning to lessons, Cognitive effort to emphasize the Virginia Standards of Learning, agricultural teachers efforts to collaborate, agricultural education lessons integrated with mathematics, and Career Development Events that utilize mathematics. Pseudonyms have been used to conceal the identities of the agricultural education teachers.

Mathematics as a Component of Agricultural Education

In response to a question regarding importance of mathematics as a component of agricultural education, all five of the agricultural education teachers said that mathematics is an essential component of their curriculum. The agricultural teachers indicated that agricultural education is mathematically-rich. Carrie Jo stated: “There’s a lot of mathematics involved in agriculture. It’s already embedded in there, and therefore kids should have to know the basics, and I’m finding out that they don’t.” Jim added: “You deal with math in every single thing you do in agriculture, so you need that background there to be competent in what you’re doing.”

Current Issues Regarding Mathematics Integration

When considering the current issues in education, mathematics integration clearly needs to be addressed. Three of the agricultural education teachers indicated the accountability associated with the No Child Left behind Act and the Virginia Standards of Learning. They all indicated that their students lack many of the basic mathematics skills they need in order to enter the workforce.

The agricultural teachers also acknowledged that they are already integrating mathematics; however, they need to do a better job of showcasing how. Jim stated: “We’ve done a lot of science integration. Even though math is an easy fit, even though we do it, you know it’s already done; it’s just not on paper. It’s important to show it on paper because we need to tie in that important aspect to remain an integral part of the educational process that we can show that we use, where students learn the math, they learn the principles and the theories and then, we give them the opportunity for practice... practical application.” Dave added: “It’s important to integrate in the agricultural education program because we’ve always been on the forefront among the CTE (Career and Technical Education) areas. We have to be ahead of the game and

by doing that, we are able to maintain our status in the educational system. Otherwise, we'd get phased out."

Cognitive Effort to Emphasize Mathematics

When asked about placing an intentional emphasis on mathematical concepts in their lessons, the agricultural education teachers indicated that there were several content areas in which they regularly integrate mathematics including agricultural mechanics and horticulture. However, the agricultural education teachers stated that they do not make the mathematical connection with their students until after the fact. The agricultural teachers all stated that they try to make the real-world connection with the mathematical concepts. Jim stated: "I'm going to show you why it's important." Dave stated: "I want to work through problems; I want them to understand how they are used. I try to take that theory that they learn in their math classes and show them the practical side of it, show them how it's actually used in real situations."

Teachers' Perceived Needs to Increase Integration

When asked what resources they need in order to help them increase their integration of mathematics, they all indicated that they could use more agricultural examples that utilize a variety of mathematical theories and principles. The agricultural education teachers had a desire to use practical problem solving exercises and scenarios. Tom stated: "The resources that I need are some different types of exercises, like scenarios and those kinds of things where you can give it to the students and let them try to figure it out."

The agricultural teachers also indicated that it would be helpful to go through the current curriculum and point out the mathematical concepts that correlate to each lesson. Marcy added: "I think correlations would help, showing specific lessons from the math setting; this is what

they're going to learn as a ninth grader in algebra 1 or geometry and this is how we can integrate it into what we're doing in agriculture.”

Educational In-service Needs of Teachers

The agricultural education teachers were asked what in-service education programs would be helpful in aiding their efforts to integrate mathematics. The teachers expressed a desire to go over the curriculum and point out how you could correlate mathematics and the Virginia Standards of Learning with the agricultural education curriculum. Jim stated: “I went to a meeting in Indianapolis and one of the workshops I went to, the states were actually getting math credit for one of the agricultural education classes. The agricultural education class then has to turn around and prove that they're teaching enough mathematics to justify it. There are possibilities here in Virginia, if we can show we're doing enough of the math, and then the conference would be the perfect time to bring that in.”

Linking the Virginia Standards of Learning to Lessons

The agricultural education teachers were asked how often they indicated specific Standards of Learning. The responded provided a wide range of responses, which included being required to by administration as indicated by both Jim and Carrie Jo to the other end of the spectrum of not as much as they should be in Tom's case. Jim indicated: “We are required to include Specific SOLs when we make our two-week lesson plans.” Carrie Jo added: “Everyday, it's required. That's one of our evaluations as teachers; our administrators look for them when they come in the room.” However, Tom stated, “Not as much as I should. I'm trying to find more ways that I can do that, but I need to do more of that and find some specific ways to do that. I need to find some more ways that I can relate to what they're actually learning in the classroom.”

Cognitive Effort to Emphasize the Virginia Standards of Learning

The five teachers all indicated that when they teach one of the topics addressed in the Virginia Standards of Learning, they teach the skill or principle first and then make the link to the SOL after the students master the task. When asked about emphasizing the SOLs to the students, Tom noted: “I very rarely say anything about SOLs because that’s more of a negative thing as I see it. If I tell them we’re going to do this SOL and they’ve already done it in math, they probably think they already know what I’m going to teach them.” Carrie Jo added to that by stating: “Students who have already mastered the SOL, they’re thinking ‘I’ve already done that; I don’t need to learn about it. If you come back to the SOL after the fact, it gives them an opportunity to understand what an SOL is, other than something they just check off in an academic class. They can see why we have them.”

Agricultural Teachers Efforts to Collaborate

The agricultural education teachers indicated that they do not collaborate with other teachers regarding mathematics at the level that they should. However, Jim suggested: “Invite teachers down to show them what we do. I do adult work just for teachers in the building. I have them come down and make projects and they see what the students do, and then it naturally leads them in to say ‘well I teach this in class’ and that’s an easier way to do it than the traditional collaboration.” Tom stated: “I try to make sure that I can cover the same thing they’re doing at the same time. To me, that backs them up. I can take a concept that they’ve taught or teach and review or add something extra to those questions that they can’t quite get. Jim stated “On a very limited basis, it’s hard to wedge your way into that math program. I mean, they’re so structured under that time basis that they have to cover this in order to get everything done for that SOL.”

Jim went on to say: “Forestry is a prime example; we’ll work with the math teachers, when we do a tree measurement. With us, it’s all calculated out on the (Biltmore) stick and calculated on the card. We put together lessons where I would go in and show them how we do it using the Biltmore stick, and then the math teachers would take it and put it into the math formulas.”

Agricultural Education Lessons Integrated with Mathematics

The agricultural education teachers were asked to provide topics in which they integrated mathematics, each of the respondents provided several agricultural topics that utilized mathematics principles. All of the teachers also indicated that agricultural business was a good topic for integrating mathematics, and three of the teachers listed agricultural mechanics. Dave stated: “Everything we do in agricultural business bases itself on math. We talk about everything from just simple elementary math, you know, counting out change and stuff like that, to getting into profit/loss margins.” Tom added: “Fractions and angles are ones that I really work a lot with and getting students to understand them and how they work and adding things up. I also work with them a lot in figuring out formulas for mixtures for fertilizers and pesticides. Those kinds of things to make sure that everything works out right and they get the right mixtures.” These statements indicate that the teachers have provided several topics in which they have already integrated mathematics in their curricula and have identified agricultural topics that they can integrate mathematics.

Career Development Events That Utilize Mathematics

The respondents were asked to identify any FFA Career Development Events that utilized mathematics. The teachers provided a wide range of CDEs that utilized mathematics, some teachers provided specific CDE’s, while other teachers pointed out that they all used

mathematics. Marcy stated: “Most all these contests have some type of problem solving or team problem and they usually incorporate something mathematical in there, whether it’s something basic like figuring square footage or volume of something to a lot of things, could be more advanced too.” Jim added: “I would think most of them would have to use math skills.” He went on to state: “ We’ve done agricultural mechanics and with that it goes from simple right on through stuff where you’ve got to use a graphing calculators and computers to be able to do.”

The agricultural education teachers were then asked to what extent they thought their efforts to integrate math have helped their students understand math concepts better. The agricultural teachers thought that what they had done had helped, but they have no concrete evidence. However, Carrie Jo noted: “I have had students tell me they learned a particular topic I am covering in another class and never really get it until now.” Jim said: “I think very much it has. I’ll get comments back from math teachers that when they’re going over a certain concept that they know is related to something that we’ve done in class, they can pick out the kids that have been in agriculture because they come in understanding that particular concept. I mean, it’s just that reinforcement thing. The rote memorization stuff is where you take something and pound it, and pound it, and pound it, but yet if you show them where they’re going to use it in real life, then they see the value in having to learn it.” Carrie Jo went on to say: “I think that I can do more in finding out what those SOLs are and relating better to what they’re doing in the classroom.” These statements indicate that the agricultural teachers think that they are helping the students learn mathematics through an agricultural context; however, they do not know if in fact it is really helping their students.

Summary

The respondents shared attitudes toward integrating mathematics into the agricultural education curriculum. The agricultural education teachers reported that they integrated mathematics into just under 22% of their lessons. The respondents indicated that they had favorable attitudes regarding their administration's support to integrate mathematics. Interest in how other teachers have integrated mathematics yielded the highest mean among teachers needs regarding integrating mathematics. Negative relationships existed between age and years teaching and the percent of mathematics integrated.

The agricultural education teachers interviewed indicated that integrating mathematics into the agricultural education curriculum is important. Providing students with the mathematical concepts applied to agriculture is important to help them make the real-world connection. The agricultural education teachers expressed the need for more problem solving activities and real-world scenarios to help them link more mathematical concepts to agriculture. The respondents indicated that they could do more to integrate mathematics into their curriculum.

Chapter 5

Conclusions, Discussion, and Recommendations

This chapter contains the purpose of the study, summary of the research methodology, and summary of the findings. Recommendations for implementation and further research, along with conclusions and discussion, implications, and overall summary are also included.

Purpose of the Study

The purpose of this study was to analyze outstanding agricultural education teachers' attitudes toward mathematics integration. The researcher also determined the outstanding agricultural teachers' level of mathematics integration into each course currently taught. An investigation into the collaboration efforts being made between the agricultural education and mathematics department was also included. The researcher identified the outstanding teachers' perceived needs related to mathematics integration and provided baseline data as the agricultural education instructors in Virginia increase their integration of mathematics. The study will result in proposed actions to increase mathematics integration into agricultural education curriculums.

Research questions investigated in this study were:

1. What are the characteristics of outstanding agricultural education instructors who were nominated by Virginia agricultural education leaders and the programs in which these instructors teach?
2. What is the self-reported level of integration of mathematics by each instructor and across instructors for each course taught?
3. What are the attitudes of the outstanding agricultural education instructors toward the integration of mathematics into the agricultural education curriculum?

4. What are the perceptions of the outstanding agricultural education instructors related to the school environment regarding mathematics integration?
5. What are the perceived needs of the outstanding agricultural education instructors regarding the integration of mathematics into their agricultural education curriculum?
6. What are the relationships among selected characteristics of outstanding agricultural education instructors, their programs, and their perceptions of the school environment, level of integration, attitudes, and needs regarding academic integration?
7. What are the primary themes related to integration of mathematics that emerge through interviews with the five outstanding agricultural education instructors who reported the highest percentage of mathematics integration in their courses?

