A Case Study of How Modern Agricultural Education Programs May Be Designed To Support Innovative Agricultural Content

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Abstract

The agricultural industry is changing every day, and new innovations are being developed faster than educational resources can be developed. Secondary agricultural education is faced with the challenges of keeping up with the changes in the industry. Determining how to bring cutting edge innovative content to the classroom is difficult and without a clear vision of what is relevant it is impossible. The purpose of this case study was to determine how modern agricultural education programs may be designed and developed to support innovative agricultural content. The researcher focused on the planning theory of (Cervero & Wilson, 2006), as well as the "Diffusion of Innovations Theory" (Rogers, 2003) for the theoretical framework of the research. The case study used a qualitative approach to examine the phenomenological views of stakeholders and artifacts collected to support the innovative program design. This qualitative study used interviews to describe and find the meanings to how modern agricultural education programs may be designed and developed to support innovative agricultural content.

The findings of this study delivered a clear picture of this innovative agricultural education program. There were five categories and nine themes to emerge from the data collected, these categories and themes support the role the participants have played in the design and development of this innovative agricultural education program. The study showed that teachers were the key to a successful program. Teachers were then connected to professional development, program support, curriculum, and expectations of students at the end of their agricultural education program.

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General Audience Abstract

This case study looked at a modern rural high school agricultural education program in Southwest Virginia. The purpose of the study was to determine how this modern agricultural education program was designed and developed to support innovative agricultural content. The researcher focused on the data collected to describe the methods and resources used to establish the current program. There were twenty-one stakeholders interviewed to examine their views and lived experiences during the development of the program, also artifacts were collected to support the innovative program design. The findings of this study delivered a clear picture of this innovative agricultural education program. There were five categories and nine themes to emerge from the data collected, these categories and themes support the role the participants played in the design and development of this innovative agricultural education program. The study showed that teachers were the key to a successful program. Teachers were then connected to professional development, program support, curriculum, and expectations of students at the end of their agricultural education program.

Dedication

First and foremost, to my wife, Sabrina and our children, Amanda, Caleb, and Lydia, who have sacrificed to allow me to pursue this educational, sometimes never-ending journey. To my parents who have believed in me for all these years, encouraged me to pursue my dreams with the support that parents give their children, no matter how old they get. I am just thankful they are still here to see me finish this journey. And, to my committee, Donna, Rick, Tom, and Hannah, who have stuck with me over the past five years and gave me words of encouragement and support at the times when I needed them the most.

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CHAPTER 1

INTRODUCTION

Background and Setting

In 1988, "Understanding Agriculture: New Directions for Agricultural Education was published, and educators were asked to step up the rigor of content in their agricultural education programs. The focus of this movement was to integrate science and cutting edge technological content into an out dated model of agricultural education (Boone, 2006). The movement to implement this content parallels the STEM movement in American education. The STEM movement began in 1989 with the "Science for All Americans" initiative, based on the thought that all Americans should be literate in Science, Technology, and Mathematics. It was through this initiative that the United States began its crusade to prepare students to be STEM literate (Rutherford, 1990). In his article, Rutherford states that students in the United States were ranked near the bottom of an international assessment of science and mathematics. This was cause for great concern in the public education system, as the report also noted that 17-year-olds were performing at levels lower than were reported in 1969. These findings inspired a push for science and technology education that had not been seen since the beginning of the space race (Rutherford, 1990). "Reinventing Agricultural Education for the Year 2020", was published in 1999, and called for agricultural education to modernize its content addressing changes in the agriculture industry (Rayfield, 2012). These changes have been difficult to address, as they have been broad based and too many in number to integrate efficiently in the classroom. This case study will look at a model which has changed the face of agricultural education in one rural community, and how that model can be localized to meet the needs of other agricultural education programs.

In October of 2013, the Virginia Department of Education, authorized and published, "A Strategic Review of Agriculture Education: Preparing Students for Successful Transition to College and Careers", (VDOE, 2013), which presented recommendations to meet existing and future workforce needs, and to devise a plan to move forward with new and emerging agriculture content integrated into course work and pathways. The Virginia Department of Education identified 11 priority action items. The action items included five opportunities for agricultural teachers to modernize agricultural education programs in Virginia:

1. Address certifications in the context of their curriculum.
2. Enhance problem-based learning instruction.
3. Acquire and maintain current technology skills.
4. Gain expertise in new and emerging agriculture content.
5. Expand partnerships with Virginia's two-year and four-year institutions for the recertification of secondary teachers in courses related to emerging high-tech agricultural content.

Gaining expertise in new and emerging agriculture content is an area where professional development can be designed and facilitated to achieve these goals. "Professional development programs are considered the most effective means of changing teacher practices" (Shoulders & Myers, 2014). Therefore, the types of professional development used to achieve modernization in agricultural education will need to be designed to facilitate a change (Rhoton & Shane, 2001). Traditional professional development programs are generally conducted at seminars, conventions, and other workshops. These programs are usually facilitated in a face to face format, limited in content because of time, limited in hands-on activities, and often lacks direct communication with the program leaders (Birman, 2000). Secondary agricultural teachers in

Virginia, have been encouraged to engage in professional development workshops, delivered by the Virginia Tech's Agricultural, Leadership, and Community Education Department and the Virginia Association of Agriculture Educators (VAAE). These workshops are used to encourage teachers to begin developing new aspects of their programs to meet priority items of the Strategic Review (VDOE, 2013). The workshops are designed to deliver more hands-on problem-based learning instruction to prepare students with the skills needed to contribute to a changing industry and to inspire them to face challenges themselves.

Agricultural education programs have not been required traditionally to adhere to end of course testing like those administered in core areas. When Virginia, revised graduation requirements to receive a standard diploma, students then had to complete a CTE pathway with an approved industry certification. In the push to address industry certification, Virginia Department of Education approved 31 credentials for Agricultural Education (VDOE, 2016). To address the credentialing requirements, agricultural education teachers found themselves in a position of teaching to a test. Students may use these certifications to gain verified credits for graduation. If a student receives two industry certifications, they must use the first as a student-selected verified credit and the second may be substituted for either a science, history or social science verified credit (VDOE, 2016).

Finally, teachers have been encouraged to expand their partnerships with Virginia's two-year and four-year institutions for the recertification of secondary teachers in courses related to emerging high-tech agricultural content (VDOE, 2013). By expanding the teacher's partnership with Virginia's two-year and four-year institutions, teachers are encouraged to continue learning in their profession and bring new content learned back to their classrooms. From this two-year

and four-year institutions are encouraged to develop programs which will enhance the agricultural education teachers recertifications.

Agricultural educators must prepare to expand their content knowledge to capture the rapidly changing field of agriculture and communicate those changes in the classroom. This will require a change in the way modern agricultural education content is delivered. These changes must be presented in a way that welcomes agricultural educators to explore new and relevant content (Boone, 2006). Agricultural teachers are the first to acknowledge they have little understanding of how to integrate all the changes which are taking place and express reservations in teaching new material (Wilson, 2002). Other agricultural teachers have expressed concerns over having resources available to integrate new and emerging agricultural content and/or having the facilities available for such changes (Mowen, 2007). Solving these problems will require further research in developing a comprehensive professional development program. Those in higher education should continue to take the lead in developing such programs which would reach out to individuals and address the needs of secondary agricultural education and recertification programs.

Personal Experience

Coming back to agricultural education after twenty years in the agriculture industry, I found that the curricula offered in agricultural education had remained the same as it was when I was a student in vocational agriculture. The world had changed but agricultural education had not. My experiences over the previous twenty years in the field of agriculture production, marketing, and sales brought relevant insight into the program. What was relevant in 1985, no longer applied to agricultural education in 2007. The agricultural programs no longer served students who were directly tied to production agriculture. I was then tasked with educating

students who were one or two generations removed from the farm. These students exhibited little or no understanding of the importance of agriculture in their daily lives. Faculty and student services saw agricultural education as place for the at-risk student population and a place where students could be placed when no other options were available. I have spent the past ten years trying to change the face of agricultural education in our local programs. Those changes have been slow, and still deficiencies exist with respect to student services, who do not understand the value of agricultural literacy and view agricultural education as a non-academic elective. Today, we are starting to see support for a more rigorous curriculum which includes courses like Biotechnology and Introduction to Veterinary Science, which carry a weighted grade and are dual-credit at the community college. The school administration, community organizations and businesses have been supportive, and I have been able to develop many educational tools that makes this program unique. I began with the development of a school research farm, contributed to the development of a regional governor's school for career and technical education, and designed and created what is believed to be the first STEM Laboratory for secondary agricultural education in the Nation. The program has brought in over $600,000 in grants and corporate donations to develop the current program. The teaching staff has received hours of training, both on site and at the State's Land Grant Universities. In the spring of 2017, the program was recognized by the Virginia Mathematics and Science Coalition, as the recipient of the 2017, "Programs That Works" Award. It has been my goal to develop an agricultural education model that is more dynamic in its approach, one that places relevant challenges on the local agriculture industry, connects student's prior knowledge to design-based learning, and where their discoveries will lead to a localized sustainable agricultural future and community viability. This model has taken time to develop and has required hours of research, trial and error in the

classroom, collaboration from multiple sources for content, and professional development in the content areas to achieve.

Theoretical Framework

Program Planning Theory

Program planning is a social activity in which individuals exchange personal and executive interests to develop educational programs, (Cervero & Wilson, 2006). These programs are developed by people who are influenced by the power or persons who authorized the development, the person or persons who are developing programs, and the social group who will benefit from the program (Cervero & Wilson, 2006). Planning therefore must be focused with a purpose, content, and a format to guide the development of the program. Since planning is a social activity, the program being developed must be negotiated, and a consensus of the planners must be reached in order for the program to be successful (Cervero & Wilson, 2006). It is with this in mind that the planners must be attentive to the interest and needs of the stakeholders from both, an educational and a political standpoint (Cervero & Wilson, 2006). Determining what to include in the program should be assimilated by the planners by identifying who and what will be affected by the program. The planners must establish a set of priorities that meet the program's educational, managerial, and political objectives (Cervero & Wilson, 2006). The theory suggest that many people benefit from the practical actions of a well-planned program, and that actions taken affects individual, organizational, and social change (Cervero & Wilson, 2006).

Theory of Diffusion of Innovations

The diffusion of innovations theory has been deliberated and found useful in an enormous collection of theoretical research and is used to support the program planner's

framework in which innovations become applicable to the stakeholders (Murray, 2009). Rogers defines diffusion as "the process in which an innovation is communicated thorough certain channels over time among the members of a social system" (Rogers, 2003). Innovations are the first element in Rogers theory and advocates the following explanation: "An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2003). The second element of the diffusion is the communication channels used to introduce the innovation. Communication is "a process in which participants create and share information with one another in order to reach a mutual understanding (Rogers, 2003). Rogers makes note that individuals make decisions based on evaluation of near peers who have adopted an innovation, and not because of expert scientific research (Rogers, 2003). The third element in the diffusion of an innovation is time. Rogers states that the time aspect is overlooked in most behavioral research. The diffusion occurs over a period of time and is conceptualized as a five-step process: first knowledge of the innovation, persuasion, decision, implementation, and confirmation (Rogers, 2003). This process is shown in Figure 1.1.

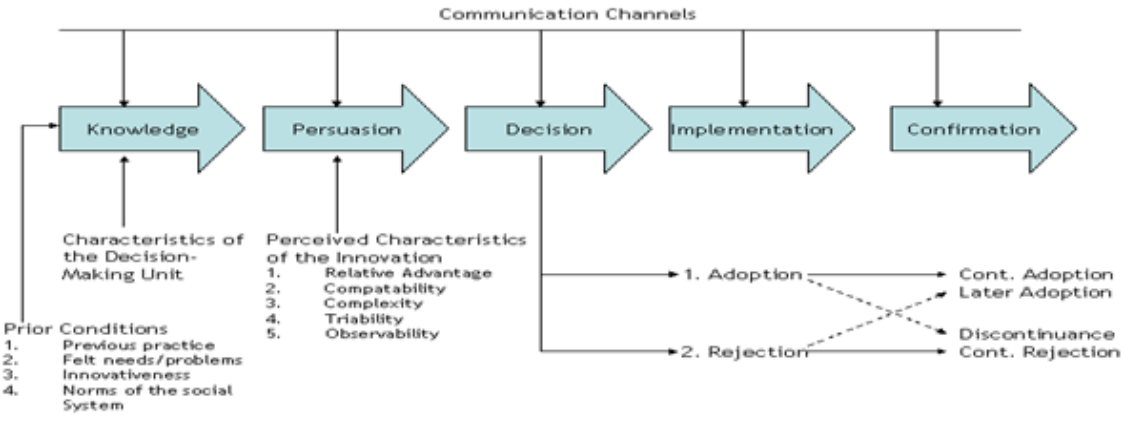


Figure 1.1. A Model of Five Stages in the Innovation-Decision Process, Source: Diffusion of Innovations, Fifth Edition by Everett M. Rogers. Copyright 2003, p. 170 (Rogers, 2003).

The last element in the diffusion process is the social system. Cervero and Wilson, frame the planning of a program as a social activity which requires the negotiation of interest expressed by the planners (Cervero & Wilson, 2006). This case study will look at how the stakeholders involved in the design and development of the innovative program have come together during planning and development. The study will explore the inputs and collaborations that have made this program unique, and how the final model can be designed and developed in other regions.

Purpose and Objectives

The purpose of this case study was to determine how modern agricultural education programs may be designed and developed to support innovative agricultural content. The researcher focused on the planning theory of Cervero and Wilson (2006), as well as Rogers' "Diffusion of Innovations Theory" (Rogers, 2003) for the theoretical framework of the research. The following questions were used to recognize how modern agricultural education programs may be designed to support innovative agricultural content:

1. How do members of the case study perceive innovative agricultural content?
2. How could the design of an agricultural program support community viability?
3. What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?
4. How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program?
5. How has participation in professional development contributed to the innovative agricultural content of this program?

Climate for Change

We now live and work in a global community, one that has changed and is changing rapidly (VDOE, 2013). Our competition for food and agricultural products are no longer local or

regional, but global (VDOE, 2013). It is with this thought in mind that students must prepare for careers that address globalization and worldwide concerns in their local communities (VDOE, 2013). By preparing educators with the tools and proper professional development, they may support students who can produce the skills and knowledge needed to be successful, and productive members of the global community. These skills initiate critical thinking and problem solving. Today's changes have broadened the opportunities and the number of careers pathways that students can choose from (Boone, 2006). These changes in agriculture are perpetual and present an evolution of change that will continue to affect businesses, institutions, and careers as we move forward (Thomasian, 2011).

A transformation of agricultural education could reestablish and sustain the historical position of agricultural education that builds a cornerstone to the future. For the stakeholders, scholars, and educators, professional development is needed to shape academic focus around a world economy which relies on agriculture for food, shelter, clothing, and energy. The 21st century agricultural education programs must have a more dynamic approach, one that presents relevant challenges to students, connects prior knowledge to enhanced problem-based learning instruction (VDOE, 2013), and where discoveries will lead to a sustainable future. In agricultural education, we must see a change in the way content is delivered. Educators must also explore content and collaborate with members of the community to integrate new content that is relevant to prepare students to meet the challenges of today's agricultural climate. New and emerging agricultural content must reflect how new trends impact business, industry, government, communities, consumer groups, and government policy (Bybee, 2013). The design of a new model for agricultural education should support STEM experiences that are enriched through an emphasis in team work, critical thinking, analysis, leadership, ethics, and research (Abell, 2007).

For this to happen a modern agricultural program may be designed to allow educators to deliver new and emerging agriculture content to their students.

John Dewey believed that education involved challenging students through real world learning experiences. Dewey's methodology and beliefs can be traced back to Thomas Jefferson, who believed that education should be afforded to every American for the citizens to be productive members of society. Dewey professed that education should ensure that students can contribute to the success of a democratic society. Through active engagements within their community, students can engage in social, political and economic decisions that will affect their lives (Dewey, 1938, 1945). Dewey believed that science was the vehicle that drives social, political, and economic progress. Dewey believed that students should interact with the world through self-guided activities that bring together and integrate hands on engagements. This can be found in all his writings where he contends that learning progresses through self-guided activities which connect relevant exploration of the real world (Dewey, 1945). In 2014, John L. Rudolph supported John Dewey's concepts of teaching science a century later. Rudolph points out that what Dewey articulated was the methods by which science produces dependable knowledge that builds a well-informed society (Rudolph, 2014). Building on the foundation of Dewey's concepts we can begin to formulate an educational model that focuses on student inquiry into new and emerging agricultural content and community engagements. Through problem solving and critical thinking students will advance through metacognitions that build on what they know (Huber & Hutchings, 2004; Rudolph, 2014).

The design of the agricultural education model is connected to the STEM movement in education to enhance the learning experiences and promote the implementation of the Next Generation Science Standards (NGSS). The Next Generation Science Standards are revisions in

science education that connects the natural sciences to practices of scientists and real-world experiences. These revisions integrate an understanding of science and methods used to develop new knowledge in the subject area. Students are introduced to crosscutting notions that connects science and engineering to disciplinary core ideas (Penuel, 2015). In agricultural education, the NGSS can be used in the educational model to explore solutions to current issues in the industry. Agricultural education courses, through focused integration of STEM, can support students in becoming more STEM literate and increase the likelihood that these students will consider a STEM-related career (Humphreys, 2005). There are many career pathways in agricultural education that promote STEM content. These career pathways include the following: Agribusiness Systems, Animal Systems, Environmental Service Systems, Food Products and Processing Systems, Natural Resources Systems, Plant Systems, Power, Structural, and Technical Systems. In the past twenty-five years, the most significant changes in agriculture and in science have come from the discoveries in biological technologies, which has a relation to all these pathways (Boone, 2006). Today much attention must be given to the rapid advances in technologies and engineering in the field of biological research and development; it also must be addressed in today's agricultural classroom.

Definition of Terms

For this study, the following terms are defined.

Agricultural Education: "Agricultural education teaches students about agriculture, food and natural resources. Through these subjects, agricultural educators teach students a wide variety of skills, including science, math, communications, leadership, management and technology"(NAAE, 2016).

Biotechnology: "means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use" (Education, 2016).

Community Viability: "a process that involves people working together in productive and non-exploitative ways in order to remove inequality and oppression to improve their collective condition of existence" (Bush, 2017).

Hybrid Online Learning: "activities take place as part of a larger in-person learning opportunity. These hybrid opportunities may use synchronous or asynchronous online tools, depending on the particular aims of the in-person sessions" (Bates, 2016).

Innovations: "An idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003).