Summary of the Research Methodology

A panel of experts identified 26 outstanding agricultural education teachers based on specified criteria. An electronic instrument was developed; student teachers field tested the instrument after it had been analyzed by agricultural and extension education professionals and a local public school secondary mathematics curriculum specialist. Reliability and face validity issues were examined through the field study. The reliability of the instrument was found to be “very good” according to DeVellis (1991) with both the Cronbach’s alpha and Spearman-Brown alpha coefficients scores falling between .80 and .90 through the results of the field study. However the results from the study yielded a lower reliability score for both Cronbach’s alpha and Spearman-Brown (0.64 and 0.66 respectively). The change in reliability scores may be due to the fact that the student teachers in the field study all received prior instruction on academic integration.

The data collection process utilized a combination of the Dillman (2000) and Truell, Bartlett, and Alexander (2002) models to distribute the instrument and collect the data. A five-step model was designed to contact the participants and alert them of the survey, then conduct the survey and the follow-up procedures. The data collected were analyzed using SPSS 13.0 Student Version. The data collected from the follow-up interviews were analyzed using both within and across-case analyses.

Summary of Findings

The summary of findings is categorized by each research question investigated, which were:

1. What are the characteristics of outstanding agricultural education instructor(s) who were nominated by Virginia agricultural education leaders and the programs in which these instructors teach?

The outstanding agricultural education teachers had 17 years of teaching experience with a range of 5 to 34 years. The respondents ranged in age from 29 to 59 with a mean of 40. Roughly half of the respondents' highest level of education was a master's degree (13) while the other half had a bachelor's degree (12). Of the 25 respondents 56% were male and females comprised the other 44%. Ninety-six percent of the respondents indicated that they were Caucasian.

Seventy-six percent of the agricultural education teachers taught at the high school, while the others taught at middle schools. Twenty-three of the respondents indicated that they were members of the Virginia Association of Agricultural Educators (VAAE). All of the teachers indicated that they were endorsed to teach agricultural education; three indicated that they were

also endorsed to teach science. One teacher indicated that he was endorsed to teach both mathematics and business.

The majority of the agricultural education teachers had completed four to five mathematics courses in high school; 11 teachers indicated they completed mathematics courses at a two-year college. Forty-eight percent of the respondents completed two to three mathematics courses at a four-year college. A majority (68%) of the teachers possessed a Collegiate Professional teaching license.

Sixty percent of the respondents taught at schools located in urban areas. The agricultural teachers indicated that 40% taught in two teacher departments. The respondents reported a range of 62 to 440 students enrolled in their agricultural education programs with a mean of 188 students. Students were able to get a general science elective in two schools and a forestry credit in another school. The teachers reported that their schools used a wide variety of schedules, with the A/B block being the most common (40%).

2. What is the self-reported level of integration of mathematics by each instructor and across instructors for each course taught?

The agricultural education teachers (n=24) reported a mean percentage of 21.63% of mathematics integrated into their curriculum with a standard deviation of 11.34. The respondents indicated a range of 4 to 47% of mathematics integrated per teacher.

The outstanding agricultural education teachers reported integrating mathematics in a mean range of 2 to 75% in individual agricultural education courses. The 24 teachers reported teaching 29 different courses. There were seven courses that were taught by only one teacher and six courses by two different teachers. There were only seven courses that were taught by at least five different teachers, with agricultural mechanics and basic plant science I being taught by

the most teachers (10). The seven courses taught by at least five different teachers had a range of 8.60 to 26.43 mean percentage of mathematics integration.

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, the other agribusiness course taught also had a mean percentage of mathematics integration of 45%. The five agricultural mechanics courses taught by the agricultural education teachers reported integrating mathematics at the second highest level ranging from 18.33 to 26.43%. The floriculture, floral design and horticulture courses yielded the lowest percentages of integration ranging from 5 to 8.6%. However, landscaping yielded 20% of mathematics integration and greenhouse management yielded 75% integration. The agricultural mechanics and basic plant science I course that was taught by the most agriculture teachers yielded 22.9% mathematics integration.

3. What are the attitudes of the outstanding agricultural education instructors toward the integration of mathematics into the agricultural education curriculum?

The teachers' attitudes toward mathematics integration utilized a 5-point Likert scale. Possible responses included: 1= Strongly Disagree, 2= Disagree, 3= Uncertain, 4= Agree, 5= Strongly Agree. The analysis of the data indicated that the respondents believed that agricultural education provides an excellent avenue to teach mathematics (4.44) and that mathematics is an integral component of agricultural education (4.36). The agricultural education teachers also felt that students learned mathematics best when it is taught in an applied environment (4.28). The agricultural education teachers indicated that agricultural education is a mathematics-rich curriculum (4.00) and they should integrate mathematics into their curriculum (4.12). The respondents have indicated that the curriculum they teach can aid students with the mathematics

section of the Virginia Standards of Learning (4.16) and that they purposely integrate mathematics (3.92) and they can integrate more mathematics than what they are currently integrating (4.04).

The respondents had six of the seven negatively worded items with the lowest mean scores, indicating that the teachers disagreed with these negative perceptions of mathematics integration. The respondents disagree with the statement mathematics is not important to the agricultural education curriculum (1.72) and mathematics should be taught in the mathematics department not in the agricultural education curriculum (1.76). The teachers also disagreed with the statement that the students do not (2.88), and are not capable (2.24) of learning mathematics in the agricultural education courses.

4. What are the perceptions of the outstanding agricultural education instructors related to the school environment regarding mathematics integration?

The results of the study indicate that most of the respondents are encouraged by their administrators to integrate academics and want to collaborate with their colleagues. However, the agricultural teachers indicated that they have not made as much of an effort to collaborate with their colleagues as they would like to do. The respondents also indicated that the mathematics teachers and other colleagues do not make an effort to collaborate with them to integrate mathematics.

5. What are the perceived needs of the outstanding agricultural education instructors regarding the integration of mathematics into their agricultural education curriculum?

The agricultural education instructors possessed generally favorable attitudes towards professional development needs regarding mathematics integration. The agricultural education instructors expressed interest in teaching mathematics in an agricultural context. Most of the

respondents also expressed a desire to see how other agricultural education teachers have integrated mathematics. They indicated a desire to review agricultural education curriculum that has mathematics integrated in the lessons.

Some of the respondents were uncertain about developing a curriculum that integrated mathematics. However, all of the agricultural teachers stated that they would increase their integration of mathematics if the curriculum specialists developed more teaching materials that integrate mathematics into the agricultural education curriculum.

6. What are the relationships among selected characteristics of outstanding agricultural education instructors, their programs, and their perceptions of the school environment, level of integration, attitudes, and needs regarding academic integration?

One limitation of the study was the small sample size; however the decision was made to investigate statistical relationships that exist. There were two teacher characteristics that had significant negative relationships with the percentage of mathematics that the teachers integrated. Age and years teaching both had significant negative relationships. There were significant positive relationships between the percentage of mathematics integrated and the teachers desire to collaborate with the mathematics teachers, enroll in courses that place an emphasis on mathematics integration and their desire to participate in an in-service workshop. It should be noted that with the small sample size the results of these findings are limited.

7. What are the primary themes related to integration of mathematics that emerged through interviews with the five outstanding agricultural education instructors who reported the highest percentage of mathematics integration in their courses?

These five agricultural education teachers indicated that agricultural education provides a mathematically-rich context in which students can apply mathematics to real-world situations. The teachers all stated that the integration of mathematics into the agricultural education curriculum is critical and that they are integrating mathematics. However, with the requirements set forth by the No Child Left behind Act and the Virginia Standards of Learning, they need to put more effort into integrating mathematics. The teachers also stated that they need to do a better job of promoting what they are already doing. One teacher noted that they are required to link the Standards of Learning to each lesson they teach and another noted that they are required to post those links in their classroom every day.

The agricultural education teachers stated that they regularly integrate mathematics into their lessons. The respondents added that they do not make the mathematical connections until after the fact because students have negative responses when the teachers tell them they are going to learn mathematics prior to the beginning of the lesson. When the teachers do emphasize a mathematical concept, they follow it up by providing a real-world application for the problem.

The teachers had similar responses related to their curriculum needs regarding mathematics integration. The respondents requested additional materials that utilized problem solving exercises and scenarios that utilize a variety of mathematical theories and principles. The problem solving exercises and scenarios should link mathematics and agricultural education to real life situations. The teachers also noted that it would be helpful to go through the current agricultural education curriculum and point out where mathematics can be integrated in those lessons.

The respondents indicated that they do some collaboration with the mathematics teachers; however they indicated that they do not collaborate enough. The teachers indicated that they

could do more to collaborate, but the mathematics teachers are typically too busy trying to cover all of the Standards of Learning. The respondents provided several topics in which they have integrated mathematics; some of the areas of inclusion included agricultural mechanics, forestry, agribusiness, and horticulture. The agricultural education teachers suggested that all Career Development Events utilize mathematics to some degree, with agricultural mechanics and forestry being the most obvious.

The participants that were interviewed think that the mathematics that they are currently teaching helps their students understand mathematics. The teachers indicated that they did not have any solid evidence that indicates that the mathematics that they are integrating help their students; however, they have noted that some students have made comments on how the agricultural application has helped them understand the concepts.

Conclusions and Discussion

1. What are the characteristics of outstanding agricultural education instructor(s) who were nominated by Virginia agricultural education leaders and the programs in which these instructors teach?

Slightly more than half (56%) of the outstanding agricultural education teachers were males, and a similar percentage (52%) had master's degrees. The mean age of all the participants was 40, the mean number of years of teaching experience was 17, and the mean number of students enrolled in their agricultural education programs was 188 (72% taught in multi-teacher departments). Of the 25 outstanding teachers, 96% were Caucasian, 76% taught at the high school level, and 92% were members of the Virginia Association of Agricultural Educators. The survey defined an urban area as having a population over 20,000, and 60% of the respondents reported that their school was in an urban location. The largest percentage of these outstanding

agricultural education teachers (44%) had completed four mathematics courses while in high school, and most had completed two or three courses while enrolled in college. The outstanding agricultural teachers identified as participants for this study were selected by the researcher with the intention that they could be described as what Rogers (1995) would classify as “early-adopters” among Virginia agricultural education teachers.

2. What is the self-reported level of integration of mathematics by each instructor and across instructors for each course taught?

The mean indicated that the typical agricultural education teacher in this study integrated mathematics into 22% percent of thier lessons; the majority of integration occurred in the agricultural business courses and the agricultural mechanics courses. The younger agricultural education teachers tended to integrate mathematics at a higher percentage than older agricultural education teachers.

The results of this study may be helpful for state leaders in agricultural education by providing the self-reported level of mathematics integration among these selected outstanding agricultural education teachers in Virginia. It was noted that the percentage of integration of mathematics is lower than the percentage of integration among agricultural education teachers in Alabama as reported by Hunnicutt (1994). However, Hunnicutt gave the agricultural education teachers the option to select a range 0 to 25, 26 to 50, 51 to 75, and 76 to 100 in their total curriculum; this researcher had the teachers report the level of integration for each course they taught.

3. What are the attitudes of the outstanding agricultural education instructors toward the integration of mathematics into the agricultural education curriculum?

The selected agricultural education teachers have a positive attitude toward the integration of mathematics. These outstanding agricultural education teachers believe that agricultural education provides an excellent avenue to teach mathematics and that mathematics is an integral component of agricultural education. The study was helpful in identifying at what stage the outstanding agricultural education teachers in Virginia were within Rogers (1995) stages of adoption.

The agricultural teachers have indicated that mathematics is an integral component of agricultural education and the integration of mathematics is vital; this would indicate that the early-adopters have already entered what Roger's (1995) classifies as the persuasion stage. The positive attitudes toward mathematics integration that have led the agricultural education teachers to integrate mathematics would indicate that the early-adopters have also entered Roger's (1995) decision stage.

These agricultural education teachers reported integrating mathematics in a range of 4 to 47%, indicating that the teachers in the study have all entered Roger's (1995) implementation stage. These outstanding agricultural teachers have been classified by Roger's (1995) as early-adopters because they are viewed as successful by their peers. If the early-adopters have entered the implementation stage it is possible that the early-majority, late-majority and laggards could be in the persuasion and decision stages. Developing workshops, courses, and teaching materials that emphasize mathematics integration will help those teachers enter the implementation stage.

4. What are the perceptions of the outstanding agricultural education instructors related to the school environment regarding mathematics integration?

The participants in this study indicated a fairly high level of administrative support encouraging them to integrate mathematics into their lessons. The agricultural education

teachers have generally expressed a desire to collaborate with their colleagues. However, all the agricultural education teachers in this study acknowledged that they are not making as much of an effort to collaborate with their colleagues as they should. The acknowledgement by the outstanding agricultural education teachers that they are not making the concerted effort to collaborate with their colleagues indicates that there may still be a prominent barrier that exists between the academic and career and technical education tracks as suggested (Kruse, Seashore, & Bryk, 1994; Newman & Associates, 1996; & Nickolas, 2000). Johnson, Charner, and White (2003) found that once agricultural education teachers teamed with academic teachers to deliver academic lessons applied to agriculture the academic teachers witnessed students becoming engaged and enthusiastic about the content and began to frequently approach the agricultural education teachers seeking additional opportunities to collaborate.

5. What are the perceived needs of the outstanding agricultural education instructors regarding the integration of mathematics into their agricultural education curriculum?

These agricultural education teachers want to see how others have integrated mathematics and need curriculum that integrates mathematics and that utilizes real-life applications and problem-solving activities. These teachers indicated that they would increase their percentage of mathematics integration if curriculum specialists would develop applicable materials. Hunnicutt (1994) encouraged curriculum specialists to develop material relating mathematics to agriculture including workshops, workbooks, and lesson plans. Teacher educators and departments of education personnel should consider developing curriculum materials and in-service activities.

6. What are the relationships among selected characteristics of outstanding agricultural education instructors, their programs, and their perceptions of the school

environment, level of integration, attitudes, and needs regarding academic integration?

Based on the results of the studies small sample, negative relationships existed between age, years teaching, and percentage of mathematics integrated. There were positive relationships between the percentage of mathematics integrated and the teachers desire to collaborate with mathematics teachers and desire to participate in in-service education programs related to mathematics integration.

The results of this study are also helpful in acknowledging that there was a negative relationship between percentage of mathematics integration and years of teaching and age. This could help teacher education program leaders recognize that their efforts to help pre-service teachers to integrate mathematics may have helped thus far. This also provides teacher education programs with the benchmark data to know that additional efforts to integrate academics into the agricultural education curriculum. This data also provides insight to curriculum specialists to identify the needs among agricultural education teachers regarding mathematics integration.

7. What are the primary themes related to integration of mathematics that emerge through interviews with the five outstanding agricultural education instructors who reported the highest percentage of mathematics integration in their courses?

These agricultural education teachers who integrate the highest percentage of mathematics indicated that they try to reinforce academic principles and theories through agricultural applications. These teachers believe that agricultural education provides students with the real-life applications needed to apply those theories and principles. The agricultural teachers have indicated that all of the Career Development Events to some degree utilize

mathematics. The respondents believe that they are helping their students learn the academic concepts, but have little evidence.

The results of this study also suggest that there is an interest in academic integration within the agricultural education curriculum by these outstanding agricultural education teachers. State agricultural education leaders should continue to make an effort to promote agricultural education courses for academic credit. Developing team-teaching course that utilize both the academic and agricultural teachers to provide students with academic theories and principles and agricultural applications may provide the contextualized learning promoted by Parr (2004) and Thompson, Jansen, and Enochs (2005).

Recommendations for Implementation

The following recommendations are based upon the findings and conclusions of this study.

1. Agricultural education practitioners should continue to emphasize the importance of academic integration into the agricultural education curriculum to improve student learning.
2. Agricultural education practitioners should continue to link academic standards of learning to each agricultural education competency. Agricultural educators should take it upon themselves to reinforce the Virginia Standards of Learning or similar standards in other states to help students connect the principles to real-life applications.
3. Agricultural education curriculum specialists should continue to develop integrated learning activities that reinforce the academic theories and principles with agricultural applications.

4. Agricultural educators should make the initial effort to collaborate with their academic cohorts, both at the secondary level and at teacher education institutions.
5. State agricultural education leaders should develop workshops that utilize hands-on activities that integrate academics. The workshops should place the teachers in the student role. The workshops should be practical, allowing the teachers to take what they learned in the workshop and implement it into their lessons.
6. State professional organizations should invite agricultural education teachers from programs that offer mathematics credit through agricultural education courses to serve as workshop presenters to share how they integrate mathematics.
7. Agricultural education teacher education departments should collaborate with academic teacher education departments to develop an agricultural education course that emphasizes academics.
8. Textbook companies that develop teacher education materials need to develop more materials that emphasize the academic theories and principles that are being integrated into the agricultural education content; specifically, the materials should utilize team activities, real-life applications, and revamp current laboratory activities.
9. Virginia educational leaders should develop a standardized curriculum that includes generic lesson plans that includes all of the Virginia Standards of Learning and workplace readiness skills associated with each lesson. These lessons will help in-service teachers who need help integrating academics into their lessons.
10. Efforts should be made to align Virginia Career Development events with the Virginia Standards of Learning, and similar alignments are important in other states.

Recommendations for Further Research

The following recommendations are based upon the findings and conclusions of the study.

1. Conduct an in-depth study that investigates the lessons plans of in-service teachers to determine to what extent they are integrating mathematics, where they are emphasizing mathematics, and where they could be integrating mathematics.
2. Investigate the achievement levels of students who receive applied mathematics instruction vs. traditional mathematics instruction in the schools that are currently offering mathematics credit for students who complete a mathematics applied to agriculture course.
3. Conduct a study that investigates the pre-service teachers' attitudes and academic problem-solving abilities before and after completing an agricultural education course that integrates academics.
4. Conduct a study that investigates the level of academic integration by teachers after they participate in workshops that emphasize academic integration.
5. Investigate the integration of other academic areas such as English, social studies, and foreign languages.
6. Conduct a study to investigate students' attitudes toward receiving mathematics credit for completing an agricultural education course that integrate mathematics.
7. Conduct a study that investigates mathematics teachers' attitudes toward mathematics integration into the agricultural education curriculum and their attitudes toward collaboration with the agricultural education teachers.

8. Conduct a national study that investigates the current needs of agricultural education teachers regarding academic integration.
9. Conduct a study that investigates the incentives and barriers to academic integration.
10. Replicate this study on a regional and national level to determine the percentage of mathematics integration into the agricultural education curriculum.
11. Replicate this study comparing agricultural education teachers who have been teaching since 1988 to those agricultural education teachers who have been teaching prior to 1988, when the name vocational agriculture was changed to agricultural education.

Summary

The purpose of this study was to analyze outstanding agricultural education teachers' attitudes towards mathematics integration. The study also determined the outstanding agricultural teachers' level of mathematics integration into each course currently taught. An investigation into the collaboration efforts being made between the agricultural education and mathematics department was also included. The researcher identified the outstanding teacher perceived needs related to mathematics integration and provided as the agricultural education instructors in Virginia increase their integration of mathematics.

The researcher used an electronic questionnaire completed by 25 outstanding agricultural education teachers and follow-up interviews with the five teachers who reported integrating mathematics at the highest level. The agricultural teachers reported having favorable attitudes towards the integration of mathematics into the agricultural education curriculum. The results of the data analysis indicated that there was a negative correlation between age and percentage of mathematics integration. Of the five agricultural education teachers who were interviewed, four were between the ages of 29 and 34. All of the agricultural education teachers thought that their

efforts to integrate mathematics have helped their students increase their mathematics achievement levels, but they have no concrete evidence.

There were several recommendations for implementation, which included encouraging agricultural education teachers to continue to integrated mathematics and other academic areas. Textbook manufacturers, state agricultural leaders, and state agricultural education curriculum specialists should continue to develop curriculum and other education materials that emphasize academic integration.

Several recommendations for research emerged from the study including the exploration of attitudes of agricultural teachers towards the integration of other academic areas, the mathematics teachers attitudes towards mathematics integrated into the agricultural education curriculum. Another recommendation that emerged from this study was to investigate the students' attitudes towards receiving academic credits for enrolling in agricultural education courses.

There were several implications that rose from this study, one of which included determining the extent of mathematics integration in each course taught. This gives curriculum specialists insight into the courses in which agricultural education teachers are struggling to integrate mathematics. The researcher also identified that the early adopters fell within the implementation stage for the stages of adoption.

References

- Advisory Council on Vocational Education (1968). *Vocational Education- The bridge between man and his work*. In Notes and working papers concerning the administration of programs authorized under vocational education act of 1963, Public Law 88-210. (Prepared for the subcommittee on education of the committee on labor and public welfare, United States Senate). Washington, DC: U.S. Government Printing Office.
- Amaratunga, D., Baldry, D., Sarshar, M., & Newton, R. (2002). Quantitative and qualitative research in the built environment: Application of “mixed” research approach. *Work Study*, 51(1), 17-31.
- American Association for the Advancement of Science (1992). *Project 2061: Science for all Americans*. Washington, DC: American Association for the Advancement of Science Press.
- Ancess, J. (2001). Teacher learning at the intersection of school learning and student outcomes. In A. Lieberman & L. Miller (Eds.), *Teachers caught in the action: Professional development that matters* (pp. 61-78). New York: Teachers College Press.
- Anderson R. (2003). Agricultural science teachers’ attitudes towards information technology. Unpublished thesis, Texas A&M University-Commerce.
- Anfara, V., Brown, K., & Mangione, T. (2002). Qualitative analysis on stage: Making the research process more public. *Educational Researcher*, 31(8), 28-38.
- Atanda, R. (1999). *Do gatekeeper courses expand educational options?* Washington, DC: National Center for Education Statistics. (NCES 1999-303)
- Bailey, T. (1998). Integrating vocational and academic education. In *National Research Council, High school mathematics at work: Essays and examples for the education of all students*. Washington, DC: National Academy Press.
- Barrick, K. (1992, December). A new model for agricultural education and SAE. *The Agricultural Education Magazine*, 65(6), 4-7.
- Bayer Corporation. (2003). *Bayer facts of science education IX: Americans' views on the role of science and technology in U.S. National Defense*. Retrieved February 4, 2006, from <http://www.bayerus.com/msms/news/pages/factsofscience/survey03.html>
- Betances, C. A. (1999). *From professional development to practices: Factors in the implementation of standards-based curriculum and instruction*. Unpublished doctoral dissertation, George Washington University. Washington, DC.