New and emerging agricultural content: was identified in "A Strategic Review of Agricultural Education" (VDOE, 2013) as,

- global hunger
- demand on U.S. agricultural production, aided by genetics and biotechnology
- technological advances within all areas of agriculture
- food safety
- agricultural research, e.g., pharmaceutical application of agricultural products
- general health and well-being
- climate change and its effects on production and supply and demand
- water management
- alternative energy sources
- new businesses surrounding agriculture

- sustainability
- agricultural economics and finance
- global marketplace, global competition for agricultural products, and international trade
- agricultural engineering and new production equipment

NGSS: Next Generation Science Standards is a revision in science education that connects the natural sciences to practices and experiences in the real world. These revisions integrate an understanding of science and methods used to develop new knowledge in the subject area. Students are introduced to crosscutting notions that connects science and engineering to disciplinary core ideas (Penuel, 2015).

Online Professional Development: "Online professional development for teachers continues to grow in popularity, as schools and educators look for cheaper, more efficient ways to meet current needs and demands" (Bates, 2016).

STEM: Science, Technology, Engineering, and Mathematics, are integrated into an interconnected learning paradigm based on real-world applications.

Summary

The purpose of this case study was to determine how modern agricultural education programs may be designed and developed to support innovative agricultural content. The researcher focused on the planning theory of Cervero and Wilson, 2016, as well as Rogers' "Diffusion of innovations theory" (Rogers, 2003) for the theoretical framework of the research. This chapter has provided a background and setting, personal experience, theory, purpose and objectives, defining model development, and definition of terms. The study sought to identify a modern model for agricultural education, determine what type of changes are needed, how the

design needs to be organized, and how to determine if the program purpose is meeting the community needs. Chapter 2 will provide a review of the literature relevant to the model agricultural education program, both in context and relevance to current trends and issues and integrating innovative content into the curricula of secondary agricultural education.

CHAPTER 2

LITERATURE REVIEW

Agricultural Education Model

Chapter 1 provided a background and setting, personal experience, theory, purpose and objectives, defining model development, and definition of terms. The study assesses a modern program model for agricultural education, determines what type of changes are needed, how the design needs to be organized, and how to determine if the model is meeting the needs of agricultural education. The 21st Century has created a new focus on Career and Technical Education, in order to prepare students for the workforce and post-secondary education (Rayfield, 2012). "Students in today's culture must develop an variety of skills outside the narrow occupational skills focused on in historical CTE programs" (Rayfield, 2012). Modern agricultural education programs should be designed and developed to offer students the chance to obtain innovative content knowledge required to succeed in post-secondary education, and the workplace (Brand, 2013). The idea as careers change so do the innovations in CTE. The Perkins Act, and the U.S. Department of Education, released Investing in America's Future: A Blueprint for Transforming Career and Technical Education (Brand, 2013). The report offers four core principles for the future of CTE: Alignment, Collaboration, Accountability, and Innovation (Brand, 2013).

> *"Effective alignment between high-quality CTE programs and labor market needs to equip students with 21st century skills and prepare them for in-demand occupations in high-growth industry sectors; Strong collaborations among secondary and postsecondary institutions, employers, and industry partners to improve the quality of CTE programs; Meaningful accountability for improving academic outcomes and building technical and employability skills in CTE programs for all students, based upon common definitions and clear metrics for performance; and increased emphasis on innovation supported by systemic reform of state policies and practices to support CTE implementation of effective practices at the local level" (Brand, 2013).*

The agricultural education model for this study is set in a rural southwest Virginia comprehensive high school. The agricultural education program offers dual enrollment opportunities, which permit high school students to engage in college-level courses that result in both high school and postsecondary credit (Williams, 2018). The school is continuing to increase course offerings that provide coherent sequences of academic and technical content, many of which span high school and postsecondary education. The courses have been driven by a collaboration of the local school system, local government, local industry, community college, and the state land grant university. The educational strategy of the program follows Brand's recommendations to provide students with academic skills, technical skills, employability, and knowledge to pursue postsecondary training or higher education, which will lead them to enter a career field prepared to contribute to the local community (Brand, 2013).

Planning for Agricultural Education

It has been said that planning educational programs is a social movement in which the planners exchange personal and organizational views to develop content (Cervero & Wilson, 2006). In this case study the planners will be identified as the "teachers" who were given the opportunity to design and develop the innovative agricultural program. Many times, these teachers are influenced by the powers which have authorized the development of the programs, which leads to the question of whom the teachers are responsible to, the power or the participants of the educational program (Cervero & Wilson, 2006). To answer the concern of accountability, the argument must be made that the responsibility of the teachers is to be sensitive to the impact educational changes will have on the everyday world (Cervero & Wilson, 2006). Therefore, it is necessary for the power to be shifted to the teachers, in that they have the authority to make discretionary and structural decisions based on their perception of needs and the impact the

program will have (Cervero & Wilson, 2006). The teachers interest will drive the progress of the educational program development when it comes to making a judgment decision about the program (Cervero & Wilson, 2006). These decisions are driven by the demand of educational reform, where teachers are called upon to improve education through new and emerging content, and how this content is taught (Garet, 2001). The teachers must have the ability to connect innovative agricultural content, and develop forward-thinking and problem solving in the classroom (Garet, 2001). Therefore, teachers hold a unique disposition in the planning of an innovative program model. Teachers often recognize the contingencies, dilemmas, ambiguities, challenges, and opportunities of working with others (Cervero & Wilson, 2006). This is sometimes overlooked in the development of innovative program planning in education (Cervero & Wilson, 2006). The planners who design and develop educational programs must do so while paying attention to the educational, social, and political outcomes in order to address the best interest of those who will be served by the program (Cervero & Wilson, 2006).

Planning for Innovations

Rogers (2003), can be used to guide planners in the development of innovations which contributes to the design of an educational model. According to Rogers, the diffusion of innovations is made up of four elements, the innovation, the communication channels, the time, and the social system in which they are introduced (Rogers, 2003). The communication channel is the means in which an innovation is delivered, in this case an educational model for secondary agricultural education (Rogers, 2003). This includes a process where contributors generate and share data with one another to reach a collective understanding of an innovative agricultural education program (Rogers, 2003). The time opportunity is complex in diffusion, which is dependent on three factors, innovation-decision process, innovativeness, and rate of adoption

(Rogers, 2003). "*The innovation-decision process is the psychological process through which an individual or group passes from first understanding of an innovation to establishing an assertiveness of the innovation, which leads to adoption or rejection, to implementation, and to ratification of this decision"* (Rogers, 2003). In the case of this study, it has taken ten years to develop and to implement the innovativeness and content to full scale . Innovativeness is the point which an individual or group adopts the innovation earlier than other members of a social system (Rogers, 2003). The rate of adoption is the time in which an innovation is adopted by members of a social system, and is usually measured as the number of members that adopt the innovation over a period of time (Rogers, 2003). The social system is defined as a set of interconnected units that are engaged in cooperative problem-solving to achieve a common objective (Rogers, 2003).

Rayfield (2012), set out to identify characteristics of innovative agricultural education programs for the future. The programs that were selected in his study were identified as groundbreaking in their methods of classroom teaching, supervised agricultural experience, and FFA participation (Rayfield, 2012). The objective of the study was to:

1) Describe what an innovative agricultural education program will look like in 2020.
2) Describe the purpose, mission, and objectives of an innovative agricultural education program in the future.
3) Describe the components/characteristics of an innovative agricultural education program in 2020.
4) Describe the people involved in innovative agricultural education programs in the future. (Rayfield, 2012)

There were a total of 142 programs identified by the stakeholders, Thirty-five programs agreed to submit their innovative program activities (Rayfield, 2012). From the thirty-five programs, fifteen were selected based on criteria for innovative agricultural educational programs. The criteria the researchers used to define an innovative program were ones which: 1) Used

innovative technology, 2) had a creative context for teaching agricultural education, 3) delivered content to new/unique audiences, 4) had a unique setting for delivering their agricultural education program or 5) had a highly specialized training program, e.g., certified vet-tech, certified welders, or meat processing facility (Rayfield, 2012). The study was completed using three questionnaires. The first-round questionnaire produced the following summary:

> Question 1. This question produced fifteen categories, which included*, "use of current technology and rigorous classroom/STEM integration were the two categories that were mentioned the most. (Rayfield, 2012).*
>
> Question 2. This question produced twelve categories which included educating the students through collaborations with parents and the community (Rayfield, 2012).
>
> Question 3. This question produced twenty-four categories, which included the use of current and new technologies, hands-on experiences, input from stakeholders both from the community and from industry (Rayfield, 2012).
>
> Question 4. This question produced fifteen categories which identified all persons who needed to lend an input from inside and outside the agricultural education program (Rayfield, 2012).

The second and third-round questionnaires produced the following summary. The findings were that innovative programs in the year 2020 will be highly technological and current with trends in the agriculture industry (Rayfield, 2012). The results also indicated that innovative programs will need to rely on "*community and industry partnerships, stay current with technological trends, teach students using hands-on experiences and community projects, and be willing to adjust and change to meet the needs of agricultural industry*" (Rayfield, 2012). These finding support the case study model and identifies key elements found within the structure of the model.

Community Viability

Cervero and Wilson 2006, and Roger 2003, focus on the ultimate outcome of innovative educational planning and the expected impact the program will have on society. When planning an innovative agricultural program, consideration should be given to the impact and contributions the program will have on the local community (Cervero & Wilson, 2006; Rogers, 2003). Planners of an innovative educational program must be able to identify how the design of the program will contribute to the viability of the community. Many federal and state education policies do not take into account rural communities educational needs and focus more on the urban model educational needs (Fishman, 2015). The policies set through the eyes of urban needs tend to be "innovation killers" for the rural communities (Fishman, 2015). To identify content needed for community viability, the planners must explore the needs afforded by: astute leadership, community sentiment, community vision, and sustainable infrastructure (Bush, 2017). Astute leadership comes from those who serve as local government officials, members of the community, industrial representatives, local groups, and other leaders who contribute in making key decisions, which affect the community (Bush, 2017). The teachers must understand community sentiment which incorporates enthusiasm, tradition, heritage, identity, and cultural competency (Bush, 2017). Through an understanding of the sentiment of the community, a vision for sustainability can be recognized. "Community vision includes goals, investment in the future, long-term planning, and strategic thinking" (Bush, 2017). Community vision should be a part of the strategic planning, designing and developing of innovative agricultural education programs. The programs using the community vision can customize content to ensure students who wish to stay in their community, and those who leave and return have an appropriate career education experience in high school (Fishman, 2015). Innovative agricultural education

programs should capitalize on the sustainable infrastructure of the community to build their programs (Croom, 2010). Community viability is dependent on the input of members of the community and the educational programs which are developed to sustain the community. Program planners must seek the input of all stakeholders in the community, from science teachers, extension agents, agricultural sales representatives, industry representatives, and local policy makers (Croom, 2010). When communities get involved in the content of agricultural education programs, they become stronger and student opportunities within the community unquestionably develop (Stachler, 2013).

Local Partnerships with Agricultural Education

Modern agricultural education must meet the needs of the community in supplying a workforce and the leadership needed to sustain the future of the community. To determine these needs the agricultural education teacher must establish an advisory committee which provides direction for the program (Foster, 2015). Agricultural teachers need to learn early in their careers that to be effective in their teaching they must provide a dynamic experience for their students (Alston, 2010). These experiences are gained through networking with resources outside the typical classroom setting, professional relationships give the teachers content and opportunities for student to engage in relevant hands-on learning (Alston, 2010). Foster explains in his study that there is a disconnect between schools and their communities, and states that the community members often refrain from reaching out to guide the schools as to the needs of the communities (Foster, 2015). This means that students will not have the skills the community is looking for to meet the workforce needs. The establishment of an advisory committee will bring the community and agricultural education together to set goals for the program (Foster, 2015). Advisory committees are nothing new, programs eligible for state and federal funding through the Carl D.

Perkins Career and Technical Improvement Act, must have an advisory committee (Foster, 2015). Even though these advisory committees are required, research has shown that their use varies from program to program (Foster, 2015). The success of the program in supplying the needs of the community is dependent on knowing those needs, and the best way of knowing is through an open dialog with the community.

Agricultural Education Teachers

Teaching is an art that is perfected over time, it is a skill that requires a certain type of person, who is willing to commit to long hours, both in and out of the classroom. Agricultural education teachers have historically taken great pride in teaching production-based content, and this is how they identify with themselves (Shoulders & Myers, 2011). Agricultural education teachers have entered the profession based off some prior experience or some inbound passion for the agricultural industry (Shoulders & Myers, 2011). These teachers may enjoy teaching hands-on activities or through some tactile lessons, and these skills are integrated into their teaching identity (Shoulders & Myers, 2011). Integrating new content will cause initial conflict with the teacher's identity and they will hesitate to engage in content which conflicts with their identity (Shoulders & Myers, 2011). In order to remove this hesitation of the teachers, continuing professional education must appeal to the teachers in a way that does not impede on their professional identity (Shoulders & Myers, 2011). Agricultural education teachers are expected to expand their skills through established means of continuing professional education to improve student learning (Shoulders & Myers, 2011). Today, secondary agricultural education teachers are reaching over 650,000 agricultural students in secondary agricultural education (Organization, 2015). These students are facing a different world, where new and emerging content is evolving quicker than textbooks and relevant content can be distributed (Rienties,

2013). To design an innovative program that delivers relevant new and emerging content, teacher input is vital. The views, attitudes, and commitment on the teacher's behalf are dynamic in shaping whether a teacher will use the innovations in their pedagogy (Stachler, 2013). Teachers must connect socially while interacting with others when engaging in continued professional education that involves new innovations (Shoulders & Myers, 2011). With a focus on a new innovative agricultural education model, teachers should gain a more in-depth understanding of changes in agriculture while helping to better understand how students will react to the new content (Shoulders & Myers, 2014). Time involved in continued professional education is also a factor that contributes to a change in a teacher's pedagogy. Continuing professional education needs to initiate a teacher's behavioral change through concentrated practices which are continual over a sufficient period of time (Shoulders & Myers, 2014). According to Shoulders and Myers (2014), there is not sufficient evidences to indicate the amount of time required for effective continued professional education but suggest, "activities that are spread over a semester and includes 20 hours or more of contact time", have positive results (p. 170). Penuel (2015), described continued professional education for science-based instruction as taking place over a period of two years, with multiple instructional sessions for teachers. During the two years of the study, teachers were engaged in hands-on, problem-based instruction. Teachers were given the opportunity to gain insight into how students, "gain experience with how cycles of developing sharing models, conducting investigations, and revising models to respond to peer critiques are integral to science learning" (p. 2-3). Through continuing professional education not only do teachers gain insight into how students could benefit, they are able to enhance their identity as agricultural educators (Shoulders & Myers, 2011).

Professional Development in Agricultural Education

To successfully implement an innovative agricultural education program, continuing professional education will be essential for current educators (Boone, 2006). Professional development cannot directly change performance or views, but it can lead the way by communicating goals, inspiring programs and teachers toward goals, and reducing conflicts among the guiding principle faced by all teachers (Rhoton & Shane, 2001). Professional development programs when introduced will need to be compatible with current instruction in agricultural education. By being compatible with the current content in agricultural education, the innovative content will be more familiar to the educators (Rogers, 2003). No changes can be made, nor will those changes be lasting unless they are a complete buy in by the teachers (Rogers, 2003). Getting the teachers on board all at once will require an instrument or tool, that makes the changeover seamless and safe for the teachers (Lester, 2003). The easier it is for agricultural teachers to see the results of implementing the new model, the more likely they are to adopt it (Rogers, 2003). Today, continuing professional education is very much needed to keep educational content moving forward, and it would seem impossible for teacher education programs to deliver all the content knowledge needed to make the changes in the paradigm, and even harder to reach teachers in the field (Bates, 2016). There are numerous resources available today, but those resources are hard to find and consolidate (Bates, 2016). Teachers need to find and select the content areas that support their local programs (Bates, 2016). Research has shown that a continual and concentrated continued professional education has a greater chance of delivering a change in the teacher's pedagogy than that of a short workshop or programs (Shaha, 2016). Continuing professional education increases the learning possibilities of teachers if used effectively (Rienties, 2013). As students have changed their means of communication and

learning through social tools like Snapchat and Twitter, teachers must adjust to new learning environments. By engaging in different types of continuing professional education, teachers will become more and more acquainted with different means of social communications (Rienties, 2013). Today's world is evolving ever so quickly, and discoveries with new and emerging agricultural implications are occurring quicker than can be communicated through traditional methods (Rienties, 2013). Teachers must be able to communicate in ways that are often new and unfamiliar to them, and that they need the content knowledge necessary to support them to guide their students' intellectual understanding of the content (Rhoton & Shane, 2001). Continuing professional education must build on teacher's current knowledge and practices, familiarizing them to new content and approaches that permits them to expand their knowledge and build their pedagogical content knowledge (Shulman, 2005). Research has shown that continuing professional education works well to develop teaching skills, as individuals become acquainted to new technologies and skills, the continuing professional education needs to provide a relaxed and non-threatening atmosphere where individuals have time to plan implementations into their programs (Smith, 2012). According to Westfall-Rudd (2011), in the expansion of a continuing professional education program, teachers should perceive it as being self-driven and facilitated, which develops a sense of ownership for the teacher. It is this sense of ownership that builds the educators individuality, which qualifies them to become part of the continuing professional education (Prestridge & Tondeur, 2015). This form of proprietorship in a continuing professional education program reassures teachers who are engaged to pay attention to different methods and try new philosophies that may develop a change in student learning (Lester, 2003).

Students in Agricultural Education

Agricultural education for the 21st century is changing, and this will require a change in the way students learn about new innovations in agriculture. With the onset of the 21st century there has been a push for agricultural education teachers to ramp up the educational experiences for their students to meet the needs of a changing world (Wilcox, 2014). Whether it is inquiry-based, problem-based, or lessons that requires students to find solutions to some proposed problem, the way agricultural lessons are delivered must change (Wilcox, 2014). The expectation of student performance is driving the push for innovative and challenging teaching and learning methods in the agricultural classroom (Wells, et al., 2015). Problem-based teaching skills encourage student's curiosity and by working together build the student's problem solving and soft-skills (Wells, et al., 2015). Research has shown that students scientific reasoning ability increases in programs where problem-based instruction is used (Wells, et al., 2015). Problem-based instruction strengthens the students interest in agricultural content, their interest in learning and provides a higher level of thinking (Wells, et al., 2015). Agricultural education students are an important part of the Science, Technology, Engineering, and Mathematics (STEM) workforce of the future (Mueller, Knobloch, & Orvis, 2015).

Students who enroll in an agricultural education course expect to engage in hands-on learning activities. Problem-Based Learning and the current methods for teaching innovative agricultural content gives students that opportunity with a new twist (Wilcox. 2014). According to Wilcox (2014), it was recommended that curriculum innovations incorporate FFA, SAE, and classroom instruction (p. 26). Wells (2015), notes that current research does not correlate the connection of FFA and SAE, with problem-based instruction (p.177).

Summary

This chapter provided an examination of the literature to support the case study of an innovative agricultural education program in one rural community, and how that model can be localized to meet the needs of other agricultural education programs. Through the eyes of Cervero and Wilson (2006), the organization of educational planning takes form through understanding the outside influences and the potential outcome of the program. The review also explains how " Diffusion of Innovations" (Rogers, 2003), applies to program planning used to facilitate innovative planning for secondary agricultural education. The need for agricultural education to integrate and address changes in the industry must be reflected in the classroom. Educators must be prepared to assist students to recognize and comprehend the fundamental workings of innovations which are crucial in their educational enrichment (Herschbach, 2011). The review indicated that innovative programs will need to rely on "community and industry partnerships, stay current with technological trends, teach students using hands-on experiences and community projects, and be willing to adjust and change to meet the needs of agricultural industry" (Rayfield, 2012). When communities get involved in the content of agricultural education programs, they become stronger and student opportunities within the community unquestionably develop (Forest, 2010). Teachers must be able to introduce new content, instructional resources, and improve their academic knowledge (Wilson, 2013). This will require that professional development should be focused on building teachers' assurances and self-confidence in the innovations (Prestridge & Tondeur, 2015). This can be achieved by educators perceiving professional development as being self-driven and facilitated and leads to developing a sense of ownership (Westfall-Rudd, 2011). This literary review suggests that there are many inputs in the development of an innovative agricultural education program. In Chapter 3, the

methods of this case study will be presented with hopes of establishing a protocol that will enhance the development and replication of the innovative agricultural education program.

CHAPTER 3:

RESEARCH DESIGN AND METHODOLOGY

The purpose of this case study was to determine how modern agricultural education programs may be designed and developed to support innovative agricultural content. The researcher focused on the planning theory of Cervero and Wilson (2006), as well as Rogers' "Diffusion of Innovations Theory" (Rogers, 2003) for the theoretical framework of the research. The following questions were used to recognize how modern agricultural education programs may be designed to support innovative agricultural content:

1. How do members of the case study perceive innovative agricultural content?
2. How could the design of an agricultural program support community viability?
3. What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?
4. How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program.
5. How has participation in professional development contributed to the innovative agricultural content of this program?

Rationale for Design

This case study is descriptive in nature, as it sought to shed light on the inputs of how modern agricultural education programs may be designed and developed to support innovative agricultural content. A case study tries to resolve why and how a decision or set of decisions, were made, how they were put into practice, and what the outcomes were (Yin, 2014). This study used a qualitative approach to examine the phenomenological views of the contributors of the

development of the innovative agricultural education in a rural community in Southwest Virginia. The study sought to gain an understanding of lived experiences and the individual's perspectives and views of the innovations related to secondary agricultural education (Rossman & Rallis, 2012). "Qualitative methods can be used to obtain the intricate details about phenomena such as feelings, thought processes, and emotions that are difficult to extract or learn about through more conventional research methods" (Corbin & Strauss, 2008, p. 11). The data were collected by means of interviews conducted with stakeholders involved in the development of the program. *"Qualitative research is characterized not using statistical tenets, but by the use of text to document variables and the inductive analysis of the data that was collected"* (Hittleman & Simon, 1992, p. 65). The interviews were collected using a purposeful sample which was deliberately selected from individuals who participated in the development of the innovative agricultural education program (Hittleman & Simon, 1992). By sampling these stakeholders, the populace was used to represent the entire population which increases the representativeness and the validity of the research (Corbin & Strauss, 2008). As this was a single case study, and is unique in its design, skepticism to the validity is circumvented, and empirical artifacts are presented to triangulate the case study. By presenting artifactual evidence of the innovative agricultural program, data triangulation assisted in strengthening the validity of the case study (Yin, 2014). Triangulation denotes the deliberate use of multiple methods, with offsetting or counteracting biases, in the inquiry of the same phenomenon to reinforce the validity of the case study (Greene, 2007). Through the use of multiple sources of data, and representing multiple periods of time in the design and the development of the innovative agricultural education program, a clear picture of the steps taken to reach the model can be

presented (Rossman & Rallis, 2012). This type of triangulation helps to ensure that the study represents the complexity of the innovative program (Rossman & Rallis, 2012).

Population Sample

The population sample came from stakeholders involved in the development of the innovative secondary agricultural education program. An invitation requesting participation in the study was sent using the contact list of stakeholders (n=30). The list of stakeholders was populated from a developmental time line of the program, which provided input into each step of the design and development of the program (See Appendix A). Invitational emails, as well as follow-up emails were sent two weeks following the original emails, to stakeholders who were involved in the design and the development of the current agricultural education program at the Southwest Virginia High School (See Appendix B). A total of thirty invitations were sent and twenty-four subjects responded and agreed to participate in a fact-finding interview. Of the twenty-four respondents, twenty-one interviews were conducted, where participants identity was concealed using pseudonyms. Three respondents withdrew prior to the interviews. One subject was away at college and was inaccessible due to scheduling conflicts, and the other two withdrew for medical reasons. This resulted in a data collection of 70% of the original pool of stakeholders, and an 88% collection of the respondents. The invitations sought to find participants who contributed to the development of the program. The participants represented educators, researchers, university faculty, local government, industry leaders, former students, parents, school administration, and community college personnel. See table 3.1

Population Sample Demographics			Table 3.1
Pseudonyms	**Position Held**	**Years Involved**	**Number of Years Assoc**
April	Community College Admin	2007- 2014	7
Austin	County Administrator	2007-2015	8
Betty	Parent	2017-2018	2
Carl	Wholesale Fruits and Vegetables Dealer	2007- Present	11
Daniel	Agricultural Education Teacher	2014-2018	4
Elmer	Former Student	2010-2012	3
Eric	Administrator	2007-2017	10
Fred	Wholesale Fruits and Vegetables Dealer	2007- Present	11
Garnett	Former Student	2010-2012	3
James	Community College Admin	2013-2017	4
John	Extension Research Specialist	2007- Present	11
June	Secondary Science Teacher	2015-Present	3
Kate	Secondary Science Teacher	2007-Present	3
Lauren	Assistant Professor	2014-Present	4
Luke	Professor	2009- Present	9
Matt	Administrator	2007-Present	11
May	Farm Bureau Representative	2007- Present	11
Ophelia	Extension Associate	2013- Present	5
Ralph	Administrator	2007- Present	11
Renee	Former Student	2010-2012	3
Wesley	Agricultural Education Teacher	2009-Present	9
Total 21			

Instrumentation

This qualitative research used interviews to seek descriptions of and to find meanings to the design and development of this innovative agricultural education program. To create a solid foundation to support the primary purpose of the study an a Priori Table was used to link data collected to propositions (Yin, 2014) (See Appendix C). The main task was to understand the meaning of what the interviewees said (Kvale, 1996). This technique provided ways of discovering and interpreting aspects of reality, through interviewing, documenting, and analyzing to capture and represent the richness, texture, and depth of the stakeholders life experiences with the topic (Rossman & Rallis, 2012).

Data Collection

Once the sample population was identified, they were contacted and provided a copy of the informed consent to review prior to the interview. At the beginning of the agreed meeting time, prior to the interview the interviewer and the participants discussed the purpose of the interview activities. The interviewer provided the participants with an informed consent form hardcopy, which explained the nature of the interview, and required the signature of all parties involved in the interview (See Appendix D). The interviewer prepared a protocol, which was used as a guideline during the interviews (See Appendix E). The questions were used while interviewing each participant, and each question was asked in the same order for each person interviewed. Each interview was recorded and transcribed using pseudonyms to protect the identity of the individuals interviewed. Open ended questions were asked to allow the participants the freedom to express their individual experiences. This allowed the researcher the latitude to modify the interviews based on the responses while staying within the framework of the research question. The interviews were approximately 45 minutes. This provided the researcher with comparable data to transcribe and analyze.

Artifacts

The collection of secondary data was collected to triangulate and support the study. This included documentation of professional recognition of the program through multiple sources, publications and conference presentations, student successes and projects, academic programs and community outreach. According to Yin (2004), the most important advantage of using multiple sources in data collection is the uniting evidence of the inquiry. “Thus, any case study findings, or conclusion is likely to be more convincing and accurate if it is based on several different sources of information, following a similar convergence of evidence” (p. 120).

Analysis of Data

With the conclusion of the interviews, and collection of the artifacts, each interview was transcribed verbatim. The respondents provided explanations as well as personal views toward the development and design of the current program, as well their perceptions of the needs of a modern agricultural education program. Each interview was transcribed and then forwarded to the participants for review. The participants were given the opportunity to respond or correct any information that they deemed incorrectly represented what they intended, or they could add any information that may have been inadvertently overlooked or was remembered by the participants following the interviews. The transcripts were then updated, and the changes were made to reflect the desires of the participants. After transcriptions, the documents were visually analyzed in search of words, phrases, or sentences that indicates a visual significance or of analytical interest to the researcher (Corbin & Strauss, 2008). A list was compiled of the words to find meaning and interpretations related to the research. Coding was used to quantify reoccurring themes to gain a deeper consideration into the meaning of the topic (Trochim & Donnelly, 2008). The numbers derived from the coding were used to recognize the similarities which opened relationships between the respondents and shed light on the phenomenon being studied. The identification of relationships found in the population responses presented patterns shared by the respondents, which lead to a common theme to support the role of agricultural teachers, professional development, support of program, curriculum, and expected outcome for the students in an innovative secondary agricultural education program. The data collected identified key quotations that related to the design and development of the agricultural education program, and categories related to the research topic were listed to delineate the properties of the quotes. The open coding resulted in twenty-eight codes utilizing Atlas.ti8 to manage the frequency of

each code or category. From the twenty-eight codes, early codes revealed five categories of interest: Teacher's Role, Professional Development, Support of the Program, Program Curriculum, and Expectations of the Students. The remaining twenty-three coded concepts pointed to the five categories, as well as some properties and dimensions directly related to the phenomenon of an innovative agricultural education program. Open coding was completed, followed by axial coding. The codes were reflective of the program and began to explain the relationships found within the data (Charmaz, 2006). By associating data to data, axial codes were formed to assist the researcher in grouping like codes and refining them into larger sets of categories (Charmaz, 2006). This assisted the researcher in bringing all of the information together and determined the themes created from the research questions (Corbin & Strauss, 2008). The researcher was able to tie the relationship of categories together which helped tie the sub-categories together (Charmaz, 2006).

The artifacts collected were organized according to the timeline of events, from oldest to the most recent. The program maintains a Facebook page which served as a chronological history of events and happenings in the program and was used to develop the timeline presented in Appendix A. There were several newspaper articles, three TV news media coverages, an RFD TV media segment on the STEM Laboratory, two conference presentations, the high schools program of study catalog, several posters presenting research conducted in class projects by students, and awards received by the program. These artifacts were compared to the data transcribed to verify and support details of the data collected. The content was then merged to report the findings in Chapter 4. Every effort was made to find artifacts which demonstrated convincing evidence of the phenomenon being studied (Yin, 2014).

Reliability and Dependability of the Research

Meaning from this research should be reliable and dependable due to the procedures used to ensure that full disclosure of the methods, cross references, and interpretations of the data collected (Hittleman & Simon, 1992). The interviews were conducted beginning on January 23, 2018 and concluded on February 12, 2018, to help establish truth claims of the qualitative methods (Rossman & Rallis, 2012). Participants were be able to elaborate, correct, or discuss their interview transcripts as a way for prompting further information about the analyses (Rossman & Rallis, 2012). This allowed the sample population the opportunities to correct any miscommunications and added validity to the research study. Triangulation of data also helped to insure the validity of the study by using the evidence produced by the artifacts to support the phenomenon. The researcher used analytic tools presented by Strauss and Corbin (1998), to recognize any "bias" which may have red flagged the data being reported (p.89).

During the course of this project, the researcher made a considerable amount of efforts to be reflexive about how he was positioned in relation to the phenomenon. The researcher in this case study has served as an agricultural education teacher in the program, and it was the researchers interest in the program that drove this study. According to Strauss and Corbin (1998) any attempt to remove all "bias" from the study is not possible. However, every attempt and precautions were taken for the researcher to step back during the analysis to give the participants account of the phenomenon (p.97). The researcher was exceptionally careful to articulate and use the analytic tools presented by Strauss and Corbin (1998, p.89) to interpret the data. As the researcher, it was his intent to explore the programs design and development through the lived experiences of the participants, and those experiences interpreted through complex cognitive analysis to remove any bias (Rossman & Rallis, 2012, p.34).

Summary

This chapter has looked at the instrumentation, artifacts, and methods used to conduct the case study to determine how modern agricultural education programs must be designed and developed to support innovative agricultural content. The case study used a qualitative approach to examine the phenomenological views of stakeholders and artifacts collected to support the innovative program design. This qualitative study used interviews that sought to describe and find the meanings of how modern agricultural education programs may be designed and developed to support innovative agricultural content. Open ended questions were asked to allow the participants the freedom to express their individual experiences. This allowed the researcher the latitude to modify the interviews based on the responses while staying within the framework of the research question. The identification of relationships found in the populations responses and artifacts have presented patterns, which have led to a common theme to support how modern agricultural education programs may be designed and developed to support innovative agricultural content. Meaning from this case study should be reliable and dependable due to the procedures used to ensure that full disclosure of the methods, cross references, and interpretations of data collected. The results are presented in a manner which others might be able to use to produce further research and prepare secondary agricultural educators to design and develop a localized innovative agricultural education program.

Chapter 4

Results and Findings

Introduction

The purpose of this case study was to determine how modern agricultural education programs may be designed and developed to support innovative agricultural content. The researcher focused on the planning theory of Cervero and Wilson (2006), as well as Rogers' "Diffusion of Innovations Theory" (Rogers, 2003) for the theoretical framework of the research. The following questions were used to recognize how modern agricultural education programs may be designed to support innovative agricultural content:

1. How do members of the case study perceive innovative agricultural content?
2. How could the design of an agricultural program support community viability?
3. What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?
4. How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program.
5. How has participation in professional development contributed to the innovative agricultural content of this program?

Context for the Study

The High School in this case study is a rural Southwest Virginia, comprehensive high school that provides students with the opportunity to enroll in career and technical education programs while pursuing either an advanced or standard diploma along with dual enrollment courses through the local community college (Williams, 2018). In recent years there has been a push for students to earn an Associates in Science degree while attending high school (Leonard,

2018). According to Daniel, a secondary agricultural teacher at the high school, the push has placed pressure on the school's Career and Technical Education programs to recruit advanced studies students into their programs by offering dual credit courses. Considering the current climate of change in agriculture, whether it is the advances in technologies, both mechanical and biological, or is simply filling the needs of the industry, through job placement, the need for secondary agricultural education programs to modernize and attract students into their programs is imperative. This program over the past ten years has worked with various resources to design and develop what is considered an innovative program, this according to the Virginia Mathematics and Science Coalition (VMSC), who named this program as the winner of the 2017 Programs that Works Award. VMSC stated that this program represents an innovative, exemplary program that has proven effective with students and teachers, demonstrated the important mathematics, science, and STEM concepts, skills and processes learned because of the program; and documented the impact on teaching and learning. A program that can address changes in the industry and provides students with the content knowledge needed to be productive members of society at all levels of entry. Key resources added to the program have included a working land laboratory (See Appendix F) which includes, a research area for field trials with row crops, three high-tunnel greenhouses, a livestock production area with a modern cattle handling facility, an outdoor classroom with a whiteboard and bleachers, and a Natural Resource Management area, with standing timber and flowing streams. The latest addition to the program was a STEM Laboratory, designed specifically for agricultural education, and believed to be the first of its kind in the Nation. The program also maintains its traditional classrooms, shops, and greenhouse. The program is served by three, 11-month personnel, and one, 10-month STEM Lab Manager. Students served by the program are grades 9th through the 12th. The

program currently offers four pathways for the students to choose from, Natural Resources, Horticulture & Greenhouse, Agricultural Production, with dual enrollment offered in Agricultural Fabrications and Technologies, and Agricultural Science. The Agricultural Science pathway offers two dual enrollment courses in Veterinary Science and Biotechnology (Williams, 2018).

Data Collection

The primary data collected represents responses to open ended questions asked during scheduled fact-finding interviews with the twenty-one participants. The interviews were intended to acquire the reflective perception of the innovative agricultural education program at the southwest Virginia high school. The questions used during the interviews explored the respondent's insight of the perceived program design and development through their lived experiences with the program. Early coding of the respondents presented five areas of interest for the case study: Role of the Agricultural Education Teacher, Teacher Development, Support for the Program, Curriculum Development, and Expectation of Students. The structure of this case study is un-sequenced, in which the sequence of the data assumes no particular order of importance, and is primarily descriptive in nature (Yin, 2014). Secondary data was collected in the form of artifacts to support the design and development of the innovative program. The artifacts were used to triangulate the data analysis.

Content Analysis

Upon the completion and review of open and axial coding, a diagram was developed to determine the relationships of the five categories to the remaining twenty-three codes. The diagram seen below in Figure 4-1, gave the researcher the ability to analyze each code to

delineate the properties along with their dimensions. This provides the foundation for a model created during the analysis of the data (Corbin & Strauss, 2008 p.229).