- Bickmore-Brand, J. (1993). Implications from recent research in language arts for mathematical teaching. In J. Bickmore-Brand (Ed.), *Language in mathematics* (pp. 1-9). Portsmouth, NH: Heinemann.
- Bott, A. (1996). *Testing and assessment in occupational and technical education*. Needham Heights, MA: Allyn and Bacon.
- Bottoms, G., & Sharpe, D. (1996.). *Teaching for understanding through integration of academic and technical education*. Atlanta, GA: Southern Regional Education Board.
- Briner, M. (1999). *Learning theories*. Denver: University of Colorado. Retrieved February 23, 2006, from <http://curriculum.calstatela.edu/faculty/psparks/theorists/501learn.htm>
- Britton, E., Huntley, M., Jacobs, G., & Weinberg, A. (1999). *Connecting mathematics and science to workplace contexts: A guide to curriculum materials*. Thousand Oaks, CA: Corwin Press.
- Brown, C. L. (1991). Whole concept mathematics: A whole language application. *Educational Horizons*, 69(3), 159-163.
- Buriak, P., & Shinn, G. (1991). A structure for research agenda education: A national delphi involving internal experts (Summary). *Proceedings of the 18th Annual National Agricultural Education Research Meeting*, pp. 281-298.
- Butler, J. N., & Lee, J. S. (1993). *The importance of selected mathematics concepts/skills and applications as perceived by Mississippi high school agriscience and mathematics teachers for the introduction to agriscience curriculum*. Unpublished manuscript. Mississippi State: Mississippi State University, Department of Agricultural Education and Experimental Statistics.
- Campbell, J. R., Hombo, C. M., & Mazzeo, J. (2000). NAEP 1999 trends in academic progress: Three decades of student performances. *Education Statistics Quarterly*, 2(4), 31-36.
- Cardwell, V. (2004). Content standards for agriculture or agriculture content imbedded within core standards. *The Agricultural Education Magazine*, 77(2), 8-10.
- Carl D. Perkins Vocational and Applied Technology Education Act of 1998, 20 U.S.C. 2301 et seq.* 105th Congress. Washington, DC: Government Printing Office.
- Castellano, M., Stringfield, S., & Stone, J., (2002). *Helping disadvantaged youth succeed in school: Second-year findings from a longitudinal study of CTE based whole-school reforms*. Minneapolis: University of Minnesota, National Research Center on Career and Technical Education.

- Castellano, M., Stringfield, S., & Stone, J., (2003). Secondary career and technical education and comprehensive school reform: Implications for research and practice. *Review of Educational Research*, 73(2), 231-272.
- Castellano, M., Stringfield, S., Stone, J., & Wayman, J. (2003). *Early measures of student progress in schools with CTE-enhanced whole-school reform: Math course-taking patterns and student progress to graduation*. National Research Center for Career and Technical Education. Retrieved September 19, 2005, from <http://www.nccte.org/publications/projectReports.asp>
- Center on Education and Training for Employment. (1998). *Implementing an integrated academic & vocational education curriculum*. Winterville, GA: American Association for Vocational Instructional Materials.
- Cetron, M., & Gayle, M. (1991). *Educational renaissance: Our schools at the turn of the twenty first century*. New York: St. Martin's.
- Cheek, J., Arrington, L., Carter, S., & Randell, R. (1994). Relationship of supervised agricultural experience program participation and student achievement in agricultural education. *Journal of Agricultural Education*, 35(2), 1-5.
- Clune, W. H., & White, P. A. (1992). Education reform in the trenches: Increased academic course taking in high schools with lower achieving students in states with higher graduation requirements. *Educational Evaluation and Policy Analysis*, 14(1), 2-20.
- Conroy, C., Trumbull, D., & Johnson, D. (1999). Agriculture as a rich context for teaching and learning, and for learning mathematics and science to prepare for the workforce of the 21st century. *National Science Foundation*. Retrieved October 15, 2005, from http://www.nsf.gov/sbe/tcw/events_990917w/2.htm
- Conroy, C., & Sipple, J. (2001). A case study in reform: Integration of teacher education in agriculture with teacher education in mathematics and science. *Journal of Vocational Education Research*, 26(2), 206-243.
- D'Augustine, C. (1989). What our college business students need from secondary schools. *Mathematics Teacher*, 82(3), 163-165.
- Darling-Hammond, L., & Falk, B. (1997). Using standards and assessments to support student learning. *Phi Delta Kappan*, 79(3), 190-199.
- Dayberry, D. T. (1991). *Mathematics and science provided through vocational agriculture in Texas*. Unpublished doctoral dissertation, Texas A&M University, College Station.

- DeVellis, R. F. (1991). *Scale development*. Newbury Park, NJ: Sage.
- Dillman, D. (2000). *Mail and Internet surveys: The tailored design method*. New York: John Wiley & Sons.
- Dormondy, T.J. (1992). Exploring resource sharing between secondary school teachers of agricultural education and science departments nationally. *Journal of Agricultural Education*, 33(3), 23-31.
- Drawbaugh, C., & Hull, W. (1971). *Agricultural education: Approaches to learning and teaching*. Columbus, OH: Charles E. Merrill.
- Drosjack, M. (2003, November 14). Texas' math scores up but reading still lagging. *The Houston Chronicle*, p. 21A.
- Duffy, M. E. (2002). Methodological issues in web-based research. *Journal of Nursing Scholarship*, 34(1), 83-88.
- Dworkin, M.S. (1959). *Dewey on education*. New York: Teachers College Press.
- Facilitating coordinators in agricultural education. (2006). *Illinois Agricultural Education*. Retrieved November 12, 2005, from <http://www.agriculturaleducation.org/news/default.asp>
- Fink, A. (1995). *How to sample in surveys* (Vol. 6, *The survey kit*). London: Sage.
- Fraze, S., Fraze, D., Baker, M., & Kieth, L. (2002). Attitudes toward and stages of adoption of information technology by agri-science teachers in Texas. *Proceedings from the Southern Association of Agricultural Educators Research Conference*, n.p. (on CD).
- Gameron, A., Porter, A., Smithson, J., & White, P. (1997). Upgrading high school mathematics instruction: Improving learning opportunities for low-achieving, low-income youth. *Educational Evaluation and Policy Analysis*, 19(4), 325-338.
- Garris, E. (1954). *Teaching vocational agriculture*. New York: McGraw-Hill Rural Activities Series.
- Glasgow, N. (1997). *New curriculum for new times*. Thousand Oaks, CA: Corwin Press.
- Gliem, J., & Elliot, J. (1988). Problem solving skills of agricultural education undergraduates when completing mathematical word problems in agricultural mechanics. *Proceedings of the 15th Annual National Agricultural Education Research Meeting*, pp. 122-136.
- Gliem, J., Lichtensteiger, M., & Hard, D. (1987). Mathematical problem solving skills in agricultural mechanics of undergraduate students in agriculture. *Proceedings of the 14th Annual National Agricultural Education Research Meeting*, pp. 87-101.

- Gliem, J., & Persinger, K. (1987). Mathematical problem solving skills of vocational agricultural students and teachers. *Proceedings of the 14th Annual National Agricultural Education Research Meeting*, pp. 146-160.
- Gliem, J., & Warmbrod, J. (1986). *Student problem solving abilities in agricultural mechanics*. Paper No. 86-5057. St. Joseph, MN: American Society of Agricultural Engineers.
- Goree, C., & Marszalek, J. (1995). Electronic surveys: Ethical issues for researchers. *College Student Affairs Journal*, 15(1), 75-79.
- Harris, S., & Dersch, C. (1999). Conducting research on the Internet: Potential, concerns, and reflections. *Kappa Omicron Nu FORUM*, 11(1). Retrieved April 2, 2006, from <http://www.kon.org/forum/harris.html>
- Haury, D., & Rillero, P. (1994). *Perspectives of hands-on science teaching*. North Central Regional Education Laboratory. Retrieved November 14, 2005, from <http://www.ncrel.org/sdrs/areas/issues/content/entareas/science/eric/eric-toc.htm>
- Hernandez, V., & Brendefur, J. (2003). Developing authentic, integrated, standards-based mathematics curriculum: (More than just) An interdisciplinary collaborative approach. *Journal of Vocational Education Research*, 28(3), 259-283.
- Hoachlander, G. (1999). Teachers, time to rethink your priorities. *Techniques*, 78(11), 74.
- Hoffer, T. B. (1997). High school graduation requirements: Effects on dropping out and student achievement. *Teachers College Record*, 98(4), 584-607.
- Hokanson, C. (1984). *Applied problems in mathematics for agriculture*. Danville, IL: Interstate Printers and Publishers.
- Hunnicut, F. (1994). *Assessment of mathematical problem-solving proficiency of agricultural education teachers in Alabama*. Unpublished doctoral dissertation, Mississippi State University, Starkville.
- Johnson, A., Charner, I., & White, R. (2003). *Curriculum integration in context: An exploration of how structures and circumstances affect design and implementation*. National Research Center for Career and Technical Education. Retrieved September 19, 2005, from <http://www.nccte.org/publications/projectReports.asp>
- Johnson, D. (1991). Student achievement and factors related to achievement in a state FFA agricultural mechanics contest. *Journal of Agricultural Education*, 32(3), 23-28.

- Johnson, D., Wardlow, G., & Franklin, T. (1997). Hands-on activities versus worksheets in reinforcing physical science principles: Effects on student achievement and attitude. *Journal of Agricultural Education*, 38(3), 9-17.
- Kahle, J. (1998). Science and mathematics education: Finding common ground. In National Research Council, *High school mathematics at work: Essays and examples for the education of all students*. Washington, DC: National Academy Press.
- Kruse, S., Seashore, L., & Bryk A. (1994). Building professional community in schools. *Issues in Restructuring Schools, Report No. 6*, pp. 3-6. Madison, WI: Center on Organization and Restructuring of Schools.
- Lazar, J., & Preece, J. (1999). Designing and implementing Web-based surveys. *Journal of Computer Information Systems*, 39(4), 63-70.
- Lee, V., Burkam, D., Chow-Hoy, T., Smerdon, B., & Geverdt, D. (1998). *High school curriculum structure: Effects on coursetaking and achievement in mathematics for high school graduates- An examination of data from the national educational longitudinal study of 1988*. Washington, DC: National Center for Education Statistics. (NCES 1988-09).
- Lieberman, G., & Hoody, L. (1998). *Closing the achievement gap: Using the environment as an integrating context for learning*. San Diego, CA: State Education & Environment Roundtable.
- Litwin, M. (1995). *How to measure survey reliability and validity* (Vol. 7). Thousand Oaks, CA: Sage.
- Loadman, W. (1986). *Comparison study of vocational and traditional students on mathematics and science achievement*. Columbus: The Ohio State University, College of Education.
- Lofland, J., & Lofland, L. (1988). *Analyzing social settings. A guide to qualitative observation and analysis*. Belmont, CA: Wadsworth.
- Locke, M. (1999). *Teacher attitudes toward implementation of school-based learning components, work-based learning components, and connecting activities, and use of instructional strategies related to school-based learning*. Unpublished doctoral dissertation, University of La Verne, CA.
- Loucks-Horsley, S., Stiles, K., & Hewson, P. (May, 1996). Principles of effective professional development for mathematics and science education: A synthesis of standards. *NISE Brief*, 1(1), 1-6.
- Marshall, J., & Hales, L. (1972). *Essentials of testing*. Reading MA: Addison-Wesley.