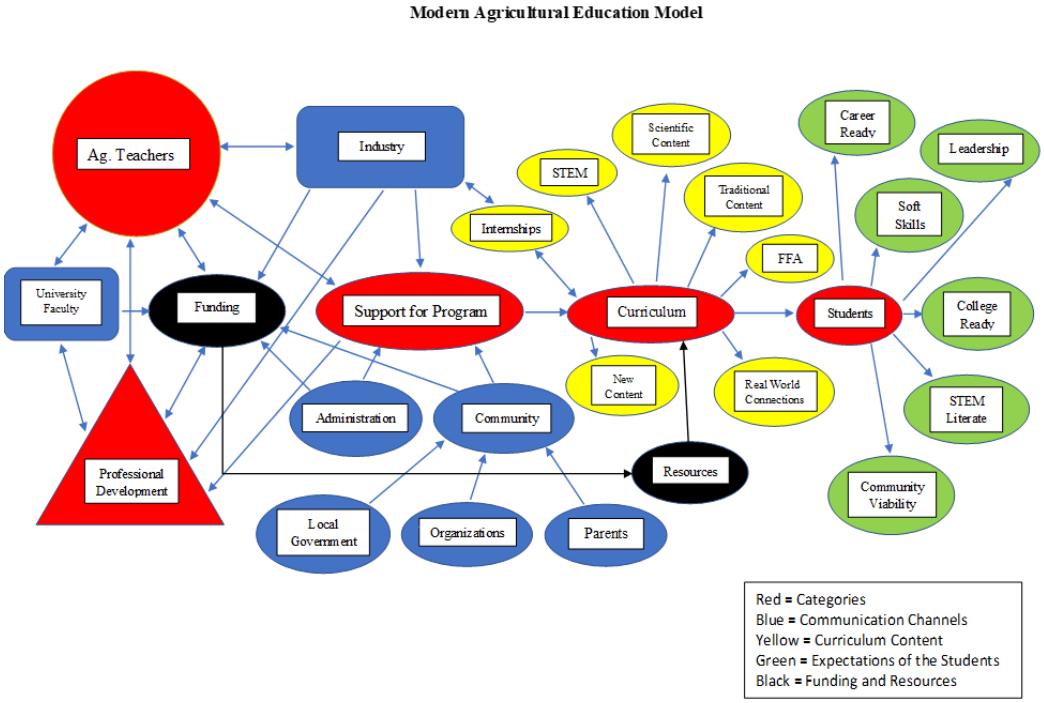
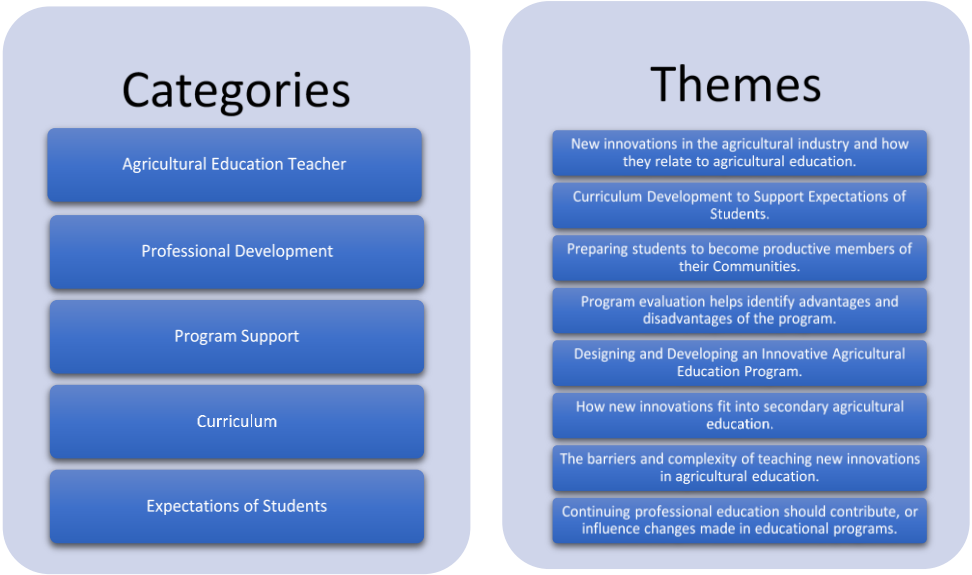


Figure 4-1

The following emerged from the analysis of the data collected, which produced initially produced five categories and eight themes presented in Figure 4-2. A ninth theme emerged in the finial anaylsis dealing with social concerns surrounding teaching new innovations.

How do Members of the Case Study Perceive Innovative Agricultural Content?

Figure 4-2



Theme: New innovations in the agricultural industry and how they relate to agricultural education.

Different perspectives shared during the interviews challenged the assumptions of the study, where each participant shared their views of new innovations and what was relevant in today's agricultural classroom. Ophelia explains from her perspective, that when she thinks about new innovations, she doesn't give the innovations much thought because she accepts the idea that all agricultural education teachers should be covering the new content. She explains that she has a much deeper concern for new innovations:

> I don't think it is the innovations as much as it would be the concepts, that have become really politicized, and the students need the ability to talk about things in an informed way. You know focusing on the science, understanding that some of these topics like GMO's for example, might be really charged… The key for them, is to communicate the message in a non-threatening or non-controversial way...

Daniel, a secondary agriculture teacher was asked if there were any new innovations in agriculture that he saw as relevant for students to learn in a high school program. Daniel's focus was primarily on the new content related to science in agriculture. His response states:

> I think that microbiology is the new frontier, …The fact that the state university, is now placing more emphasis on food safety in its food science program ...To me this is an indication that this is one sector of agriculture that is really growing, and really a new frontier.

Wesley is another agricultural teacher, and when asked the same question replied by saying:

> I think that anything that is technology driven needs to be taught, I like to say it is a dovetail between traditional agriculture and new technologies. You know a new

> technology within itself, is useless if you do not have a fundamental understanding of agriculture and applying it. A drone as nifty as they are, without a purpose is a whole lot like a toy. To me that is what really excites our kids, you know we could show them all kinds of nifty stuff in the STEM lab or at the middle school, but when they get their hands on whatever we are talking about or producing something or seeing an experiment come to life, they really get excited and learning becomes fun for them.

Renee, a former student of the high school program, and a recent graduate student from the state university with a master's degree in an agricultural related field, was asked if new innovations needed to be addressed in secondary agricultural education.

> So, for an agricultural education program to not focus on new technologies and new ways of farming and producing food, it is doing a disservice, not only to students, but to the agricultural industry, because today's agricultural students are our future leaders... Students must have a realistic view and understanding of how they are going to feed a growing population by the year 2050.

These responses represent the position that many of the other participants shared, and are shown in Table 4.1, for the expectations for students at the end of their secondary agricultural program.

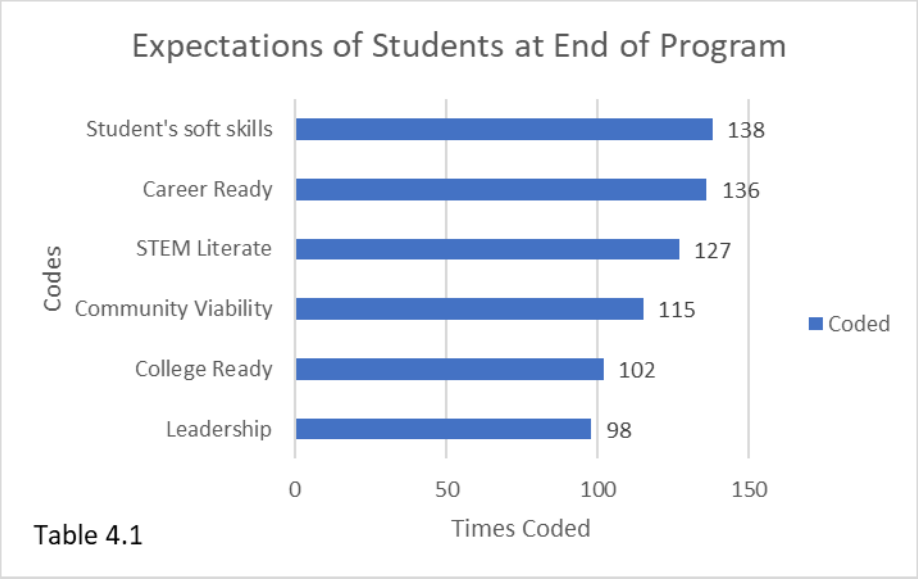


Table 4.1

The changes are allowing the students to take ownership of their learning. Eric, an administrator in the school system described it this way:

> Oh man, the changes in the program and the addition of the STEM Lab, is the best thing I have seen in my whole life as far as getting kids engaged, they are not just thinking about learning, they are doing the learning, and that is huge... Seeing the kids engaged and asking questions and performing things that seem unimaginable for high school students.

Another way the program is addressing soft skills and career readiness is through a recently added internship program. The internships have given both the teachers and the students the opportunity to network within the community. The students are excited and are developing their professionalism through blending and integrating a variety of skills in a real-world setting. The internship program was developed in a collaboration led by the state university, with the high school, local businesses, farmers, and community college. Funding for the interns was gained through a USDA, NIFA, Secondary Education, Two-Year Postsecondary Education, and Agriculture in the K-12 Classroom Challenge Grants Program (SPECA). Another goal of this

grant was to develop a sequenced pathway for biotechnology and food safety (LeBeaux, 2018). Through the development of this goal, opportunity for students to develop STEM Literacy was integrated into the content. The STEM movement began in 1989 with the "Science for All Americans" initiative (Rutherford, 1990), which was based on the thought that all Americans should be literate in Science, Technology, and Mathematics. It was through this initiative that the United States began its crusade to prepare students to be STEM literate. Since that time, STEM has been the driving focus of modern education. Austin, a county government official for several years, was involved in finding the USDA funding for the program's STEM Laboratory, said that:

> You can end up teaching every single aspect of agriculture or life, through the utilization of STEM in the agriculture program… If that is taught along the way, then agriculture has a relevance far beyond any other curriculum in the high school setting, in the community college setting, or the university setting.

The data identified the need for students to be STEM literate and able to use concepts from science, technology, engineering and mathematics to understand complex problems and to innovate with others to solve them. To address this need June said, "that the student enrolled in the courses taught in the STEM Laboratory were assigned groups and given problems to solve. The teacher makes these assignments a semester long project where students are able to demonstrate their STEM proficiency and problem-solving skills".

Community viability was coded 115 times. The participants presented the idea that by connecting an innovative modern agricultural education program with the community, not only could you prepare students for careers in their community, but the program could be used as an economic platform to attract new businesses to the area. Austin ties it to student expectations best by saying:

> How it could impact the community is that everything is going to talent based economic development. And, you must have talent (students), within the community to be able to attract business and industry. Problem solving is one of the biggest pieces of talent that is associated with and in conjunction with technology. So, if you tie those together, and you have a training program, which is at a local level, that is generating students who have problem solving skills and abilities, and technological backgrounds, and scientific backgrounds and then you automatically end up with a workforce in the future that will attract business and industry.

According to Rogers, (2003), innovations are anything consider new or changing by the social system in which it is presented. The view of the participants in this study sees this program addressing developments in the agricultural industry that are new or changing and relevant to the future needs of the students.

Theme: Curriculum Development to Support Expectations of Students.

The perception of how the design and development of this program was meeting the needs of students through innovative content was explored. It was the intention of the stakeholders to design and develop an innovative program that taught and prepared students for the changes and challenges that they will face in the future. During the interviews, curriculum development emerged as one of the categories. New content was coded 115 times, signifying the relevance of new and emerging content. The data that emerged during this part of the research related to the theme of new innovations and how they relate to the curriculum development. Matt, an administrator for the school system stated during his interview that:

> The agricultural program at the high school is very updated now, the curriculum has a lot of focus on food safety, lab procedures, and it is more scientific based than it ever was

> before, rather than the focus on some of the agricultural practices of the past. It has a very scientific base to it, and it seems like a major focus is on lab work and integrating science into the agriculture curriculum, and we are doing this with all the courses that we are offering.

Ralph who is an administrator at the high school sees the program as truly unique when it comes to agricultural education. Ralph is familiar with the traditional curriculum and what is being taught in other programs. Ralph, when asked his perception of this program, he states:

> I think our program would be hard to match..., it is the instructors. You know the STEM Lab came about and it has opened doors to tremendous opportunities for students and teachers... the new bio-printer, and I never thought anything about a bio-printer, but the idea was well received from the staff... I think it is a piece of technology that will be utilized. I think it is something that students will need to know about, or know that it exists, and the uses for it that are on the horizon... equipment like this set our program apart from others. So, we have gone from teaching shop and teaching welding, which we still do, but we have gone from that to be a science-based program with a laboratory that you would see in a college setting...

Elmer a former student who graduated from the program in 2012, had this to say:

> I graduated six years ago …seeing the opportunities that exist today, students are getting an even more wholesome experience than I did only six years ago. You know the smallest percent of the agricultural industry is the farmers, outside of that you have the scientist, the agricultural sale representatives, and you have all these other professions in agriculture. It seems that the students in this program now can see and experience firsthand what all is out there, and from that they can make career choices in agriculture

that are not just farming. You know a lot of people don't understand agriculture and a program like this helps spread the word.

According to the high school's Comprehensive Program of Studies Secondary Education 2018-2019, students enrolled in agricultural education have thirteen courses to choose from during their high school career (Williams, 2018). According to Ralph, this is unusual for most high school programs, and he believes it is this diversity that sets the program apart from others in the state.

The data coded from the interviews identified seven areas within the curriculum that should be considered focus areas in curriculum development. See Table 4.2. These include: New Content, Real World Connections, STEM, Traditional Agriculture Education Content, Scientific Content, Internships, and FFA. These areas should be studied further to identify their direct correlations with an innovative agricultural education program.

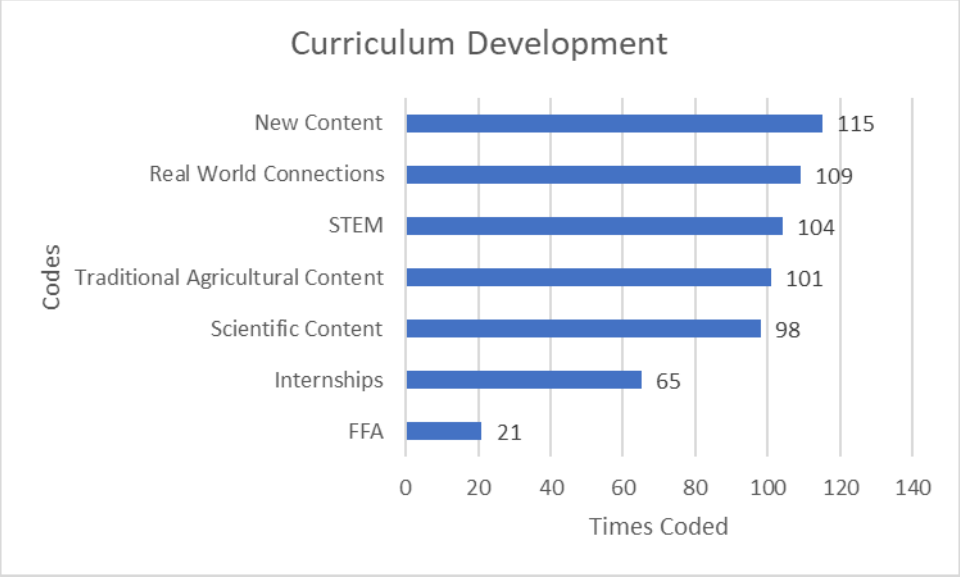


Table 4.2

How could the design of an agricultural program support community viability?

Theme: Preparing students to become productive members of their Communities.

Community viability is dependent on the input of members of the community and a strong educational program is key to preparing the leaders and laborers which serve to sustain the community. Thomas Jefferson believed that education should be afforded to every American for the citizens to be productive members of society and their communities (Dewey, 1938). Program planners must seek the input of all stakeholders in the community, from school administration, science teachers, extension agents, local agricultural organizations, agricultural sales representatives, industry representatives, and local policy makers (Croom, 2010). Eric explains the inputs that lead to the development of this program in the following way:

> I think it began because of the local farmers, producers, and distributors. Because, they were looking down the road and seeing changes that were coming in the industry, and they were really worried about those changes, changes in testing, changes in reporting and categorizing things... that caused the local government to get involved, which caused everybody else to get together and make that decision... I know a lot of people were involved, so I think the roots of the program began with the community and worked its way here. And now it is going the other way, it is going back out to the community, which is what the design was really meant to do.

Community vision should be a part of the strategic planning, designing and developing of innovative agricultural education programs. The programs using a community vision can customize content to ensure students who wish to stay in their community, and those who leave, and return have an appropriate career education experience in high school (Fishman, 2015). During the interviews, support for the program was coded 188 times, which indicates that the

participants of the study saw that support for the program was critical in the successful development of an innovative program. June, who is involved in the program daily sees the community support and its impact on the program as follows:

> So, our role in schools is to obviously to prepare students for when they leave high school and go on to work in the community or become a citizen in the community. This program has implemented a lot of partnerships, between community members and the school in different ways… For example, there are a lot of people in the community who come in and help with the program… the school farm, where you know it can partner up with other farmers… research at the state university, or again growing crops to sell at the farmers market. The kids are exposed to a lot of different real world and community activities. Finally, you know the internships and going out and working with some of these businesses in the community…

The school community is also changing its perception of the agricultural education program and giving insight into how the program can impact community viability. Kate a science teacher at the high school, shared the changes she has noticed in the program.

> I am now seeing my very best students taking agricultural education classes, and I see that these are people who have ties to the land and the community and ones who just want cutting edge expertise in the future, and I feel like those are the ones most likely to bring real positive progress, keep the community the small wonderful place that it is, but also bring sustainability and economic improvement to this area. I think we will have students who set up testing facilities and test things and are able to produce high quality products and make a good income in an agricultural field, because of the foundation that is getting laid here.

While working with the community has been a vital part of the design and development, the program has also worked closely with faculty members at the state university. One of the current collaborations is one that is funded by a USDA/NIFA grant, the goal of this project was to develop a model program for enhancing community viability through connecting STEM education in agriculture, career exploration, and local workforce development in the agricultural food safety sector (LeBeaux, 2018). The intent of the project is to serve as a reagent for innovations in developing supportive associations between secondary schools, two-year postsecondary institutions, and agriculture industry partners in Southwest, Virginia. Lauren, a faculty member at the state university serves as the project director. The objectives were two-fold, one to integrate food safety into the biotechnology curricula to meet the needs of the community and provide the students with a food safety and science certification. The second was to develop an internship program with an emphasis on the local agricultural industry and the educational field. The interns were and are currently employed by local agricultural related organizations and companies. The internship program allows students to work with more than one employer. This gives the students the opportunity to experience different careers in the field of agriculture, which should help direct their career choices and develop those soft skills employers are looking for. Lauren describes her experience with the program.

> I think that being locally focused is one of the things that is so exciting about this program. I like how the competencies are set up in Virginia, and that there is room for programs to add that local piece. So, with this program and the internship program, and trying to tie that local piece to the experiences of the students, allows the program to connect the local community to the curriculum, especially in food science, and it is new, so you're ahead of the curve. I think that having the ability of tying those experiences in

> the community to the students, bringing those experiences back to the classroom after seeing it out in the real world is what makes this project so innovative.

Another one of the connections with university faculty is working with field trials in vegetable production. This program has worked with a horticultural research specialist for the past eleven years. In this partnership, the program focused on crops that could be or was grown in the region. The trials have included pumpkins and tomato variety trials, new sweet corn varieties, squash varieties, pepper varieties and cilantro. These projects focused on treatments to crops and soils, in both pre and post planting (Straw, 2016). This partnership has given the students first-hand knowledge of food production, marketing, and the skills of how to conduct research and collect data on that research. John, the research specialist, sees his connection to the students as valuable in expanding his research acreage abilities and teaching secondary agricultural students how to properly keep accurate records, record and analyze the data. He feels that this program is supporting a need within the community and designates it this way:

> I think the program has introduced a lot of new ideas, whether it is trial studies at the school farm... teaching these young people not only about the production parts, but the economic parts... it is preparing these students to address things like food safety, what can be grown here, and explore their careers early on. These students may someday become microbiologist, researchers, and soils people because of this experience, and I think those are all things that can support the local community and the economy.

The question when posed to a professor at the state university about how the design of the program could support community viability, responded to the question insightfully:

> ... the germination of the program occurred with a discussion with potential employers about the pros and cons of coming to the county..., the community must have strong

> schools and a well-trained workforce. High tech people do not want to raise their kids in a low-tech school environment, so if you are going to attract and thrive you are going to need that meshing between school curricula and those companies who want to come and invest and positioning their kids to take advantage of those jobs as they appear.

Community support is key to changes that take place in modernizing secondary agricultural education (Rayfield, 2012). To make changes without consideration of who or what might be affected could work against the community. So, the need is to identify content needed for community viability, the program must explore the needs afforded by: astute leadership, community sentiment, community vision, and a sustainable infrastructure (Bush, 2017). Astute leadership comes from those who serve as local government officials, members of the community, industrial representatives, local groups, and other leaders who contribute in making key decisions, which affect the community (Bush, 2017). Austin leaves it this way:

> So, to support community viability the community must find ways of tying it all together. They must get the county administration to understand that it is a positive for the community, and they tout that, they energize that, they publicize that, and they market that for recruitment purposes. So, if that don't happen then you have two disjointed resources. You have the county resources searching for something that they can't find, and you have the resources of the talent of students, that is being created through the high school setting. Now you can, one either utilize the talent locally, second the talent moves on to higher education, or thirdly you are educating students to serve other communities, and hopefully that is not what's taking place.

Today, the program is seeing students returning to the community after four years of college and finding jobs in the local agricultural community. These students are realizing the unique

opportunities they were afforded through this program. This is evident from the three students who participated in the interviews. All three students went on to a post-secondary education and returned to the area with jobs in the local agricultural community. They are more than willing to share their experiences as students in the program, and how those experiences are impacting the community. Elmer, another recent graduate of the state university, and manager for a local farm supply company, shares his thoughts on how this program is reaching the community.

> We live in a rural community with a lot of farmers and agriculturist. The types of things these students are learning about ... is vital for sustaining an agricultural future... There are many opportunities for careers, whether it is in extension, government agencies, equipment dealers and services, and farm supply companies. And all these places are looking for students who have the knowledge that is gained in programs such as this one…

According to the participants in this study an innovative agricultural education program must be given the latitude to focus on the local culture and needs of the community. According to Renee, to sustain agricultural production in the future and to meet the needs of a growing population, agricultural education programs must start locally and build a network of agriculturalists that will grow and support the community. Community viability thus can be enhanced through an educational program that prepares students to be contributing members of their communities (Bush, 2017).

What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?

Theme: Program evaluation helps identify advantages and disadvantages of the program.

This study used open-ended questions to help identify the advantages and disadvantages of localized agricultural content, which helped to address any uncertainties in the design of the program (Rogers, 2003). The participants were asked to describe advantages and disadvantages that have enhanced or prevented the program from meeting the educational needs of the agricultural education program. According to the responses from the teachers, during the design and development of this program they continually evaluated the program to determine the advantages and disadvantages of new content. During this study the researcher used a similar method to evaluate advantages and disadvantages of the program through the views of the participants. The participants shared their perceptions of disadvantages related to a localized program. John gives warning to programs that focus on local agricultural content.

> If you design the program around the local community, then you are focusing on things that are pertinent to the local community... Unfortunately, if you don't reach outside that area, then you limit the understanding of the students of what else is out there... they need to know that there is something else out there and that there are other ways of doing things. These are important when these students are planning a career or deciding where they want to go after high school, whether it is to work or further their education through a two or four-year degree, or maybe even further.

Ralph feels that students need a comprehensive understanding of the agricultural industry. If students were to focus entirely on what is being done locally they would miss out on the extensive scope of the agricultural industry.

> So, agriculture differs from one location to another and students need to understand those differences before they leave here. Just knowing that there is something different out there, and the way we do things is not the only way of doing things. Knowing the differences will allow them to talk intelligently about agriculture across the nation.

May, a Farm Bureau member, felt that having certain resources was necessary to make a localized program work. Without these key resources in place, then there would be no difference than teaching the traditional programs. Students must have opportunities to apply what is learned in the classroom to real world applications, and this works best when they have the resources to apply them.

> One of the big limitations is the ability for students to engage in local agriculture at home. If the students didn't have access to a school farm, if they did not have employment opportunities that were supervised by agricultural people in the industry, and you must focus and understand what is good for one school system, is not the same in another area. You need educators who can organize and develop a curriculum that pulls all these resources together. Not every school system is going to have the same resources as we do, but if they are innovative in their thinking, they can put together a localized program that will work for them.

Lauren sees limitations to innovative programs, ones that integrate biotechnology. The limitations relate to students not being properly prepared for the content of the class. There is a certain amount of prior knowledge needed to successfully engage and understand the content of biotechnology. This program has attempted to address this concern by developing a three-course pathway that provides scaffolding to prepare the students for the complexity of the advanced content. The courses are Pre-Biotechnology, Biotechnology I, and Biotechnology II (Williams,

2018). These courses build off one another to prepare the students for a comprehensive understanding of biotechnology.

> I think and it would seem that attracting students to the program and then retaining them, if it is not what they are looking for or what they are expecting...if you can get them into the program and it is a challenge... If it is all biotechnology from day one, that could be a limitation in terms of preparation as well as motivation and interest, so if it is not appropriately scaffolded to have an entry point for students without that preparation to still be able to come in and work their way up to a point to where they can fully participate. I think that could be a challenge.

This also presents a problem that several faculty members shared, in that today's students are programed for an end of course examination. This programing began in grade school (K-6) and continued into high school. These students perceive this end of course testing as a point where what was just learned is no longer needed, and the next course will present new material for another end of course test (Virginia Department of Education, 2018). Their teachers begin day one teaching new material that will be found on the next end of course test, rarely tying previous content to current or new content. Kate expresses her frustration with the current educational model, where students fail to exhibit prior subject knowledge as they enter her college biology classes.

> Just speaking for me personally, I want to start my teaching instruction where the last course left off. And, I find that I spend a ridiculous amount of time, I did say and that is my opinion, that it is ridiculous, perhaps it is the design, but I reteach to senior's things I taught them in my biology class, and they appeared to have mastered, and that they succeeded by our Standards of Learning (SOL). They seem to come with the opinion, I

> finished that course and now I am done with needing to know this anymore... When we must go back and go over something that was introduced in the fifth grade and expanded on, you know we have this scaffolding in our curriculum where they should reach their senior year with a wealth of knowledge, …

These concerns are not only apparent in secondary education, but it is carrying over into post-secondary education. Luke's story is very similar to Kate's, the only difference is, he is seeing the problem in students who reach what is considered a highly complexed field of study at the university level in both undergraduate and graduate studies. Luke believes that the problem stems from students being conditioned to memorize the answers to a test. He believes that students need to focus more on critical thinking and problem solving to learn and have a personal connection to the learning that allows them to build on to what they know.

> … we are not teaching critical thinking throughout K-12, those are skills that must develop slowly and continuously over time. The SOL model of I must pass this test, I have got to memorize this information. To memorize is not to know, and so if those kids walk in the door needing a ton of remediation to get there, to connect to what is happening, then we have a problem. And that is what is happening, we see it here at the university, ... They have got great SAT's, great GRE's, they have gotten through all these extra-curricular things, and it has always been about passing a test and it has never been about developing skills. So, we have a systemic problem.

Luke believes these cognitive problems are limiting what students can learn later in their developmental knowledge. The students have made it through the educational process without having to relate what they are learning to reality.

> I think the biggest concern is always showing a connection to reality. The danger we get into as teachers is that we start teaching things as entities in and of themselves, and we don't show the connection, don't show what you can do with it, don't show how it answers questions that everyday people or provides for needs of everyday people, that's something that we have gotten way too hypothetical, theoretical in STEM education across the board, and we let it get divorced from the world and the people in it, and that is the biggest thing we need to reconnect. We need to reconnect, so that people see us as part of their community, and students need to see this as something worthwhile, something that adds value to their lives. Instead of something that is required to their degree.

The program has made every effort to address these limitations as the program has evolved over the past ten years. According to Daniel, the teachers have been given the same planning period along with the STEM Laboratory Manager. He states that it gives them, "the opportunity to work together and plan the nature of their program". It is during this time they can meet with outside resources, such as university faculty, business leaders, and other stakeholders.

> By having the same planning period, we can find time to sit down and work things out. This has had many benefits that has allowed us to work with the university. By having this time set aside, we can set up meeting with the faculty members and graduate students we are working with in a Zoom or Google Hangout meeting. It has really worked well with the internship program, where if we have students who need rides to the internship site, or just having the time to visit the site to evaluate the students. I think the administration has seen this as a much-needed part of our program.

The program has a local approach to the teaching innovative agricultural content. This is thanks to the network of supporters from local agricultural industry leaders. The teachers can communicate content from other areas of agriculture and then relate it to what is being done in the local area. The innovations of biotechnology are scaffolded over a three-year program that begins with an introduction to agricultural biology course that compares in content to the academic 10th grade core biology course ("The CTE Resource Center", 2018). The core biology course is required of all 10th grade students in the state and requires an end of course test (Virginia Department of Education, 2018). The program has integrated science-based content in all the courses offered in the program. And according to Daniel, there were several pedagogical adjustments made along the way to address limiting factors as they became apparent during the development of this program. These adjustments were quickly addressed with the help and collaboration of the stakeholders, who were more than willing to share their prospective and insight.

Stated advantages of the program seemed to reveal several areas that makes this type of program unique in its structure. The students first and foremost are excited about getting involved in something new, something cutting edge, and something they can relate to. Luke sees the advantages of an innovative program and explains it this way:

> Any subject, if students are going to perform well in it, and are going to be sponges for it, they have got to be excited about it. They have got to see a connection to it and their lives. When you can show how new technology is used, and how that technology informs them about their world and not someone else's 100 miles away, that gets them excited. I think that making it real, and it is important to getting kids that initial burst of interest that will help them carry through.

Ophelia believes one of the advantages of this program, is how real it makes the learning for the students. She shares from her perspective, that this type of locally focused program artificially stimulates the students learning by relating it to the world they live in.

> I feel like this type of design makes it more real for the students, in that they see the connection to their families, their family's livelihood, their neighbors, you understand why the community exist where it does, and how people make a living there. I think that is just more meaningful than focusing on the ideas and contents of a canned curriculum. I think place-based education is valuable. I think it is important to learn about other cultures and other places that are different from you, but that is where I feel like the rubber hits the road, it is where you have student learning about something that they can not only study about, but it could potentially impact their lives, future actions, and their work.

The local connection seems to resonate with the students in the program. The program through its local approach is giving students career choices earlier and it has opened the doors for career exploration. June feels the program is like nothing she has ever experienced and sees it as one of the most innovative educational programs in preparing students for the future. She explains her perspective of the programs advantages as:

> ... locally focused program helps to prepare students for the needs of the community... students in this program can participate in internships that rotate through the different agriculture fields such as farm supply stores, wholesale produce companies and value-added products, local farmers, extension office, etc... They explore different aspects of the agriculture industry, so they have a better idea of what they are interested in pursuing. They see how their education can translate into a job in their community. If they pursue a

> post-secondary education, they have a focused interest, so that they can complete that education in a timely and streamlined manner... they leave the classroom with the skills the local employers are needing, which helps them to leave career ready or they can leave with the knowledge of what they need to pursue further in post-secondary education.

Local businesses have supported the program through providing insight into the changes that are coming in the agriculture industry (Worrell, 2011). This provides content for the teacher to integrate into their programs. They have provided financial support and opened their doors for students to experience real-world connections that otherwise could only come from a book or video. These experiences are reaching the students as they are making career choices, ones that will lead them to a job, or post-secondary education. Fred a local businessman, who points out during the interview, that he never went to college, but was given the opportunity to continue learning after high school. He claims that learning can take place in many forms, and that is why he and his family have gotten on board with the development of this innovative agricultural education program. He explains what he sees as the benefits of this program.

> ... it gives the kids the opportunity to make up their minds in choosing a career... through the internship program they get to experience it, and you know that helps them more than anything else. Just getting to experience the career opportunity first hand, helps these kids to make up their minds in seeing if this is what they really want to do for the rest of their life. I see a lot of kids go off to college and after a couple or four years of college they decide this is not what I want to do with my life, but if they had been given the opportunity to explore their career choices in high school they may have chosen something different...

In recent years, there has been a push to support locally grown food, whether it is fresh grown fruits and vegetables, free range poultry products, or grass-fed beef (Eischen, 2017). This area has seen farmers taking advantage of this movement, they have engaged in marketing their products to address this interest within the community. The area has seen three weekly farmers markets open in the local towns where farmers bring their freshly harvested crops, value added canned jams, jellies, and vegetables. Beef farmers are having their grass-fed beef processed locally, where they are offering it at the farmers markets, and through online orders. Kate sees this movement as beneficial for the students to learn about, and through their experiences at the school farm, these students are given the opportunity to learn about it firsthand. Daniel described the student opportunities in 2017,

> that this past growing season, the students were able to grow tomatoes, peppers, beans, squash, corn, and blackberries. All these products were sold at the farmers market, except for a lot of the blackberries. There were just too many of them, so the students decided to take the extra to the cannery at the end of the season and made blackberry jelly. I had taken them during the summer to my grandmothers, where she taught them to make jelly. So, each week the students froze the extra berries, and after a field trip to the cannery, they decided to explore their options. At the cannery they learned that for them to market their jelly they would have to meet certain requirements for value-added products. The students researched the requirements, designed and developed a label that met the requirements and by Christmas they had sold over 400 jars of jelly. The students then compared their revenues from both the fresh berries and the jelly and realized that with a little extra work they added great value to their crop.

Kate explains this benefit of the localized program as follows:

> Being in the southern Appalachian region, we have a unique environment where that the local agriculture and local management practices are different,...I think there is a lot of interest in local agriculture and there are a lot of consumers that would like to be buying products that are from this area and teaching our students management practices that work here and showing them the market that provides for them is the key to having sustainable agricultural businesses in our area.

From the data collected in this study there are several advantages to designing and developing a localized secondary agricultural education program. The advantages seem to support the expected outcomes for the students and builds a foundation for community viability.

As the program has evolved, changes have addressed the needs and vicissitudes within the local community. The stakeholders shared both their concerns and touted the successes of the program. The limitations reflected a need for students to be aware of the diversity found within the scope of the agricultural industry. Stating that an overall understanding of agriculture provided students with a general knowledge of agricultural practices in other places that could be used to compare to the local practices. The benefits of the localized program shared by the stakeholders gives light to the innovation of connecting classroom content to real-world practices that builds a pathway for student success.

How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program?

Theme: Designing and Developing an Innovative Agricultural Education Program.

The stakeholders were asked to describe their views of teaching new and emerging content in the agricultural classroom. June felt that agriculture was moving fast into the future trying to find a solution to a global demand for food, fiber, and energy. She felt that it was

critical that students should be aware of and understand the changes which are taking place. She explains the advantages of new and emerging agricultural content.

> The biggest advantages are that the new content is current, it is relevant, and it allows the students to be more engaged with what you are doing, and it helps us to continue moving into the future, and education is slow to adapting to how the real world is working... I really feel like this program does that, and I really feel like that it puts some of the kids ahead of the curve... we don't want to prepare students for agriculture that existed twenty years ago, we want to prepare them for agriculture that is occurring now and will continue to advance in the next twenty years... it is going to be this generation that will have to find a solution to feed and shelter that global population. The chances are that the solutions will be found in the technologies that are being developed today, and we need to be teaching that in agricultural education...

Matt, an administrator in the school system, sees this agricultural education program as a leader in changing the face of agricultural education. Not only has it made changes at the local level, but the agricultural teachers are spreading those changes around the state to other programs. When Matt discusses the advantages of teaching new and emerging content, he believes this program is leading the state in its innovative design.

> I think we are well ahead of the game as far as secondary agricultural education goes, because our teachers have all participated in curriculum development at the state level. They have had a lot of input into the competencies required by the state. They have served on the state review committees for courses like biotechnology, and agricultural biology classes, and they have influenced the development of the curriculum at the state level. So that has allowed us to take as what we see as important ... and share it with

> others in a state-wide curriculum. When it shows up in the competencies passed down from the state, you know what we are doing is relevant, and it's not coming from someone sitting there in an office saying, I think this is what we need to teach, because it was what we have done for the past 50 years.

Ralph sees the advantages of teaching new and emerging innovations as twofold, benefiting both the teachers and the students. For the teachers, he thinks that keeping up with changes occurring in the field of agriculture, helps keep the program moving forward and the teacher learning new content. This benefits the students, when the new content is brought into the classroom. Luke had said, *"that as content and technology advances individuals not keeping up, will find it harder to grasp new content".* This statement by Luke gives relevance to what Ralph is saying when he made the following statement about teachers and new innovations.

> I think the advantages for the teachers, especially for teachers is keeping abreast of what is going on in agriculture. Knowing what's going on and being able to share that with the students, so they are in tune with what is going on in the field of agriculture and where we are with new technology. I think as a person grows older it becomes more and more difficult. Once you have gotten set in your ways of doing things, it becomes more difficult to keep up with technology, to keep up with modern ways of doing things.

With these two statements there is a correlation that supports the need of teachers to stay abreast of new and emerging content. As teachers have relied on the content of textbooks, and their educational training in both the pre-service venues and through in-service training, changes in the industry are happening quicker than textbooks, programs, and workshops can be developed (Stachler, 2013). Teachers tend to settle into their jobs, they get comfortable teaching what they know, using the resources available. Teachers therefore, must step forward and continue to learn

new and emerging content to deliver current and relevant content to their students (Boone, 2006). Donna Westfall-Rudd stated that, "when the teachers took primary responsibility for planning their own professional development they, seemed to assume an increased sense of ownership for practice in their profession" (Westfall-Rudd, 2011). Ralph extended his view of the advantages by stating that students not only learn content from their teachers, they tend to emulate the actions of their teachers, who serve as an impressionable role model.

> I think students need to see teachers learning new things and keeping up with changes in technology, growth of agriculture, the modernization of it. So, hopefully no matter what field they go in, they will have an interest to keep up with what is going on, seeing the changes in new technology... Things are different, so I think keeping up with the technology is tremendously important, and the way information is growing, boy that is a task of its own.