- Maykut, P., & Morehouse, R. (1994). *Beginning qualitative research*. London: Falmer Press.
- Melodia, A., & Small T. (2002). Integrating math and science into agriculture. *Agricultural Education Magazine*, 75(3), 18-19.
- Miller, G. (1992). *Secondary agriculture teachers' attitudes and ability regarding the application of mathematics to secondary agricultural instructional programs*. Unpublished doctoral dissertation, The Ohio State University, Columbus.
- Miller, G., & Gliem, J. (1993a). Integration of mathematics into the agricultural curriculum: Are teachers ready? *Proceedings of the 47th Annual Research Conference in Agricultural Education*, pp. 24-36.
- Miller, G., & Gliem, J. (1993b). Integration of mathematics concepts into the agricultural programs. *Proceedings of the 20th Annual National Agricultural Education Research Meeting*, pp. 64-78.
- Miller, W., & Vogelzang, S. (1983). *Importance of including mathematical concepts instruction as a part of the vocational agriculture program of study*. Ames: Iowa State University, Department of Agricultural Education.
- Mitchell, C. (1990). Real-world mathematics. *Mathematics Teacher*, 83(1), 12-16.
- Murname, R., & Levy, F. (1996). *Teaching the basic skills: Principles for educating children to thrive in a challenging economy*. New York: Free Press.
- National Association of Secondary School Principals. (1996). *Breaking ranks: Changing an American institution*. Reston, VA: Author.
- National Commission on Excellence in Education. (1983). *A nation at risk*. Retrieved November 12, 2005, from <http://www.ed.gov/pubs/NatAtRisk/index.html>
- National Commission on Secondary Vocational Education (1984). *The unfinished agenda* (Information Series No. 289). Columbus, OH: National Center for Research in Vocational Education.
- National Research Council. (1988). *Understanding agriculture: New directions for education*. Danville, IL: Interstate Printers and Publishers.
- Newcomb, L., McCracken, J., & Warmbrod, J. (1993). *Methods of teaching agriculture* (2nd ed.). Danville, IL: Interstate Printers and Publishers.
- Newman, F., & Associates. (1996). *Authentic achievement: Restructuring schools for intellectual quality*. San Francisco: Jossey-Bass.

- No Child Left Behind. (2005). *The No Child Left Behind Act of 2001*. Retrieved online November 12, 2005, from <http://www.ed.gov/nclb/landing.jhtml>
- North Central Regional Educational Laboratory. (1995). *Critical issue: Providing hands-on, minds-on, and authentic learning experiences in science*. Retrieved November 12, 2005, from <Http://www.ncrel.org/sdrs/areas/issues/content/contareas/science/sc500.htm>
- Ohio Department of Education, Division of Vocational and Career Education (1990). *Action plan for accelerating the modernization of vocational education in Ohio: Ohio's future at work*. Columbus: Author.
- Nickolas, M. (2000). *Teacher collaboration: A survey of factors, attitudes, and preferences affecting implementation in mathematics*. Unpublished doctoral dissertation, University of Pennsylvania, Philadelphia.
- Parr, B. (2004). *Effects of a math-enhanced curriculum and instructional approach on the performance of secondary education students enrolled in an agricultural power and technology course: An experimental study*. Unpublished doctoral dissertation, Oklahoma State University, Stillwater.
- Parnell, D. (1995). *Why do I have to learn this?* Waco, TX: Center for Occupational Research and Development.
- Parnell, D. (1996). Cerebral context. *Vocational Education Journal*, 71(3), 18-21.
- Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis*. Hillsdale: Hove and London.
- Peterson, P., McCarthy, S., & Elmore, R. (1996). Learning from school restructuring. *American Educational Research Journal*, 33(1), 119-153.
- Phipps, L. J., & Osborne, E. W. (1988). *Handbook on agricultural education in public schools* (5th ed.). Danville, IL: Interstate Printers and Publishers.
- Prescott, C., Rinard, B., Cockerill, J., & Baker, N. (1996). Science through workplace lenses. *Educational Leadership*, 53(8), 10-13.
- Resnick, L., & Hall, M. (1998). Learning organizations for sustainable education reform. *Daedalus*, 127, 89-118.
- Rogers, E. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.
- Romberg, T., & Kaput, J. (1999). Mathematics worth teaching, mathematics worth understanding. In E. Fennema & T. Romberg (Eds.), *Mathematics classrooms that promote understanding*. Mahwah, NJ: Lawrence Erlbaum Associates.

- Rosenbaum, J. (2002). *Beyond empty promises: Policies to improve transitions to college and jobs*. Paper commissioned by the U.S. Department of Education, Office of Vocational and Adult Education (contract no. ED-99-CO-0160).
- Russell, A. (1995). Stages in learning new technology: Naïve adult email users. *Computers in Education*, 25(4), 173-178.
- Schmidt, B., Finch, C., Faulkner, S., & Kandies, J. (1995). *Preparing teachers to successfully integrate vocational and academic education: A case study approach*. Berkeley, CA: National Center For Research in Vocational Education.
- Simesk, Z. (1999). Sample surveys via electronic mail: A comprehensive perspective. *RAE-Revista de Administração de Empresas*, 39(1),77-83.
- Shinn, G. (2002). Student achievement in agricultural education: Who's doing the math? *Agricultural Education Magazine*, 75(2), 14-15.
- Shinn, G., Briers, G., Christiansen, J., Edwards, C., Harlin, J., Linder, J., et al. (2003). *Improving student achievement in mathematics: An important role for secondary agricultural education in the 21st century*. Monograph, National Council for Agricultural Education. Retrieved March 19, 2006, from <http://www.agedhq.org/AgEdResearchWorkGroupMonographMathematics02Dec03.pdf>
- Smith, J. (1996). Does an extra year make any difference? The impact of early access to algebra on long-term gains in mathematics attainment. *Educational Evaluation and Policy Analysis*, 18(2), 141-153.
- Stasz, C., Kaganoff, T., & Eden, R. (1994). Integrating academic and vocational education: A review of the literature, 1987-1992. *Journal of Vocational Education Research*, 19(2), 25-72.
- Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage.
- Taylor, P., & Mulhall, A. (1997). *Contextualising teaching and learning in rural primary schools: using agricultural experience*. (Volume 1). Department for International Development Education Paper Serial No. 20. Retrieved February 23, 2006, from <http://www.id21.org/education/4ajd4.html>
- Team Ag. Ed. (2004). *About agricultural education*. Retrieved online November 7, 2005, from <http://www.teamaged.org/aged.htm>
- Thompson, G., Jansen, D., & Enochs, L. (2005, May). *Seven steps to enhancing mathematics in the agricultural education curriculum*. Poster presented at the National AAEE Research Conference, San Antonio, TX.

- Tolor, A. (Ed.). (1985). *Effective interviewing*. Chicago: Charles C. Thomas.
- Truell, A., Bartlett, J., & Alexander, M. (2002). Response rate, speed, and completeness: A comparison of Internet-based and mail surveys. *Behavior Research Methods, Instruments, & Computers*, 34(1), 46-49.
- Van Blerkom, M. L. (1986, August). *Mathematical ability in college students: A causal analysis*. Paper presented at the Annual Convention of the American Psychological Association, Los Angeles, CA.
- Virginia Career and Technical Education Resource Center. (2005). *Agricultural education task list*. Retrieved November 19, 2005, from <http://www.cteresource.org>
- Virginia Department of Education. (2005). *Standards of learning currently in effect for Virginia public schools*. Retrieved November 19, 2005, from <http://www.pen.k12.va.us/VDOE/Superintendent/Sols/home.shtml>
- Von Secker, C., & Lissitz, R. (1999). Estimating the impact of instructional practices on student achievement in science. *Journal of Research in Science Teaching*, 36(10), 1110-1126.
- Warmbrod, J. (1974, December). *The liberalization of vocational education*. Paper presented at the annual meeting of the American Vocational Association, New Orleans, LA.
- Warnat, W. (1991). Preparing a world-class workforce. *Vocational Education Journal*, 66(5), 22-25.
- Washington Office of Superintendent of Instruction. (2004). *Career and technical education*. Retrieved December 2, 2005, from <http://www.k12.wa.us/CareerTechEd/default.aspx>
- Watt, J. (1997). Using the Internet for quantitative survey research. *Quirk's Marketing Research Review*, Article Number 0248. Retrieved March 9, 2006, from http://www.quirks.com/articles/article_print.asp?arg_articleid=248
- Wasley, P. (1991). Stirring the chalkdust: Changing practices in essential schools. *Teachers College Record*, 93(1), 28-58.
- Wilhelm, A. (2003). NCLB, standards, and the future of agricultural education. *Agricultural Education Magazine*, 76(3), 18-19.

Woglom, C., Parr, B.A., & Morgan, J.A. (2004). *A comparison of commonwealth accountability standardized test scores between high school agricultural education/career and technical education students and the Kentucky state standards*. Proceedings of the 55th Annual Southern Agricultural Education Research Conference, Little Rock, AR.

Ziglio, E. (1996). The Delphi method and its contribution to decision-making. In M. Adler & E. Ziglio (Eds.), *Gazing into the oracle: The Delphi method and its application to social policy and public health* (pp. 3-33). London: Jessica Kingsley.

Appendix A

E-mail Message to Panel of Experts

Dear _____

The purpose of this email is to ask for your assistance in identifying ten outstanding secondary agricultural education instructors in Virginia. Those instructors identified as outstanding will be contacted to participate in the study I am completing for my dissertation. The title of the study is "Attitudes of Outstanding Agricultural Education Teachers toward Mathematics Integration."

The purpose of this study is to analyze outstanding agricultural education teachers' attitudes towards mathematics integration. I will also determine the outstanding agricultural teachers' current level of mathematics integration in each course they are currently teaching. An investigation into the collaboration efforts being made between the agricultural education and other faculty members will also be included. I will collect the outstanding teachers' perceived needs to increase mathematics integration. The study will result in proposed actions to increase mathematics integration into the agricultural education curriculum.

The research study will be conducted utilizing an electronic survey system through Virginia Tech. The teachers will receive an e-mail with an electronic link that will allow them access to the survey instrument. This will work similarly to a link to a website; they can simply click on the hyperlink or copy and paste it to a new Internet browser window. Their responses to the questions will be kept confidential. Please nominate 10 outstanding agricultural education teachers based on the following criteria:

- Knowledgeable of the agricultural education curriculum in Virginia;
- Demonstrates characteristics of an outstanding agricultural education instructor;
- Willing to complete the electronic study thoroughly; and
- Able to communicate effectively through email.

Please reply to me with your nominations by Tuesday, May 2, 2006, by 5:00 p.m. If you have any questions regarding this message, please do not hesitate to contact me either through email or phone. My contact information is located below. Thank you for your assistance with this matter.