Elmer, a former student who graduated from the program in 2012 and went on to pursue a degree in animal and poultry science at the state university, sees the advantages of teaching new and emerging innovations as critical in establishing a life-long learning pattern for the students.

> ... students need to be introduced to changes as they occur, and they need to understand what is driving those changes. By doing this it will encourage them to follow changes in the industry after they have left an agricultural education program. To make them lifelong learners is key to agricultural education, because the industry is changing every day, so you must teach new things to keep up...it will help develop the student's knowledge and ability to act and formulate an educated opinion about those changes. I think it will also make them more productive within their communities, if they have the knowledge and can contribute out in the real world.

Eric, one of the administrators summed it up by saying, the advantages of teaching new and emerging innovations, are far reaching beyond just the agricultural classroom.

> The advantages are that if we are not teaching what is new and relevant, we are simply getting behind. And we are way ahead of the curve here and it is because of this program. We have kids coming back to us, who have learned things here, and telling us that their first year of college was just a repeat. Well that tells you something. Secondly, the local farmers and people understand what we are doing is something that is important to them and important to our students. And, they are helpful, they are providing places for us to send students for internships and those kinds of things. It is a joint effort, it is not just us, but I'll tell you that the science-based curriculum, and you know that agriculture has always been science based, but putting in the lab, changes the focus a little. I think it is causing some students, who are going into chemistry, biology or whatever, to say you know I can learn those things in an agricultural environment and be able to use it in where they want to go is huge.

The participants, all seemed to agree that addressing new and emerging innovations in agriculture was key to preparing the students for a successful career and giving them the tools needed to address changes as they develop, no matter what field they choose.

Theme: The social concerns surrounding teaching new innovations to an uninformed community.

Daniel, an agricultural education teacher, shares his method for addressing these concerns.

> Well, it is not like we try to brainwash the students, I think we try to present both sides of the issue, and I know a lot of the times in my class, I let them debate whatever side they

> choose to be on. So, I think that is healthy, because there is a lot of things in our country that are not black and white and especially in the case of genetic engineering, where science and I mean good science should win out. Unfortunately, so many of those issues are more emotional than scientific, so the students get to exchange their opinions on those issues, they get to see how things are not always black and white, and how science needs to come into play, how people can be affected by emotional and social beliefs. So, I think it is a good exercise when we teach and discuss those things.

Students will be able to communicate these concerns in a way that informs others. This can also be an advantage to teaching new and emerging content, as May, a former middle school agricultural education teacher, expresses her concern for the uninformed community and the importance of teaching new innovations in a secondary program.

> It is like my mother for example, she does not think DNA is real, she thinks ancestry.com just makes it up, so we need to be educating a new generation of what GMO's are... My mother at 82 years of age, thinks that there is no such thing as DNA. So, we must teach these kids what genetics are, we have to teach students about GMO's and these new emerging technologies. So, they can teach the older generations involved in agriculture, because they need to know what's out there, and they need to be well informed about what is going on in agriculture. Not just believing what they hear on TV and read in social media.

The belief that GMO's or biotechnology is something that should not be taught at the secondary level, is not a belief shared by this program, nor with the stakeholders. It is the consensus that this is a topic that needs to be addressed and discussed in an informed way that not only educates

the students but reaches out into the community. Kate explains the community and the need to have those discussions in a way that informs the relevance of these new agricultural innovations.

> ... anytime there is DNA being manipulated, any time you are creating a new species, faster than the old fashion way of selective breeding or artificial selection, then you are doing something you shouldn't be doing. We have been making GMO's ever since we quit hunting and gathering and started doing what is known as agriculture. Now, that is not always an easy lesson to teach our students, they really think that all the animals we have, that is the way they have always been, and you don't play "God", … I don't want to come in-between anyone and their parents or their pastor, but I want them to understand what science shows, what evidence, and what reason says... that is something that we do and something that we will have to handle tactfully, thoughtfully and humanely, if we are going to fulfill our roll as educators.

According to the information presented by the participants of this study, social concerns are not based on an informed understanding of new innovations. Today, people are influenced by the things that they see on the TV, read in magazines and newspapers, or pickup on through the internet and social media. The participants believed that through informed scientifically backed resources, that these highly charged topics could be addressed in a non-threating way. In a way that students can benefit and then communicate that understanding to others.

Theme: How new innovations fit into secondary agricultural education.

Wesley, a current middle school agricultural education teacher explains his position, and how once changes are made to the curriculum they must keep changing because agriculture keeps changing.

> I think new innovations not only fit into secondary agricultural education, but they are the life blood going forward. You know basically either you are improving with time, or you're not. I think a lot of agricultural education programs through the years have gotten stale, because they are doing the same thing. Even though the same thing was valuable, those programs are trying to hold on to things that were valuable, but at the same time not adopting the new stuff. The program here is one of the very few programs in the state that is doing what a normal program should be doing. I think all these other programs are behind, and that makes me proud of the role we are playing in agricultural education. But with that being said, we don't need to stop, and that is the key right there.

The new innovations in agriculture is not just limited to the science curriculum. But, technology has also reached the agricultural education shops and production management content areas. Wesley touts that the program here has also focused on new innovations related to the mechanical side of agricultural education. Computer Numerical Control, also known as CNC, is a process involving computers that control machine tools. Starting in the middle school agricultural education students are introduced to this technology. At the middle school, students learn to program a Shopbot CNC Router. This is a skill they will continue to use throughout their high school experience. This program has focused on the CNC technology, beginning with the CNC Router doing simple woodworking projects, and finishing with complex CNC Plasma projects in their metal fabrications course. Other innovations in the shop classes include alternative energy (solar and wind), pulse and spray welding, GPS, and the use of drones in production agriculture. Daniel sees this program as being truly unique in terms of the scope in which the program has addressed the changes in agriculture, and how they have incorporated new innovations into the program.

> I think we are blessed here with this program that we have here, with the CNC machines, both wood and plasma, so, take the welding class for example, instead of just the traditional stick welding, we have MIG, TIG, and the plasma machine, so now they are also learning computer skills to operate the CNC Plasma cutter, whereas five years ago that would have never been an option. Our production classes are learning the uses of drones in crop production, and how they can be used to help farmers manage their inputs, to reduce cost and increase their profits.

There is a definite consensus that new innovations belong in agricultural education and getting them integrated into the program seems to get everyone energized. You can hear the excitement when the stakeholders share their experiences with the changes. Ralph, an administrator shares that excitement when he describes how the innovations fit into the program.

> ... The new stuff coming out is hard to keep abreast of... not only are we seeing new technology in production, we are seeing it in mechanics. 10 years ago, you would have never heard about a CNC Plasma, and now we have it and we are cutting out material for the welders, and it is the same for the bio-printer, that is a piece of technology we would have never thought of. But, these are the types of things when you go to farm shows you see new technology. At conferences, you see new welding machines, and the virtual welders ... it is hands on but it's not real, it is interactive but it's not real welding. So, technology has come a long way in just the past 10 years... CNC is a big thing in all industries, and even in agriculture. The new types of welding, pulse welding, I didn't have any idea what pulse welding was until the teachers told me and showed me what it was all about...Technology can get ahead of you quickly... It seems like the classes are

> changing every year and that keeps the students excited, they are always learning something new.

New innovations in the agricultural industry are constantly evolving ("Innovations at Work in Agriculture", 2018) and the participants in this study see the need for agricultural education programs to integrate these new innovations. They believe that programs must be willing to adapt to changes as they develop, and teachers must develop methods to keep them in step to bring those changes to their students.

Theme: The barriers and complexity of teaching new innovations in agricultural education.

The concerns were broad as the stakeholders addressed this question. The group felt that the utmost burden of integrating the new innovations rested on the ability and drive of the teachers. June shared her concern this way:

> This is my concern... you yourself must know what the newest things are, and how they work... requires a lot of extra drive and time... you must learn these new techniques... require some type of continuing education. So, one way to prepare is through professional development... Another concern... is the expense of these new technologies, since they are new and as with all new technologies they are always more expensive at the beginning...The programs must identify their needs, business wise, career wise, or what ... are actual opportunities for students. You don't want to spend a lot of energy teaching student's new technologies that there is no career base for them to go into.

Ralph sees his biggest concern is finding the right type of qualified teachers. Teachers who can move agricultural education forward and maintain the foundational needs which are still needed in preparing students for a career.

> Shop teachers are hard to come by, I think that the training for new teachers is not good, when it comes to teaching them how to do shop work. I hear stories about new teachers when I go to meetings across the state. The stories are that they are not prepared for the job, the new teachers come in and they have no idea how to weld, and no idea of the oxy-acetylene torches, and shop projects are something just unheard of... The STEM Lab, I am very pleased with our staff... embracing those ideas, but I have heard of other colleagues, who have had trouble with older teachers not willing to embrace technology, as far as STEM related technology... The STEM Lab has brought students to a different place in agriculture... I like seeing it balanced, and I think we are balanced, and I like that balance.

Eric sees time as the biggest factor preventing new innovations from being incorporated in programs. Eric explains his position on this subject as:

> … giving teachers time to create programs that incorporate all the things we are talking about, and again like I said, teachers need to have the opportunity to go back and learn themselves. So, between those two things, finding the time to create the projects and giving the teachers the time, we have never been good in education at giving the teachers the time to plan or get ready for something. Never have we done that very well, and by the way, if you go to other countries who are doing very well, you would see that teachers, teach half a day and the other half they are planning and getting ready, and we don't do that...

The second concern shared by the participants was funding. Eric, an administrator, describes overcoming the barriers this way:

> ...we were very fortunate, and we just happen to run into this at the right time, with the right people leading the agricultural program, support from the state university, a push from the local farmers and businesses, and the right people in the governmental offices to seek out the funds, so money is a biggie... but you must have someone out there leading the way, and we have been very fortunate with our group here. We have people here leading the way, not just here in in this county, but they are leading the way in the state, and just maybe in the nation. I think from what I know, and what I have seen in education, there is not another program that has done and is doing what this program has done.

From the perspectives of the participants, time and money are the two biggest concerns when it comes to designing and developing an innovative program. They are in consensus that teachers must be giving the time to explore and learn new technologies to bring to their students. They all agree that funding for new technologies are great, and that acquiring the equipment when it is the latest thing out there presents budget problems in a normal situation. This program was fortunate that the funding was available at the time the development moved forward. (See Table 4.3)The administrators now see it as an investment in the future and are making every effort to find the resources to keep it current.

Funding for the Agricultural Education Program 2007-2018			
Source	Investment	Funding	Year
Carl Perkins Funding	Iron Worker 55-Ton	8,500.00	2008
Virginia Agricultural Council	Fencing and Land Lab Devlopment	10,500.00	2009
Virginia Agricultural Council	2nd Year Funding/ Livestock Facility	7,500.00	2010
StayTuff Fencing Company	Demostration Fence Supplies/Post	6,500.00	2010
Carroll County Public Schools	Kawasaki Mule 4X4 ATV	8,500.00	2011
Virginia Agricultural Council	3 rd Year Funding/ Aturnative Energy	7,500.00	2011
Virginia Tech - Matching Grant	2- High Tunnel Greenhouses	10,500.00	2011
Food City Stores	Greenhouse	8,500.00	2012
Virginia Agricultural Council	Construction of Greenhouse	5,000.00	2013
USDA/ Rural Development	STEM Laboratory	550,000.00	2013
Carroll County Public Schools	Ford Tractor	3,500.00	2013
Carl Perkins Funding	Plasma CNC	12,500.00	2014
USDA, NIFA, SPECA	Internship/Travel/Biotechnology	15,000.00	2016
Carroll County Public Schools	Water and Electricty at Farm	4,800.00	2017
Carl Perkins Funding	Bio-Printer - STEM Lab	12,000.00	2018
Table 4.3		670,800.00	

In Summary, from the views of the stakeholders, the program is meeting the needs of the community, through academics, relevance, and innovative content. The program is delivering cutting edge technology with new and emerging agricultural content. The current administrators see this program as a leader in shifting the awareness of what agricultural education is. Through its focus on foundational content and building on that underpinning content of basic agricultural skills, the program is changing the perception of agricultural education ("High School STEM Ag Class", 2016). With concerns that are raised surrounding biological advancement in agriculture, this program is delivering a balanced approach to the discussion. These changes have not been easy, nor have they come without some growing pains. There have been obstacles to overcome, the two most recognized were time for teachers to prepare for the changes, and funding. Time for the teachers to prepare new content, and time to seek out relevant professional development. This required a commitment from the teachers, which they were willing to commit. The teachers in this program have taken ownership of the program with a shared vision for the future. The funding required stakeholders to seek out resources from many different providers. The key to their success appears to have come from a sound foundation in networking. Being able to

communicate the needs to modernize the program, having a committed team working together with that shared vision has made all the difference. That more than anything has convinced investors and secured the funding needed to make the changes that makes this program truly unique.

How has participation in professional development contributed to the innovative agricultural content of this program?

Theme: Continuing professional education should contribute, or influence changes made in educational programs.

This program has sought professional development in both traditional and non-traditional formats. The teachers have attended workshops targeted at professional development for secondary agricultural education teachers. They have reached out to professional organizations and businesses to learn in the field and bring that content back to their program. June sees the importance of professional development from her experience as a critical component.

> So, being able to actually be trained by experts in that field or being able to work alongside experts in that field, dramatically increases your knowledge in that subject area. It also, dramatically increases your comfort level in that subject, which allows you to be able to relay that knowledge to the students in the classroom.

Daniel, who has been with the program for the past three years, expressed his experience and opportunity for professional development as one of opportunity for the program.

> I think that is another thing we are truly blessed with here, we have opportunities for professional development and money to do that. You know I was given the opportunity to go to Iowa, last year to learn about hydroponics, that was a great opportunity, but it was expensive, so it was nice that we had the money and support to do that.

Continuing professional education for this program began with a workshop but has grown as the program has grown. June, a biology teacher, recalls that she was approached by the agriculture education teachers and was asked if she would be interested in a workshop for biotechnology at the state university.

> I remember that the agricultural education teachers asked if I wanted to go with them and do a workshop on biotechnology. The group that went was two of the agricultural education teachers, three students, another biology teacher and myself. We spent three days traveling to campus to learn about teaching biotechnology through the field of agriculture. I was hooked, and the rest is history. I think that was about six years ago and just before we got the STEM Lab.

Meaning that the teachers have sought out new opportunities to advance their programs. Much of the development has come from a continued relationship with the faculty at the state university. That relationship has allowed the program to participate in several research projects which have provided new content to advance the program. A recent collaboration made funding available for teachers to travel to Delaware to tour a community college, who's program was focused on agriculture, biotechnology, and food safety (LeBeaux, 2018). Other collaborations have created curriculum content and provided the students with learning experiences outside the classroom. The teachers have also sought out professional development with industry and seeking to bring relevant real-world experiences to their students. Wesley, a middle school agricultural education teacher, who feeds the high school program has found professional development with industry beneficial for his program.

> I guess when you look at professional development, I would like to see teachers encouraged to go out and seek their professional development out in the field, with

> industries that relates to what they are teaching…today I feel like there is less professional development than I have ever seen within the school system. But, the agricultural teachers in this county are getting out there and are looking down the road to bring the latest things related to their programs to their students.

What seems to have made this program's professional development work so well, is the fact that it has come entirely from small group or through one on one engagements. The teachers have experienced biotechnology by doing electrophoresis and PCR with university faculty. The professional development took place in a setting where individual attention was given to help the teachers understand and master the techniques. Matt sees this type of professional development as key to the success of the program. One of the things he sees, is that the teachers have sought their own professional development, and from his prospective the teachers have taken on the continued learning that keeps the program moving forward. To him it appears that the teachers once they master the content of a new technology, it leads them to something newer, and the program is constantly advancing its content.

> I think providing teachers time, to get together and work on issues, partnerships with the universities, like we are taking advantage of right now, and using their expertise and help in designing programs and projects…. It needs to be a little more individualized, you know go to a conference and you hear a lot of really good ideas. But, do you get a chance to get involved and do the hands-on pieces of that. I kind of like some of the ways we do some things.

From the perspective of the university faculty, the collaboration between the secondary agricultural teachers and the university faculty is powerful. Taking advantage of the land-grant university and the research that is happening there is beneficial to both the secondary agricultural

education teachers and the researchers at the university. Lauren a professor at the university, and a researcher who works with this program states:

> This model of professional development that builds those relationships and those connections, I think can be really powerful. So, making that connection of teachers to the experts allows the teacher the access to those experts when questions arise, or problems occur. And thinking of that professional development as part of their practice then they have someone they can call, and say, "Hey, I was wondering what is going on with this thing", when problems arise.

Continuing professional education was a central theme that was presented from the 21 stakeholders interviewed. During the interviews teacher sustenance was coded 72 times. This related to the willingness of the teachers to commit to continuing professional education, and their willingness to be open to new concepts and technologies for their program. Second, the collaboration and the relationship with the state land-grant university was coded 67 times. The codes related to the advantages shared by both teachers and university faculty in relation to the design and the development of this innovative program. The development of this relationship has provided benefits for both the teachers and the researchers. For the teachers, they can bring the latest technologies and content related to the agriculture industry to their classroom. According to Lauren, it gives the researchers, a place to test their research, and provides an open dialog for both to communicate and contribute to each other's endeavors. For this program funding was a concern in the future, but for now they consider themselves fortunate to have had the money available for professional development. So, funding was coded 48 times during the interviews. The teachers of this program with sights set on a local focus, have made connections with local businesses. Coded 45 times during the interviews, the relationship with local business has

allowed teachers to learn how to apply local content to new and emerging innovations. As with the relationship with the university faculty, the relationship with local business, has provided content for professional development for the teachers. Local businesses have shared future concerns they are facing soon with changes within the industry. These concerns have been addressed through an open channel of communication between the businesses and teachers, and then on to the university. For example, to address these concerns a grant was written to develop a model educational program to address the needs of industry through education at the secondary and post-secondary levels, and to prepare students to enter the workforce at different levels of education (LeBeaux, 2018) .

Summary

This chapter has reviewed the data collected during twenty-one interviews with stakeholders of an innovative secondary agricultural education program in southwest Virginia. Several themes emerged from the analysis of the research questions asked to the participants. The responses were collected from a diversified group, representing teachers, former students, university faculty, farmers, business professionals, local government, and school administration. This increased the breadth of the phenomenon being studied and provided a comprehensive view of the program. The interviews produced over two hundred pages of transcriptions from the twenty-one participants. Artifacts were used to support and collaborate the views of the stakeholders.

Beginning with the first question, “How do Members of the Case Study Perceive Innovative Agricultural Content?” This question produced themes that described how new innovations in the agricultural industry relate to agricultural education, presented expectations of

the students at the end of their agricultural education program, and how innovative curriculum development supports the expectations of students. The key expectations of the students were identified as soft skills, career readiness, STEM literacy, community viability, college readiness, and leadership skills.