Sincerely,

Ryan G. Anderson
Agricultural and Extension Education
268 Litton-Reaves Hall
Virginia Tech (Mail Code 0343)
Blacksburg, VA 24061
Voice: (540)231-6836,
Fax:(540)231-3824
E-Mail: randrsn@vt.edu

Appendix B

Follow-up to Panel of Experts

Dear _____

The purpose of this email is to ask for your approval of the 26 teachers that were nominated as outstanding agricultural education instructors in Virginia. Those instructors identified as outstanding will be contacted to participate in the study I am completing for my dissertation. The title of the study is “Attitudes of Outstanding Agricultural Education Teachers towards Mathematics Integration.”

If you feel that one or more of the teachers who have been nominated as outstanding agricultural education instructors does not meet your approval as an outstanding teacher, please provide a justification for removal from the study. Here are the 26 agricultural education instructors who have been nominated:

The 26 agricultural education teachers’ names were listed here

Please reply to me with your approval by Tuesday, May 9, 2006, by 5:00 p.m. If you have any questions regarding this message, please do not hesitate to contact me either through email or phone. My contact information is located below. Thank you for your assistance with this matter.

Sincerely,

Ryan G. Anderson
Agricultural and Extension Education
268 Litton-Reaves Hall
Virginia Tech (Mail Code 0343)
Blacksburg, VA 24061
Voice: (540)231-6836,
Fax:(540)231-3824
E-Mail: randrsn@vt.edu

Appendix C

Notification E-mail

Dear _____

The purpose of this email is to ask for your assistance in determining the attitudes of outstanding agricultural education teachers in Virginia towards the integration of mathematics. You have been identified as an outstanding agricultural education teacher for your efforts put forth in the classroom by the state leaders in agricultural education. The title of the study is “The Attitudes of Outstanding Agricultural Education Teachers toward Mathematics Integration.”

The purpose of this study is to analyze outstanding agricultural education teachers’ attitudes towards mathematics integration. I will also determine the outstanding agricultural teachers’ current level of mathematics integration into each course. An investigation into the collaboration efforts being made between the agricultural education and mathematics departments will also be included. I will also collect the outstanding teachers’ perceived needs on mathematics integration. The study will result in proposed actions to increase mathematics integration into the agricultural education curriculum.

The research study will be conducted utilizing an electronic survey system through Virginia Tech. You will receive an e-mail with an electronic link that will allow you access to the survey instrument. This will work similarly to a link to a website; simply click on the hyperlink or copy and paste it to a new Internet browser window. Your responses to the questions will be kept confidential throughout the study. You will also receive a copy of the results at the conclusion of the study, if requested. Please accept the nomination and participate in the study to determine the attitudes and needs of agricultural education teachers regarding their efforts to integrate mathematics. Congratulations on being identified as an outstanding agricultural education teacher. The research can benefit the Agricultural Education profession. Please reply to me acknowledging your acceptance of the nomination by Wednesday, May 31, 2006, by 5:00 p.m. If you have any questions regarding this message, please do not hesitate to contact me either through email or phone. My contact information is located below.

Thank you for your assistance with this matter.

Sincerely,

Ryan G. Anderson
Agricultural and Extension Education
268 Litton-Reaves Hall
Virginia Tech (Mail Code 0343)
Blacksburg, VA 24061
Voice: (540)231-6836,
Fax:(540)231-3824
E-Mail: randrsn@vt.edu

Appendix D

E-mail with Survey Link

To:

You have been selected to answer questions about your efforts to integrate mathematics in the agricultural education curriculum. It should require about twenty minutes of your time. Usually it is best to respond with your first impression, without spending too much time on each question. Your answers will remain confidential. You can access the survey at:

<https://survey.vt.edu/survey/entry.jsp?id=1149020682127>

If you have questions about the study or any items in the questionnaire, please contact the researchers at (540)231-6836 or via e-mail to randrsn@vt.edu. Each participant will receive a summary of the study's results if requested. Please complete the survey by June 5th, 2006.

Thank you for your cooperation! Your participation is greatly appreciated.

Ryan G. Anderson, Graduate Assistant
John H. Hillison, Professor and Department Head
Agricultural and Extension Education Department
Virginia Tech

Appendix E

E-mail Request for Follow-up Interview

Dear _____

The purpose of this email is to ask for your assistance in determining the attitudes of outstanding agricultural education teachers in Virginia towards the integration of mathematics. You have been identified as integrating mathematics into the agricultural education curriculum at the highest level among your peers.

The purpose of this study is to analyze outstanding agricultural education teachers' attitudes towards mathematics integration. I will also determine the outstanding agricultural teachers' current level of mathematics integration into each course. An investigation into the collaboration efforts being made between the agricultural education and mathematics departments will also be included. I will also collect the outstanding teacher's perceived needs on mathematics integration. The study will result in proposed actions to increase mathematics integration into agricultural education curriculums.

The research study will be finalized by conducted an interview while you are attending the Virginia FFA convention at Virginia Tech. If you are willing to participate in the interview, we can setup a time that is convenient to you. The interview will last approximately thirty minutes. Your responses to the questions will be kept confidential throughout the study. You will also receive a copy of the results at the conclusion of the study, if requested via e-mail. Please accept the nomination and participate in the study to determine the attitudes and needs of agricultural education teachers regarding their efforts to integrate mathematics. Congratulations on being identified as an outstanding agricultural education teacher. The research will benefit Agricultural Education. Please reply to me acknowledging your acceptance of the nomination by June 15, 2006 by 5:00 pm. If you have any questions regarding this message please do not hesitate to contact me either through email or phone. My contact information is located below.

Thank you for your assistance with this research.

Sincerely

Ryan G. Anderson
Agricultural and Extension Education
268 Litton-Reaves Hall
Virginia Tech (Mail Code 0343)
Blacksburg, VA 24061
Voice: (540)231-6836,
Fax:(540)231-3824
E-Mail: randrsn@vt.ed

Appendix F

Survey Instrument

Survey of Mathematics Integration

To: Agricultural Educators

You have been selected to answer questions about your efforts to integrate mathematics into the agricultural education curriculum. It should require about twenty minutes of your time. Usually it is best to respond with your first impression, without spending too much time on each question. Your answers will remain confidential.

If you have questions about the study or any items in the questionnaire, please contact the researchers at (540)231-6836 or via e-mail to randrsn@vt.edu. Each participant will receive a summary of the study's results if requested.

Thank you for your cooperation! Your participation is greatly appreciated.

Ryan G. Anderson, Graduate Assistant
John H. Hillison, Professor and Department Head
Agricultural and Extension Education Department
Virginia Tech

Teacher Characteristics

Please respond to each question below by selecting the response item that applies to you or filling in the blank.

1. How many years have you been teaching (including this year)? _____
2. Please indicate your levels of education below:

Degree	Major	Year Received
Associate's		
Bachelor's		
Master's		
Specialist		
Doctorate		
Other:		

3. What is your age? _____
4. What is your gender?

___ Female ___ Male
5. What is your race or ethnicity?
___ African American ___ Caucasian ___ Hispanic

___ Asian ___ American Indian ___ other, please specify _____
6. What grade levels do you teach?
7. Are you a member of the Virginia Association of Agricultural Educators?
___ Yes ___ No
8. What areas are you endorsed to teach in Virginia?
___ Agricultural Education
___ Mathematics (Mathematics, Algebra I)
___ Science (Earth Science, Chemistry, Biology, Physics)
___ Other (Please specify) _____
9. How many courses have you completed in mathematics?
___ High school
___ Two-year college/community college
___ Four-year college/university

10. What type of teaching license do you currently hold?
 Collegiate Professional License
 Postgraduate Professional License
 Technical Professional License
 Provisional License

Program Characteristics

11. How would you describe the location of your school?
 Rural (population under 5,000)
 Small Urban (5,000-20,000)
 Urban, (20,000+)
12. How many Agricultural Education teachers currently teach in your school?
 1 2 3 4 or more
13. How many students are currently enrolled in your Agricultural Education program? _____
14. Do students receive academic credit outside of agricultural education for any courses taught in the agricultural education department?
 No Yes, please specify _____
15. What type of scheduling does your school system utilize?
 A/B block
 4x4 block
 6 period
 7 period
 8 period
 Other
16. For each class period you are currently teaching, regardless of the subject, give *course title*, the Virginia State Department of Education approved *course number* (agricultural education course numbers can be found at <http://www.cteresource.org/>) the *number of students* in the class and the overall *percentage of course content that utilizes mathematics* in the curriculum of each course. If you teach more than one section of a course, record each section separately below.

 Course Title

 Course Number

 # Students

 (% Math Integration)

 Course Title

 Course Number

 # Students

 (% Math Integration)

Course Title

Course Number

Students (% Math Integration)

Course Title

Course Number

Students (% Math Integration)

Course Title

Course Number

Students (% Math Integration)

Course Title

Course Number

Students (% Math Integration)

Course Title

Course Number

Students (% Math Integration)

Course Title

Course Number

Students (% Math Integration)

Teacher Opinions

Please provide your opinion about each of the following statements by circling the number most appropriate number using the following scale:

Strongly Disagree: 1; Disagree: 2; Uncertain: 3; Agree: 4; Strongly Agree: 5

17. Students learn mathematics best in a traditional mathematics course.

1 2 3 4 5

18. Students learn mathematics best in applied learning environments.

1 2 3 4 5

19. Mathematics is an integral component of agricultural education.

1 2 3 4 5

20. Mathematics teachers in my school recognize the value agricultural education has for teaching mathematics.

1 2 3 4 5

21. I believe I should integrate mathematics into my curriculum.

1 2 3 4 5

22. Agricultural education provides an excellent avenue to teach mathematics in an applied context.
1 2 3 4 5
23. I purposely integrate mathematical concepts into my lessons.
1 2 3 4 5
24. Agricultural education is a mathematics-rich content area.
1 2 3 4 5
25. I enjoy linking mathematical concepts to agricultural settings.
1 2 3 4 5
26. Mathematics should be taught in the mathematics department not in the agricultural education department.
1 2 3 4 5
27. The curriculum I teach can aid the students with the mathematics section of the Virginia Standards of Learning.
1 2 3 4 5
28. Student achievement increases with the integration of mathematics into the agricultural education curriculum.
1 2 3 4 5
29. I can integrate more mathematics skills into my agricultural education curriculum than what I am currently integrating.
1 2 3 4 5
30. There are adequate curriculum materials available to integrate mathematics into my curriculum.
1 2 3 4 5
31. Mathematics integration is not important to the agricultural education curriculum.
1 2 3 4 5
32. The Standards of Learning have played a role in the decreasing number of students enrolled in the agricultural education department.
1 2 3 4 5
33. If I increase the academic rigor of my courses, the students will elect to not enroll in my courses.
1 2 3 4 5
34. Students do not want to learn about mathematics in my courses.
1 2 3 4 5

35. My students are not capable of understanding difficult mathematics concepts used in the agricultural industry.

1 2 3 4 5

Teacher Collaboration

36. I want to collaborate with the mathematics teachers in my school.

1 2 3 4 5

37. The mathematics instructor(s) make an effort to collaborate with me.

1 2 3 4 5

38. I make an effort to collaborate with the mathematics instructor(s) at my school.

1 2 3 4 5

39. My colleague(s) outside of the mathematics department and I regularly share ideas and materials related to mathematics instruction.