The second question, "How could the design of an agricultural program support community viability?", focused on preparing students to become productive members of their Communities. Programs using the community vision can customize content to ensure students who wish to stay in their community, and those who leave, and return have an appropriate career education experience in high school (Fishman, 2015). This program appears to be focusing its program content toward preparing the students to be productive members of their community.

The third question, "What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?". The theme that emerged from this question was the disadvantages and advantages found in a localized program. The limitations seemed to be focused in the lack of diversity within the program if all the content was focused on the local community. The opportunity to continue traditional content, integrated with new innovations connected to the real-world, supported by local applications seemed to support the direction of this program.

The forth question, "How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program?", was used to investigate the local approach taken by this program. There were several benefits observed of new and emerging agricultural content in this localized program. There were some social concerns surrounding teaching new innovations to an uninformed community. But, the participants seem to agree that new innovations fit well into secondary agriculture education. There were barriers

and complexities found in teaching new innovations in agricultural education. The key was having teachers who were committed to the change and having the funding available to make the changes.

The fifth question, “How has participation in professional development contributed to the innovative agricultural content of this program?”. Continuing professional education should contribute, or influence changes made in educational programs. This program’s teachers have participated in continuing their professional education, which has driven the design and development of the current program. They have sought out opportunities to learn new content and integrate new innovations into their program. They continue to look ahead to for the next thing coming down the road, and that is what seems to keep this program moving forward, being new and innovative.

The data collected produced valuable insight into this innovative agricultural education program. From the coding a diagram was developed to determine the relationships of five categories. The five categories and nine themes appeared to support how a modern agricultural education programs may be designed and developed to support innovative agricultural content. These will be discussed at length in Chapter 5, in the conclusions, discussion, and recommendations.

Chapter 5

Conclusions, Discussion, and Recommendations

The purpose of this case study was to determine how modern agricultural education programs may be designed and developed to support innovative agricultural content. The researcher focused on the planning theory of Cervero and Wilson (2006), as well as Rogers' "Diffusion of Innovations Theory" (Rogers, 2003) for the theoretical framework of the research. The following questions were used to recognize how modern agricultural education programs may be designed to support innovative agricultural content:

1. How do members of the case study perceive innovative agricultural content?
2. How could the design of an agricultural program support community viability?
3. What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?
4. How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program.
5. How has participation in professional development contributed to the innovative agricultural content of this program?

Through a thematic analysis of the data, five categories and nine themes appeared to support how a modern agricultural education program may be designed and developed to support innovative agricultural content. These themes settled as the data was analyzed from the twenty-one interviews collected in a one on one face to face recorded interview. Once the interviews were completed they were transcribed and coded simultaneously to gain a holistic understanding of this innovative agricultural education program. This chapter will present the conclusions, discussion of the findings of this case study, and suggest recommendations for other agricultural education programs to model, and areas for future research.

Conclusions and Discussion

New innovations in the agricultural industry and how they relate to agricultural education.

Over the course of the past ten years, and the development of this program, agriculture has changed and continues to change. In fact, by the time that this study reaches publication, the industry will have announced many more new innovations related to agriculture ("Innovations at Work in Agriculture", 2018). It will be up to the agricultural education community to determine what is the most relevant content to teach (Brand, 2013). From the data collected and the artifacts from this program, innovative content can be defined as follows:

> Innovative Agriculture Content – is the integration of new content with real world connections that improve and support an agricultural education program. This is to include STEM focused lessons that incorporate scientifically based research which builds on the traditional focus of the programs. The content should be relevant to meet the educational needs of all students. The new content should advance the knowledge of students and teachers, including continuing professional education activities that will ensure well-informed instruction in the classroom.

This program has been successful at integrating new innovative content and technologies into a traditional agricultural education program. The teachers have reached out to professionals in the community and at the state university for innovative content (Brand, 2013). They have collaborated with the university to pilot and develop new programs, they have worked with local businesses to prepare students for careers in agriculture and food safety. "Strong collaborations among secondary and postsecondary institutions, employers, and industry partners improve the quality of CTE programs" (Brand, 2013). Agricultural education teachers are the driving force in the modernization of an agricultural education program. It is the teachers who bring the

innovations to their programs, and to keep the programs moving forward (Stachler, 2013) . Teachers will have to be motivated and prepared to be life-long learners to bring new innovations and keep pace with the changing agricultural industry (Shoulders & Myers, 2011). Teacher motivation must come from within; it must come from a passion to teach and to stay current with trends and issues in the field of agriculture. There is an old saying, "You can lead a horse to water, but you can't make him drink". You can provide teachers with all the resources they need to teach, but if they don't have the motivation to change, nothing is going to happen (Cervero & Wilson, 2006; Rhoton & Shane, 2001). It was the consensus of the participants, that teaching new innovations in agriculture was not an option for content in the agricultural education programs it was a necessity (Shoulders & Myers, 2014). Teachers must be willing to makes changes as they occur, they must prepare students for the future, and as they do they will be in step with the changes in the industry (Garet, 2001).

The focus of this program has been to prepare students to enter the field of agriculture with an understanding that the industry is changing (Brand, 2013). The teachers admit that what is relevant today will be replaced or improved on in ten years, but the concepts and potential end goals will be the same. The technology revolution is expanding or replacing the Green Revolution, and these teachers are challenging the students in this program to look outside the box for solutions to feed a growing population (Brand, 2013). The program still maintains its foundational hands-on skill-based content as a starting point or foundation to agricultural education. The feeling is that there is a demand for skilled laborers and students develop a foundational understanding of general applications they can build on as they progress in content knowledge.

This program has had to diversify instruction to meet the challenges of the expanded content and offers four pathways for instruction (Williams, 2018). The traditional pathways include: Horticulture and Greenhouse Production, Agricultural Production combined with Metal Fabrication and Technology, and Natural Resource Management. The added pathway has a broader focus on science-based content, and includes: Biological Applications, Introduction to Veterinary Science, and two courses of Biotechnology in Agriculture (Williams, 2018). The number of classes offered in this program has changed from year to year based on the demand for each class, and in recent years the science-based programs have grown. The greatest changes occurring in the agricultural industry are related to biotechnology (Boone, 2006), this movement is anticipated to continue. According to Mueller, (2015) "Biotechnology and genomics are relevant, cutting-edge topics for high school students to learn science in the 21st century" (p. 138). This program has anticipated these trends and has prepared itself to be able to meet the needs of both the students and the community. The teachers in this program, have worked together to identify new innovations in the agricultural industry and adjusted the program to keep it moving forward (Brand,2013).

Curriculum Development to Support Expectations of Students

The changes this program has made in the course offerings and pathways, have been made with the focus of what students need to know when they completed their agricultural education program (Brand, 2013). The data revealed that students today needed to develop more soft skills, be STEM literate, be career and college ready, have leadership skills, and contribute to community viability and economic growth (See Table 4.1)(Wilcox, 2014). This is the direction the teachers of this program have taken to develop the curriculum. According to the

participants, the innovative changes are advantageous for the program, it is keeping it cutting edge, current, relevant, and it allows the students to be more engaged (Wells, et al., 2015).

This method of teaching new content as it becomes relevant is challenging for the teachers. They must develop a network that keeps them informed of changes as they happen. Partnerships with the community, businesses, and especially with the university faculty and researchers is key to letting them know what new is coming in the agricultural industry (Brand, 2013). A teacher's time is limited and preparing new content is time consuming, so an open line of communication with their network of partners is essential to keeping the program moving forward (Brand, 2013). Curriculum development for this program has been a collaborative social activity, the curriculum that was developed was negotiated, and a consensus of the teachers was reached for the program to be successful (Cervero & Wilson, 2006; Bates, 2016). The collaborations used to develop the curriculum stemmed from teachers seeking input from their network of supporters (Rayfield, 2012). Collaborations from university faculty allowed new content to be introduced to the classroom through pilot programs of innovational content. One of the methods used was to integrate STEM concepts through Problem Based Learning (PBL) activities (Garet, 2001). Teachers in the program also sought out local emerging content from industry. Being local the content was something that the students could connect with and apply to their daily activities. The data coded from the interviews identified seven areas within the curriculum that should be considered focus areas in curriculum development. See Table 4.2. These include: New Content, Real World Connections, STEM, Foundational Agriculture Education Content, Scientific Content, Internships, and FFA. These areas should be studied further to identify their direct correlations with an innovative agricultural education program.

Preparing students to become productive members of their Communities.

The goal of this program is that the students will become productive members of their communities. It was the consensus of the participants that a strong relationship with the community must be established. According to the data collected during the interviews, there are valuable resources available in the community for modernizing secondary agricultural education. Teachers must tap into these resources and expand their classrooms to collaborate and learn new content (Fishman, 2015). Rayfield (2012), "The group of individuals who will play a key role in programs of the future is… community members and local agricultural businesses" (p. 48). It was a common theme among the participants that this program had reached out to the community to bring in resources and give students the opportunities to explore careers in the agricultural industry (Brand, 2013). This program is using community vision to customize its content to ensure students who wish to stay in their community, and those who leave, and return have an appropriate career education experience in high school (Fishman, 2015).

The program has designed course content that integrates curriculum and real-world connections. The program has partnered with local farmers to grow early plants in the greenhouses, worked cattle to get hands-on experiences with live animals, they have negotiated internship experiences with several farms and agricultural businesses (Croom, 2010). Local agencies have been invited into the classroom to bring their knowledge and experiences to the students. Students have grown crops at the school farm and marketed those commodities at the local farmers market. This program allows students get a lot of exposure to the community, whether it be participating in the community activities, by selling their crops at the farmers market, or working with local farmers, or local agricultural organization, or agencies and businesses in this area (Croom, 2010).

Program evaluations help identify advantages and disadvantages of the program.

Any time after a program is designed, developed, and implemented then it must be evaluated to determine if the program is meeting its goals. It is through the evaluation process that teachers can see value or worth of the content being taught (Cervero & Wilson, 2006). The participants indicated that the program was continuously being evaluated based on the integration of new content. The use of these evaluations is to determine if the new content is meeting the needs of the program. According to Rogers (2003), evaluation questions help identify advantages and disadvantages of an innovation and helps address any uncertainties in the design of the program (Rogers, 2003).

There were a few disadvantages identified during the analysis of this localized program. The idea that if the program solely focused on local content, the students would not be exposed to a holistic view of agriculture. Another disadvantage that had been addressed by the program but should be noted for others to be aware of is teaching Biotechnology, because it requires more analytical approaches than does agricultural science or biology (Mueller, Knobloch, & Orvis, 2015). This program created a pathway for the Biotechnology program, which scaffolded content to develop the students' knowledge leading up to the complexity of the subject matter. The challenge that this program has faced is that getting the students to move away from the rote learning and getting them to understand and connect to what they were studying (Mueller, Knobloch, & Orvis, 2015). This year there was a push to introduce a certification test for the Biotechnology program. This changed the dynamics of the course from a mostly hands-on laboratory, problem-based experience to teaching to a test (Wells, et al., 2015). It was the recommendation of the teachers to avoid this in years to come, because it was not what the

students or the teachers expected from the course. The gains that were made in making the students responsible for their learning was lost in preparing for the certification test.

There were advantages found in this program that drive the students interest and keeps the program moving forward through new innovative content. Participants believed that one of the biggest advantages of this is that the content is made real for the students. It gives the students something they can relate to in their lives and how they can apply what they are learning to their day to day experiences. This program is aiding in student's career choices earlier in their young adult lives, and it is giving them the opportunity to explore a career in the field through supervised internships. Students are experiencing a broader scope of the agricultural industry in this program. Not only is the program maintaining its traditional agricultural programs, it is preparing students to engage in agricultural research and biotechnology. Rayfield (2012), states that "innovative programs are ones of hands-on experiences that will match industry trends and will be led by highly motivated teachers" (p. 47). This program by all accounts is doing this.

Designing and Developing an Innovative Agricultural Education Program

Agricultural education programs must be designed and developed to address frequent changes in the agricultural industry. New content must be added to offer students the chance to obtain the content knowledge compulsory to succeed in post-secondary education, and in the workplace (Brand, 2013). The participants of this study see value in adding new content, it is the view of the participants that it helps to keep the program moving forward and the teachers learning new content (Garet, 2001). There are several factors which will drive the design and development of any program (Cervero & Wilson, 2006). The first factor and probably the most important is the teacher, and their willingness to make changes to their programs (Stachler, 2013). Second, is the support unit for the teachers and the network of resources that will

contribute to the content (Stachler, 2013). Third, is to identify what curriculum needs to be taught (Cervero & Wilson, 2006; Rogers, 2003). Forth, what is the expectations of the program itself, what is to be accomplished (Cervero & Wilson, 2006).

The first thing is the teachers and their willingness to take on the challenge of making significant changes to their programs (Shoulders & Myers, 2011). Changes require extra time to discover relevant content, changes require teachers to extend and continue their learning in the subject area, changes require teachers to plan and develop new lessons, and teachers must be able to communicate these changes to the students in a way that it enhances the students learning experience (Stachler, 2013). Therefore, without the commitment of the teachers to change the direction of their programs, no change will occur (Roger, 2003). The teachers are the early adopters, who provide the communication link between the resources and the students. According to Rogers (2003), the early adopters are a more integrated part of the local social system and influence other by putting their stamp of approval in new innovations (p. 283).

Second, is the support unit for the teachers and the network of resources that contribute to the content (Rayfield, 2012). This program has developed a network of contributors and those contributors have worked together to produce the educational outcomes that makes this program innovative (Cervero & Wilson, 2006). The value of this type network is that it involves the contributors suggesting new content that is relevant to the needs of student learning. The program sought out community, businesses, educational and political leadership to partner in the development of this program (Bush, 2017). The support for the program is built as the program adopts content which brings changes which are beneficial to people educationally, socially, and politically (Cervero & Wilson, 2006).

Third, is to identify what curriculum needs to be taught, because you can teach anything, but if it is not relevant what good is it (Foster, 2015). According to a university faculty member, secondary agricultural education programs must focus not only on the new innovations coming down the line, but the programs must prepare students to communicate these innovations to others (Wilcox, 2014). Modernization of agricultural education will require that new innovations are presented in a way that those not involved in agriculture can understand it, and the students will need to improve their ability to communicate that understanding to others (Fishman, 2015). Curriculum development for this program has been a collaborative social activity, the curriculum that has been and is still being developed was negotiated, and a consensus of the planners was reached for the program to be successful (Cervero & Wilson, 2006). Those involved in the development were attentive to the interest and needs of the stakeholders from an educational, political, and economic standpoint (Cervero & Wilson, 2006). Determining what was included in the program was assimilated by the teachers by identifying who and what (students, and community) would be affected by the program. The planners established a set of priorities that meet the program's educational, managerial, and economic objectives (Cervero & Wilson, 2006). The data suggested that many people have and will benefit from the actions of this program (Croom, 2010) . The actions taken by the teachers have had a positive effect on students, businesses, and the community according to the participants (Cervero & Wilson, 2006).

Forth, expectations of the program itself, what is to be accomplished (Cervero & Wilson, 2006). Student soft skills and career readiness were presented as the top two expectations being coded 138 and 136 times respectfully (Wilcox, 2014). These two areas are being addressed in several ways in this program. The program focuses on learning activities that builds the students communication skills, through projects that require the students to work together as a team, and

to think critically to solve problems presented in class (Wilcox, 2014). At the end of most of these projects students are required to present their projects to their peers (Wells, et al., 2015). These projects have required the teachers to rethink their methods of teaching, but they believe that it has energized their classes. Aside from soft skills and career readiness, other expectations presented were college readiness, STEM literacy, leadership, contributions to community viability, and a talent (students) to serve as an economic platform for business recruitment (Mueller, Knobloch, & Orvis, 2015).

Social concerns surrounding teaching new innovations to an uninformed community.

Today we are constantly faced with the influence of social media, and the impact it is having on the perception of new and emerging innovations in agriculture (Smith, 2013). These informational gateways tend to influence the perceptions of an uninformed audience, leading them to draw an unsupported conclusion that these innovations are having or could have a negative impact on society (Smith, 2013). This program has taken steps to introduce these new innovations in a way that is non-threatening, where students are presented both sides of the conversation (Wells, et al., 2015). The students are then given the opportunity to study research supported by facts, versus the concerns raised through media outlets (Smith, 2013). It is the belief of the programs agricultural teachers, that by educating the students, the message will carry forth into the community.

How new innovations fit into secondary agricultural education.

The participants of this study concur that there is a definite advantage to teaching new and emerging innovative content in agricultural education (Rayfield, 2012). The participants also felt that foundational skills and practices needed to remain intact and serve as an underpinning for agricultural education programs. They felt that the new innovations should be integrated into

the foundational content to give students a greater understanding to build on (Rayfield, 2012). In the foundational agricultural courses students are taught to use various hand-tools and power equipment. They are taught to use torches and welders that are still very much a part of the skill sets needed in today's workforce. But, today technology is driving new shop and production related tools that are being used. New technologies with pulse welding, CNC Plasma, drones, and GPS equipment are being used and students have a need to learn these technologies (Garet, 2001). Agricultural education programs must also address the changes in the field of science related innovations. Biotechnology is an area of the agricultural industry that cannot be ignored (Mueller, Knobloch, & Orvis, 2015). "In recent years, curriculum integration of science and agriculture has accelerated due to the biological revolution that requires the agriculturist to understand more science" (Wilson, 2002). This program has developed a pathway for those interested in this sector of agricultural science, where biotechnology takes the center stage in what is believed to be the first STEM Laboratory dedicated to secondary agricultural education in the Nation. Having the resources available to make changes in this program has made all the difference. Having the right people come together to design and develop new content and having the interest from the students has driven the new innovations in science and agriculture (Hurst, 2015). According to those involved in this program, the excitement surrounding the integration of biotechnology and science has changed the perception of agricultural education in the school and local community. According to the participants, they are seeing the more academically advanced students enroll in the program and taking advantage of the new innovations and laboratory practices. This can be viewed as a two-fold advantage for agricultural education, one it is spreading agricultural content knowledge to those who are not considered traditional

agricultural students, and second it is preparing the next generation of agriculturalist to find solutions to problems they will face in the agricultural industry.

The barriers and complexity of teaching new innovations in agricultural education.