1 2 3 4 5

40. My school administrators encourage academic integration through collaboration.

1 2 3 4 5

Teacher Needs

41. I have participated in professional development activities related to academic integration.

1 2 3 4 5

42. I would like to participate in additional workshops related to mathematics integration.

1 2 3 4 5

43. I am interested in how teachers have integrated mathematics into their agricultural curricula.

1 2 3 4 5

44. I am interested in taking courses on mathematics integration in agricultural education.

1 2 3 4 5

45. I am interested in learning how to teach mathematics in applied contexts.

1 2 3 4 5

46. I would teach a course focusing on “mathematics applied to agriculture” if students could receive mathematics credit for the course?

1 2 3 4 5

47. I would be interested in reviewing a curriculum for a mathematics course that is applied to agricultural education.

1 2 3 4 5

48. I would be interested in developing a curriculum for a mathematics course applied to agricultural education.

1 2 3 4 5

49. I would be interested in an in-service workshop on mathematics integration that would include the mathematics instructors from my school.

1 2 3 4 5

50. I would increase my integration of mathematics if the curriculum specialists develop more teaching materials that integrate mathematics into the agricultural education curriculum

1 2 3 4 5

51. Please list below the name of school where you teach. This information will allow the researcher to contact the non-respondents with follow-up e-mails, and then it will be omitted from the data to be analyzed. Your identity will remain confidential with the researcher. No information will be linked to specific respondents or their schools in reporting the results.

Thank you for your cooperation and dedication!

Appendix G

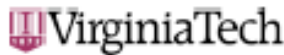
Follow-up Interview Guide

Follow-up Interview Guide

1. Why do you think that mathematics is an important component of agricultural education?
2. Considering some of the current issues in education, why is it important to integrate mathematics into the agricultural education curriculum?
3. What are some of the ways that you intentionally emphasize mathematical concepts in your lessons?
4. What resources are needed to help you increase your integration of mathematics?
5. What sessions at conferences or other in-service education programs might help you integrate mathematics?
6. How often and in what ways do you indicate specific Standards of Learning that relate to the concepts you are teaching?
7. Do you collaborate with any teachers in your school regarding mathematics? Why or why not? If yes: Please give me a few examples of lessons or topics on which you have worked with another teacher.
8. Please describe a few of the topics in which you integrate mathematics.
9. Briefly explain a Career Development Event in which your students needed to use math skills.
10. To what extent do you think your efforts to integrate math have helped your students understand math concepts better? Please share any examples related to how your students have done on standardized tests or in their math classes.

Appendix H

IRB Approval Form



Office of Research Compliance
Institutional Review Board
1880 Patton Drive (0497)
Blacksburg, Virginia 24061
540/231-4991 Fax: 540/231-0959
E-mail: moored@vt.edu
www.irb.vt.edu
EPA0000672, codes 700007
IRB # 188000087

DATE: May 30, 2006

MEMORANDUM

TO: John H. Hillson
Ryan Anderson

Approval date: 5/30/2006
Continuing Review Due Date: 5/15/2007
Expiration Date: 5/29/2007

FROM: David M. Moore

SUBJECT: **IRB Expedited Approval:** "Attitudes of Outstanding Virginia Agricultural Education Teachers Towards Mathematics Integration", IRB # 06-323

This memo is regarding the above-mentioned protocol. The proposed research is eligible for expedited review according to the specifications authorized by 45 CFR 46.110 and 21 CFR 56.110. As Chair of the Virginia Tech Institutional Review Board, I have granted approval to the study for a period of 12 months, effective May 30, 2006.

As an Investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in previously approved human subject research activities to the IRB, including changes to your study forms, procedures and investigators, regardless of how minor. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.
2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.
3. Report promptly to the IRB of the study's closing (i.e., data collecting and data analysis complete at Virginia Tech). If the study is to continue past the expiration date (listed above), investigators must submit a request for continuing review prior to the continuing review due date (listed above). It is the researcher's responsibility to obtain re-approval from the IRB before the study's expiration date.
4. If re-approval is not obtained (unless the study has been reported to the IRB as closed) prior to the expiration date, all activities involving human subjects and data analysis must cease immediately, except where necessary to eliminate apparent immediate hazards to the subjects.

Important:

if you are conducting **federally funded non-exempt research**, this approval letter must state that the IRB has compared the OSP grant application and IRB application and found the documents to be consistent. Otherwise, this approval letter is invalid for OSP to release funds. Visit our website at <http://www.irb.vt.edu/pages/newstudy.htm#OSP> for further information.

cc: File
Department Reviewer: Patricia Sobrero

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE UNIVERSITY AND STATE UNIVERSITY
An equal opportunity, affirmative action institution

Appendix I

Informed Consent Form for Participant

INFORMED CONSENT FORM FOR PARTICIPANTS

Title of Project: Attitudes Of Outstanding Virginia Agricultural Education Teachers Towards Mathematics Integration

Investigators: Faculty: Dr. John Hillison

Graduate Student: Ryan Anderson

I. Purpose of the Project

The purpose of this study is to analyze outstanding agricultural education teachers' attitudes towards mathematics integration. The researcher will also identify the outstanding agricultural teachers' self-reported level of mathematics integration into each course. An investigation into the collaboration efforts being made between the agricultural education and mathematics department will also be included. The researcher will further identify the outstanding teachers perceived needs to increase mathematics integration.

II. Procedures

The population for this study consisted of outstanding agriculture teachers across the state of Virginia. The panel of agricultural teachers was identified by a nominating committee consisting of state leaders in agricultural education.

For this study the participants will be interviewed while they are attending the Virginia FFA convention at Virginia Tech. They will receive a cover letter from the researcher and major professor outlining the purpose of the research containing instructions for setting a time and place to meet for the interview. The interviews will last approximately 10-15 minutes and will be audio recorded. Responders will be allowed to withdraw from the study at any time.

III. Risk & Benefits

There are no more than minimal risks involved in participating in this project. The participants will contribute to the body of knowledge already present in this field. The participants will be given the opportunity to reflect upon their own

experiences. No promise or guarantee of benefits has been made to encourage them to participate.

IV. Anonymity and Confidentiality

Results will be kept confidential. Only the researcher will know the identity of the participants, and the researcher promises not to divulge the identity of the participants to anyone. Only team members directly involved in data analysis will have access to interviews transcripts.

V. Compensation

There is no compensation for participating in the project.

VI. Freedom to Withdraw

Participants are free to withdraw at any time. Participants may ask that the tape recorder be turned off at any time during the interview.

VII. Informed Consent

Participants will receive a copy of the consent form prior to the interview and asked to indicate their agreement with the stated conditions.

This project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Tech

VIII. Participant's Permission

I have read and understand the Informed Consent Form for Participants and the conditions of this project. I voluntarily agree to participate in this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent

I acknowledge my rights and consent to participate in this study.

Signature: _____ **Date:** _____

Should you have any questions about this research, contact the investigator listed at the top of this form or Dr. David Moore, IRB Chair, Research Compliance Office, 231-4991, moored@vt.edu

Should you have any additional concerns the interviewer is: Ryan Anderson, 540-231-6836, randrsn@vt.edu

Virginia Polytechnic Institute and State Universit

Ryan G. Anderson, Ph.D.

Curriculum Vita

Home Address	Work Address
1217 Diuguid Dr. Apt. B	213 S. Oakley Applied Science
Murray, KY. 42071	Murray, KY. 42071
636-698-4158	270-809-6591
ryang.anderson@murraystate.edu	

EDUCATION

- Ph.D. **Virginia Polytechnic Institute and State University, Blacksburg, VA.**
Career and Technical Education (Emphasis Agricultural Education)
Research Interest: Academic Integration, Expected 12/2006
- M.S. **Texas A&M-Commerce, Commerce, TX.**
Master of Science, Agricultural Education, August 2003
- B.S. **Illinois State University, Normal, IL.**
Bachelor's of Science Agricultural Education, August 2000

EXPERIENCE

- 2006-Present **Murray State University, Murray, KY.**
School of Agriculture
- *Assistant Professor, Agricultural Systems Management*
 - *Agricultural engineering advisor*
 - *Collegiate FFA advisor*
 - *Research Policy Committee member*
 - *Student Retention Committee member*
- 2005-06 **Virginia Polytechnic Institute and State University, Blacksburg, VA.**
Department of Agricultural Extension and Education
- *Graduate Teaching Assistant*
 - *Teach undergraduate and graduate courses*
 - *Supervise student teacher*
- 2005 **Virginia Polytechnic Institute and State University, Blacksburg, VA.**
Department of Crop, Soil, and Environmental Science
- *Field and Laboratory Assistant*
 - *Research Instrument Designer*

- 2003-05 **Virginia Polytechnic Institute and State University, Blacksburg, VA.**
 Department of Agricultural Extension and Education
 Department of Biological Systems Engineering
- *Graduate Teaching Assistant (Split appointment)*
 - *Teach graduate and undergraduate courses*
 - *Supervise student teachers*
- 2004 **Virginia Governor’s School for Agriculture, Blacksburg, VA.**
- *Plant Science Group Leader*
 - *Supervise four independent group research projects*
- 2003 **Texas A&M-Commerce, Commerce, TX.**
 Department of Agricultural Science
- *Graduate Research Assistant*
 - *Graduate Teaching Assistant*
 - *Technical assistant for distance education students*
- 2001-02 **A-C Central Community Unit School District, Ashland, IL.**
- *Agricultural Education Instructor*
 - *FFA Advisor (100% Membership, 12 CDE teams)*
 - *FFA Alumni Advisor*
 - *Supervised Agricultural Experience Supervisor (7 sections winners)*
 - *Agricultural Education Advisory Committee*
 - *Livestock Judging Invitational Supervisor*
 - *Weight room supervisor*
- 2001 **Virginia Community Unit School District, Virginia, IL.**
- *Head Junior Varsity Football coach (5-4)*
 - *Head Freshman Football coach (4-4)*
 - *Assistant Varsity Football Coach (6-4)*
 - *(A-C Central Coop with Virginia)*
- 2000- 01 **Aledo Community Unit School District, Aledo, IL.**
- *Agricultural Education Instructor*
 - *Co-FFA Advisor (100% Membership, 9 CDE teams)*
 - *Supervised Agricultural Experience Co- Supervisor (5 section winners)*
 - *Assistant Freshman Football Coach (7-2)*
 - *Assistant Varsity Football Coach (6-4)*
 - *Assistant Junior Varsity Baseball Coach (12-18)*
 - *Senior Class Sponsor*

- 2000 **Eureka Community Unit School District, Eureka, IL**
- *Agricultural Education Student Teacher*
 - *FFA student advisor (100% Membership, 10 CDE teams)*
 - *Agricultural Education Advisory Committee*

- 1999-2000 **Metamora Township High School, Metamora, IL**
- *Assistant Freshman Football Coach (8-1)*
 - *Assistant Varsity Football Coach (13-1, State Runners-up)*
 - *Assistant Varsity Baseball Coach (25-12)*

TEACHER CERTIFICATION

Teacher License, Agriculture Endorsement, Grades 6-12
 State of Illinois, Number 1697977

Certificate Endorsements:

- Agriculture Business & Management
- Agriculture Power & Machinery
- Horticulture
- Agricultural Resources

TEACHING: COURSES

Virginia Polytechnic Institute and State University

Course Instructor:

AT 0124	Agricultural Machinery and Mechanics	Spring 2004
ALS 4884	Youth Program Management	Fall 2005

Course Teaching Assistant:

AEE 4034	Methods in Planning Education Programs in AG ED	Fall 2003-2004
AEE/BSE 3084	Agricultural Metal Fabrication	Fall 2003-2004
AEE 5104	Research Applications in AEE	Fall 2003
ALS 5034	Teaching Agricultural Mechanics	Fall 2003
AT 0384	Agricultural Buildings	Spring 2004-2005
AEE 4964	Field Study	Spring 2004-2005
AEE 4244	Methods of Teaching Career and Occ. Education	Spring 2004-2006
AEE/BSE 3074.	Procedures in Agriculture Construction	Spring 2005
AEE 4754	Internship in Agricultural Education	Spring 2005-2006

Texas A&M-Commerce University

Course Teaching Assistant:

AGED 572	Special Populations	Spring 2003
----------	---------------------	-------------

A-C Central Community Unit School District

Courses Taught:

Agricultural Business Operations I & II
Agricultural Construction and Technology I & II
Basic Agricultural Science I & II
Introduction to Agriculture I & II
Natural Resources Conservation & Management I & II
Resource Utilization & Conservation I & II

Aledo Community Unit School District

Courses Taught:

Agricultural Business Operations I & II
Agricultural Construction and Technology I & II
Agricultural Machinery Service I & II
Horticulture Production and Management I & II
Natural Resources Conservation & Management I & II

Eureka Community Unit School District

Courses Taught:

Agricultural Construction and Technology
Agricultural Mechanics and Technology
Basic Agricultural Science
Biological Science Applied to Agriculture
Horticulture Production and Management
Introduction to Agriculture

PROFESSIONAL SERVICES

Illinois FFA Association

Judge	State Proficiency Award	Spring 1999
Judge	Section V Parliamentary procedure Career Development Event (CDE)	Fall 1999
Judge	Section V Proficiency Award	Spring 2000
Judge	District I Proficiency Award	Spring 2000
Judge	Section IV Proficiency Award	Spring 2001
Judge	District I Proficiency Award	Spring 2001
Judge	State Proficiency Award	Spring 2001
Facilitator	State Agricultural Mechanics CDE	Spring 2001
Judge	Section XII Proficiency Award	Spring 2002
Judge	District III Proficiency Award	Spring 2002
Judge	State Proficiency Award	Spring 2002

Kentucky FFA Association

Judge	State Agricultural Mechanics Career Development Event	Fall 2006
Judge	State Small Engines CDE	Fall 2006
Judge	State Agricultural Communications CDE	Fall 2006
Judge	Fruit Production Proficiency Award	Fall 2005

National FFA Association

Judge	National Agricultural Mechanics Career Development Event	Fall 2004
Committee Member	National Agricultural Mechanics Committee	Fall 2004
Judge	National Agricultural Mechanics CDE	Fall 2005
Judge	Fruit Production Proficiency Award	Fall 2005
Committee Member	National Agricultural Mechanics Committee	Fall 2005
Judge	National Agricultural Mechanics CDE	Fall 2006
Judge	Agricultural Mechanics Proficiency Award	Fall 2006
Committee Member	National Agricultural Mechanics Committee	Fall 2006

Texas FFA Association

Judge	Regional Agricultural Mechanics CDE	Spring 2003
Committee member	State Agricultural Mechanics committee	Spring 2003

Virginia FFA Association

Ex Officio	Tractor driving Career Development Event	Fall 2003
Ex Officio	Tractor Troubleshooting CDE	Fall 2003
Facilitator	AES Leadership Conference	Fall 2003
Ex Officio	Junior Agricultural Mechanics CDE	Spring 2004
Ex Officio	Senior Agricultural Mechanics CDE	Spring 2004
Facilitator	AES Leadership Conference	Fall 2004
Ex Officio	Junior Agricultural Mechanics CDE	Spring 2005
Ex Officio	Senior Agricultural Mechanics CDE	Spring 2005
Facilitator	Middle School Agricultural Mechanics CDE	Spring 2005
Ex Officio	Small Engines CDE	Fall 2005
Facilitator	AES Leadership Conference	Fall 2003
Ex Officio	Junior Agricultural Mechanics CDE	Spring 2006
Ex Officio	Senior Agricultural Mechanics CDE	Spring 2006

FUNDED PROPOSALS

Rufus Beamer Professional Development Award	\$150	2006
Rufus Beamer Professional Development Award	\$500	2005
Illinois Soil and Water Conservation District Greenhouse applications	\$4000	2002
Facilitating Coordinators in Agricultural Education Incentive Funding Grant	\$3800	2002
Facilitating Coordinators in Agricultural Education Incentive Funding Grant	\$3200	2001

PROFESSIONAL ORGANIZATIONS

Agricultural Education Society	2003-Present
Alpha Tau Alpha	2003-Present
Association For Career and Technical Educators	2000-Present
Omicron Tau Theta, (Secretary 2005-06)	2003-Present
Illinois Farm Bureau Association	1996-Present
Illinois Association For Career and Technical Educators	2000-2002
Illinois Association For Vocational Agriculture Teachers	1998-2002
FarmHouse International Fraternity Alumni	2000-Present
Eastern Educators Research Association	2005-Present
National Association of Agricultural Educators (NAAE)	2000-Present
Virginia Association of Agricultural Educators	2005-Present
Virginia Association For Career and Technical Educators	2003-Present

PROFESSIONAL MEETINGS

NATIONAL

- 2006 National FFA Convention- Indianapolis, IN.
- 2006 OMEGA Conference- Indianapolis, IN.
- 2006 National Agricultural Education Research Conference, Charlotte, NC. - **Chair**
- 2005 National FFA Convention- Louisville Ky.
- 2005 American Association Agricultural Education- San Antonio, TX. - **Presenter**
- 2005 Association for Career and Technical Educators (ACTE) National Policy Seminar- Washington, D.C.
- 2004 National FFA Convention- Louisville, KY.
- 2003 National FFA Convention- Louisville, KY.
- 2001 National FFA Convention- Louisville, KY.

REGIONAL

- 2006 Southern Agricultural Education Research Conference, Orlando, FL. - **Presenter**
- 2006 Eastern Educational Research Association Conference, Hilton Head, SC. - **Presenter**
- 2005 Southern Agricultural Education Research Conference, Little Rock, AK.

STATE

- 2005 Virginia FFA Convention- Blacksburg, VA.
- 2004 Virginia FFA Convention- Blacksburg, VA.
- 2002 Illinois FFA Convention- Springfield, IL.
- 2002 Illinois Association of Vocation Agriculture Teachers Conference- Decatur, IL.
- 2001 Illinois FFA Convention- Springfield, IL.
- 2001 Illinois Association of Vocation Agriculture Teachers Conference- Decatur, IL.
- 2000 Illinois FFA Convention- Springfield, IL.
- 2000 Illinois Association of Vocation Agriculture Teachers Conference- Mt. Vernon, IL.
- 1999 Illinois Association of Vocation Agriculture Student Teachers Conference- Decatur, IL.
- 1999 Illinois Association of Vocation Agriculture Pre-service Teachers Workshop- Bloomington, IL. - **Chairman**
- 1998 Illinois Association of Vocation Agriculture Student Teachers Conference- Decatur, IL.

REFEREED JOURNAL ARTICLES

- Swafford, M. & Anderson, R. (In Press) A Two Decade Analysis of the Literature Cited in the Journal of Agricultural Education. *Journal of Agricultural Education*.

REFEREED PAPER PRESENTATIONS

- Anderson, R., Miller, R., & Cannon, J. (2007). *Gender differences among agricultural education instructors toward information technology*. Proceedings of Eastern Educational Research Association Conference, Clearwater. FL.
- Cannon, J., & Anderson, R. (2007). *Factors influencing college choices of gifted and talented students*. Proceedings of Eastern Educational Research Association Conference, Clearwater. FL.
- Anderson, R., & Miller, R. (2006). *Agricultural Instructors' Attitudes Toward Information Technology*. Proceedings of Eastern Educational Research Association Conference, Hilton Head, S. C.
- Miller, R., & Anderson, R. (2006). *Instructor Perceptions of Communication in Online Courses*. Proceedings of Eastern Educational Research Association Conference, Hilton Head, S. C.

Miller, R., & Anderson, R (2006). *Instructor Perceptions of Communication in Online Courses*. Southern Region American Association for Agricultural Education Conference, Orlando, FL.

Anderson, R., Miller, R., & Williams, R. (2006). *Agricultural Instructors' Attitude Toward Information Technology*. Virginia Tech School of Education Student Association Research Symposium, Blacksburg, VA.

REFEREED POSTER PRESENTATIONS

Cannon, J., & Anderson, R. (2005). *Perceptions of Agriculture by the 2004 Class of the Virginia Governor's School for Agriculture*. Presented at American Association for Agricultural Education, San Antonio TX.

Anderson, R., & Cannon, J. (2006). *Career Interest in Agriculture of the 2004 Class of the Virginia Governor's School for Agriculture*. Southern Region American Association for Agricultural Education Conference, Orlando, FL.

Miller, R., Siebel A., & Anderson, R. (2006). *Maximizing Students Quality of Life by Utilizing Career Development Events*. Southern Region American Association for Agricultural Education Conference, Orlando, FL.

Anderson, R., Miller, R., Swafford, M. & Anderson S. (2006). *Spanish For The Agricultural and Green Industry*. Virginia Tech School of Education Student Association Research Symposium, Blacksburg, VA

Anderson, R., & Cannon, J. (2006). *Career Interest in Agriculture of the 2004 Class of the Virginia Governor's School for Agriculture*. Virginia Tech School of Education Student Association Research Symposium, Blacksburg, VA.

Cannon, J., & Anderson, R. (2006). *Perceptions of Agriculture by the 2004 Class of the Virginia Governor's School for Agriculture*. Virginia Tech School of Education Student Association Research Symposium, Blacksburg, VA.

Cannon, J., & Anderson, R. (2006). *Independent Group Projects for the Virginia Governor's School for Agriculture*. Virginia Tech School of Education Student Association Research Symposium, Blacksburg, VA.

Miller, R., Siebel A., & Anderson, R. (2006). *Maximizing Students Quality of Life by Utilizing Career Development Events*. Virginia Tech School of Education Student Association Research Symposium, Blacksburg, VA..

Anderson, R., Miller, R., Swafford, M., & Anderson S. (2006). *Spanish For The Agricultural and Green Industry*. 22nd Annual Virginia Tech Graduate School Assembly Research Symposium, Blacksburg, VA

Byers, C., Anderson, R., & Cannon, J. (2006). *Career Interest in Agriculture of the 2004 Class of the Virginia Governor's School for Agriculture*. 22nd Annual Virginia Tech Graduate School Assembly Research Symposium, Blacksburg, VA

Miller, R., Siebel A., & Anderson, R. (2006). *Maximizing Students Quality of Life by Utilizing Career Development Events*. 22nd Annual Virginia Tech Graduate School Assembly Research Symposium, Blacksburg, VA

Thesis

Agricultural science teachers' attitudes toward and adoption of information technology. Study completed July 2003 and funded by Houston Livestock Show and Rodeo (\$1,500).

Dissertation

Attitudes of Outstanding Virginia Agricultural Education Instructors Toward Mathematics Integration