The concern for designing and developing an agricultural program based on teaching new innovations is that of teachers having the time to prepare for the changes, having the resources available to integrate the new content, and the finances available to fund the changes. Time is something that cannot be created, there is only 24-hours in a day and that is it. So, for teachers to prepare and develop new content, they must be given the time to do so (Shoulders & Myers, 2011). This school system has been supportive of their teachers taking the time during the school year to seek out professional development. Today many agricultural educators are open to teaching new concepts but lack the knowledge to integrate biological and technology content (Mowen, 2007). Agricultural educators are the first to acknowledge they have little understanding of all the changes that have occurred and express reservations in teaching new material (Mowen, 2007). Other agricultural educators have expressed concerns over having resources available to integrate science and having the facilities available for laboratory exercises (Conner, 2002; Dunham T., 2002). The teachers in this program have taken advantage of continued professional education that excited their interest in biotechnology. This excitement was brought back to the school and sparked the design and development of the biotechnology program (Wells, et al., 2015). Their excitement spread to the school administration, local county administration, and local businesses, which got them on board, which led to finding the resources necessary to move the project forward.

The thought that new innovations cost a lot of money, and knowing the cost of this program, could present a barrier preventing other programs from reaching the same levels of

innovativeness. This program has been very fortunate in obtaining the funding needed to make the changes that have occurred. The first thing to understand is that this program nor the local school system bared the full burden of funding the development of the current program. (See Table 4.3). The funding came from help and support of the stakeholders seeking the funds to design and develop new innovations and concepts for agricultural education (Stachler, 2013). The most critical partnership was established between the high school's agricultural education teachers and the faculty at the state university, with a shared vision for modernizing secondary agricultural education. The second partnership came from reaching out to the businesses, who saw the value of preparing students to enter the field of agriculture in the future. These shared visions for the program allowed the group to seek out grant opportunities and funding from outside resources to invest in this innovative program.

Continuing professional education should contribute, or influence changes made in educational programs.

Continuing professional education has been the key to the changes which have occurred during the development of this program (Rhoton & Shane, 2001). Through continued professional education the teachers in this program were inspired to change the direction of what was considered a dying program in the school (Lester, 2003). It was the consensus of the teachers involved in the program, that when they were invited to participate in an on-campus pilot program for biotechnology at the state university, they saw an opportunity to bring new life to the program (Rogers, 2003). Continuing professional education cannot directly change performance or views, but it can lead the way by communicating goals, inspiring programs and teachers toward goals, and reducing conflicts among the guiding principle faced by all teachers (Rhoton & Shane, 2001). The initial three-day workshop included four teachers (2- agricultural

and 2- science teachers) from the high school and three students. This experience led two of the teachers to learn more about biotechnology. They were given the opportunity to work for the next 3 months in the biochemistry laboratory on campus at the state university doing genetic research. One of the teachers was an agricultural teacher and the other was a biology teacher from the science department at the high school. The science teacher later joined the agricultural program as the STEM Laboratory manager, and the agricultural education teacher developed a science-based program that focused on biotechnology.

Continuing professional education has driven the changes in this program (Bates, 2016). There were two key components that became evident during this part of the study. The first was the sustenance of the teachers to commit time for continuing professional education and implementing those new ideas and content in the program (Rogers, 2003). Second, is the support for continuing professional education from the administration, which is critical when developing anything new in education. Continuing professional education must be relevant to the teachers and connect with what they want to learn. The teachers in this program have participated in continuing professional education programs and workshops, but they have also facilitated their own professional development (Shaha, 2016). The teachers have gone out-side the box and engaged in learning in the field and with businesses and organizations. They develop relationships with these resources and gained first-hand real-world experiences that are brought back and shared with their students (Smith, 2012). Participants in the study believes that making that connection of teachers to experts allow the teachers access to those experts when questions arise, or problems occur and thinking of that continuing professional education as part of their practice then they have someone they can call on.

Continuing professional education can address new innovations in agriculture and can give teachers different perspectives of what is going on in the industry (Rienties, 2013). Changes occur daily in the agricultural industry and teachers must have a network that not only shares these changes but provides the teachers resources to use to keep their programs current (Rienties, 2013). From the perspective of the participants, continuing professional education should contribute, or influence changes made in educational programs.

Recommendations

Teachers and Their Professional Networks

Based on the findings of this case study of an innovative agricultural education program, there are several teacher practices and further research recommendations. It was evident from the data collected, the teachers of this innovative program served as early adopters who facilitated the changes in the program. Teachers, therefore must be at the center of the design and development of any innovative agricultural education program. As early adopters, teachers should first start by developing a network that represents members of the local community, businesses, local government, and most especially work with agricultural education faculty at the land-grant universities. One connection not mentioned during the study was the role that the extension service and agents could play in the development of an innovative program. The extension service as a part of the university system has access to current innovative trends and issues. A connection and working relationship with the agricultural education teacher could provide additional resources for the innovative programs. This would be a good time for secondary agricultural education to bridge the disconnect that many agricultural programs have with extension. Network members from the community can share with the educator, the vision of the locality and the role of agriculture in that location. Businesses can share their needs and

expectations of students as they enter the workforce, whether it is directly from the secondary program or if they would require some type of post-secondary education. Members of the local government can share economic planning for the future. The local government can help find funding which will help develop a marketable education program designed to attract agricultural investment to support community viability. By working with the faculty at the land-grant university, teachers develop a connection to resources to support the innovative changes they need in their agricultural education program. This connection gives teachers the opportunity to have access to the latest educational content. The teachers can bring back new content to integrate into their programs. Agricultural education faculty can also help teachers by including them in collaborations of research to enhance secondary agricultural education programs. Through many of these collaborations teachers work with research scientist in the field of agricultural research, which increases the breadth of the teacher's knowledge, therefore strengthening their programs. The data from this study shows that the teacher's network was the key to this innovative program's design and development and the teachers were the early adopters which made it happen.

Further research is recommended to investigate how the teacher's role as early adopters for new innovations is established and what would encourage them to take on this role. According to this study the teachers are the key to a successful innovative program, so further research could focus on the role of the teachers. What inputs are required of the teachers? How do teachers become willing to change their pedagogy after settling into a routine of what they know and what they do best? What incentives would encourage teachers to become lifelong learners? These questions could be used to focus on the teacher's role of designing and developing an innovative agricultural education program.

Continuing Professional Education

Continuing professional education for teachers is the only means in which an innovative program can be designed and developed. Based on this study, continuing professional education takes on many forms for the teachers in this program. The teachers in this program have sought professional development in industry and have gone to where the innovations are happening in the field (Hurst, 2015). They have spent time with industry leaders and farmers to gain insight into the needs of the industry. They have partnered with the local community college and state land-grant university to develop courses and content to meet the needs of the local community. The teachers of this program have collaborated with the state land-grant universities agricultural education faculty to study and develop innovative practices which promotes content knowledge and contribute to the teacher's agricultural education programs. It is therefore recommended that once the teachers determine the needs of their program, that they develop a continuing professional education plan. The key is to focus on the expected needs of the students in their programs and seek relevant content and methods. The teachers must connect the continued learning to their teaching identity, which makes the connections to their pedagogy and their ability to communicate the content in a way that students see the connection to their daily lives. Continuing professional education should be teacher driven, where the teachers seek out opportunities that drive their interest in new innovations. They should make connections of new innovations with what they know and teach and build on that knowledge. Agricultural education teachers already have the foundational knowledge to build on, so integrating new content and innovations should be the natural course of continuing their professional education.

Further research should investigate the different methods of continuing professional education used in this program. The first was a small group workshop where teachers and

students were involved in a hands-on learning experience. The second format was one on one experiential learning in the field with researchers at the land-grant university. Third, teachers sought out programs offered in their field of interest. Fourth, teachers went out to farms and businesses to learn new innovations directly from those who were implementing those technologies in a real-world setting. How could continuing professional education lead to innovative program development? How could the agricultural industry contribute to continuing professional education for the teachers? How can agricultural education teachers collaborate with the state land-grant universities to develop an innovative program and enhance their continued professional education? Although, continuing professional education has been extensively studied, these finding suggest that there are areas which warrant further exploration.

Program Support

For programs to succeed, teachers must have support from others. This program demonstrated several ways agricultural education programs can build support. The support for the program is based on the program alignment with the needs of the community, and the educational system. Teachers need to establish an advisory committee that will contribute and support their agricultural education program. Teachers should utilize their network to gain insight into the needs of the community. When programs start filling the needs of the community, support seems to develop and that development shows relevance to the administration for their support. Teachers need to seek out opportunities that involve the community in connecting with the program, they should be able to demonstrate how innovative changes contribute to community viability. This program has demonstrated how the innovative changes impact their community and how they are preparing students to be productive and contributing members of their community. It is recommended based on the data from this study

that teachers should consider including members from local agricultural businesses, farmers, agricultural organizations, local government, and university agricultural education faculty to their advisory committees. It is also recommended that a program be developed to help pre-service and in-service agricultural education teachers establish an effective advisory committee. Teachers should select their committees based on a shared interest in agricultural education and a common goal for the agricultural education program. By working together with a common goal, teachers and advisory committees can develop an innovative program that gains support for the program.

Support for programs is an area that further research could prove valuable for others to advance their programs. Areas of support could be, but not limited to: Administrative, Community, Corporate, Student, Parents, Organizations, Private Sponsors, or Financial.

Curriculum

Agricultural education pathways deliver many options for course selection and community needs. The agricultural industry is a diverse network of career pathways which differ from location to location. Every localities agricultural base is different; teachers must identify what courses need to be taught to support their base. The best way to do this is find out what is driving the agricultural industry in that area, find out what skills are needed as students are entering the agricultural workforce, identify trends and issues facing the agricultural industry, and then decide what to teach based on those needs. The recommendation for identifying what needs to be taught, is the teachers should periodically perform a needs assessment of the local agricultural workforce. With the changes occurring in the agricultural industry, so will the needs of the agricultural education curriculum. It is also recommended that pre-service agricultural education teachers be familiar with a curriculum needs assessments. Pre-service agricultural

education teachers should as part of their student teaching be required to conduct a curriculum needs assessment. This could not only prove valuable to the pre-service teacher, but also the teaching site. The teachers in this program have addressed the changing trends and issues in the local agricultural industry, and by doing so they are seeing increased interest in the agricultural education program. By adding new courses and content that address these changes in agriculture, the enrollment in this program is steadily increasing, and both teachers and students are excited about the direction the program is taking. Agricultural education teachers should select the proper courses that address those needs. By making the courses relevant to the location, students see the connection to what is being offered, thus driving interest in the program.

Further research could produce valuable insight into what needs to be taught. How do you identify courses that need to be taught in your program? How do you keep your curriculum current and relevant? How do programs use their support network to select curriculum content? These are just a few questions that could drive future research related to curriculum development.

Expected Outcome for Students

Students are the reason for agricultural education programs, and their exiting performance and abilities should drive the curriculum. Teachers in this program have worked with the local industry, community college, and state land-grant university to determine the needs of the students as they leave the secondary agricultural education program. Knowing what each of these entities are looking for post-secondary will help agricultural teachers identify content needed to prepare the students. This study suggests that students should leave the program with soft skills which are relevant in all three post-secondary options. Agricultural education teachers can address this issue by integrating STEM concepts and PBL. These

integrations foster student learning through problem solving, social interactions, and teamwork. Students need to be able to articulate their knowledge of current agricultural issues, more especially when discussing biological advancements in agriculture. Teachers need to deliver content relevant to the advances in science as related to current agricultural applications. They need to be STEM literate, career and college ready, and ready to adapt to changes in their chosen field of study. Teachers need to apply integrated STEM applications, in a way that students adopt the procedures related to problem solving. This allows the students to transfer those adopted and learned procedures to other applications. Teachers need to demonstrate the value of becoming a life-long learner. Students tend to emulate their mentors, so the impact that teachers have on the students can be life changing for the students.

What students need to know and how do they need to perform beyond their secondary agricultural education program could be studied further to identify student needs. How do you teach students to transfer procedural knowledge between applications? How do you differentiate the difference of STEM literacy and STEM proficiency? How do you encourage students to become life-long learners? These are a few questions that could warrant further research.

Summary

The public's idea of food production and farming are based on the illusions envisioned through stories, movies, and misconceptions presented through media (Smith, 2013). Over the years agricultural education has contributed to this stagnated image of agriculture by not addressing the changes in curriculum as they evolved. Today agricultural education must prepare a different type of student. A student who is ready to tackle changes in the agricultural industry. Students who complete an agricultural education program today must be college and career ready, exhibit soft skills that employers and colleges are looking for, be STEM literate, and able

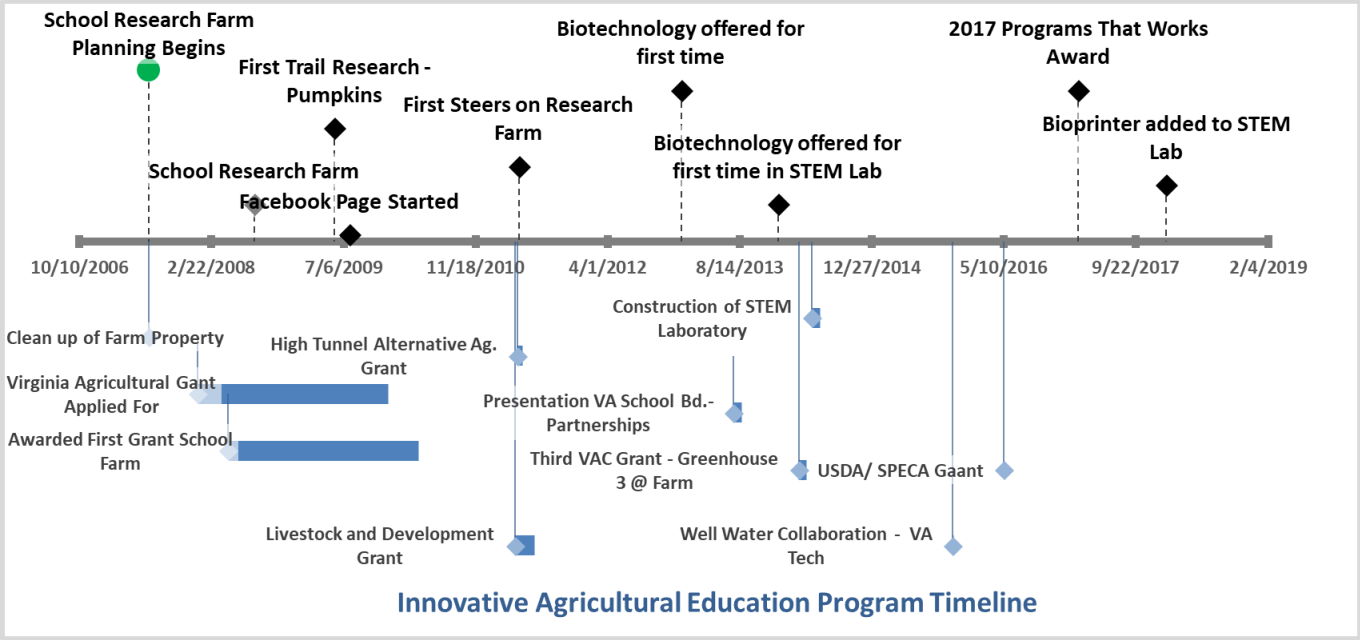
to demonstrate leadership and communication skills. To face these challenges, agricultural education programs must become innovative to keep pace with the changes in the industry. If changes are not made, then agricultural education will no longer spread the knowledge of how and when new agricultural innovations are presented.

The program in this study has made many changes to its curriculum, ones that would give the appearance of innovations in action. To accomplish these changes, teachers have collaborated with faculty members at the state land-grant university to identify what an innovative agricultural education program should look like. They have developed a network of contributors from research, education, government, and industry. The program has integrated STEM and science content that reaches beyond what the state competencies require by adding their own localized content. They have given the learning experience back to the students, to allow them to explore and find meaning to problems presented in the agricultural industry. These changes have infused a dynamic learning environment that has created excitement for the teachers and students. Teachers are constantly seeking new content and implementing changes to the program for students to have exposure to the latest innovations in the agricultural industry.

The findings of this study have delivered a clear picture of this innovative agricultural education program. There were nine themes to emerge from the data collected, these themes support the role the participants have played in the design and development of this innovative agricultural education program. These themes could be used to drive research questions for other studies to examine the relation of industrial innovations to agricultural education programs. Other programs should be looked at and compared to this program to determine the innovativeness of this program. In closing, it is suggested that additional research should be

conducted to gain insight into helping agricultural teachers deliver innovative agricultural education programs heading into the future.

Appendix A


School Research Farm Planning Begins
First Trail Research - Pumpkins
First Steers on Research Farm
Biotechnology offered for first time
2017 Programs That Works Award
Bioprinter added to STEM Lab
School Research Farm Facebook Page Started
Biotechnology offered for first time in STEM Lab
10/10/2006
2/22/2008
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
2/4/2019
Construction of STEM Laboratory
Clean up of Farm Property
High Tunnel Alternative Ag. Grant
Virginia Agricultural Gant Applied For
Presentation VA School Bd.- Partnerships
Awarded First Grant School Farm
Third VAC Grant - Greenhouse 3 @ Farm
USDA/ SPECA Gaant
Livestock and Development Grant
Well Water Collaboration - VA Tech
Innovative Agricultural Education Program Timeline

Appendix B

Request to Participate

January 13, 2018

Greetings Friends and Colleagues,

It is hard to believe it has been 11 years since I began teaching at Carroll County High School, and even harder to believe all the changes that have been developed to modernize the agricultural education program. None of these changes would have been possible without your contributions and inputs. I would like to thank you for your help, which has allowed me to be at the center of these changes, which has impacted over 2,000 students with an innovative learning experience that is truly unique.

As we move forward, we must stop and reflect on the course of actions that have allowed us to reach this milestone. We must reflect on what has worked, what has not, and what could be improved to make it better. Once again, I would like to call upon you to reflect on your lived experiences with this program. Over the next few weeks, I ask you to sit down with me and participate in a fact-finding interview, which will allow me to document and analyze the development of this program. It is my hope that this research project will produce an innovative model for other agricultural education programs to replicate.

Participation in the interview is voluntary and will take approximately an hour. I hope you will consider helping me with this project. If you are interested, reply to this email, and say that you are willing to participate. I will contact you to set up a time for us to meet. Thank you in advance for your consideration of contributing to this project, and more especially for all that you have done to contribute to the development of this program.

Respectfully,

Randy C. Webb, PhD Candidate

Appendix C

Priori Table

Proposition	Supporting Literature	Research Questions	Interview Questions
Different perspectives challenge the assumptions of the case study.	Gaining lived details about the phenomena, such as feelings, thought processes, and emotions (Strauss & Corbin, 1998, p. 11). To avoid reader's suspicions of validity in a case study, the researcher must account for different perspectives and points of view (Yin, 2014, p. 203)	How do members of the case study perceive innovative agricultural content?	1) Please tell me about where you learn about new innovations in agriculture, ones that keeps you informed about relevant trends and issues in your professional life. 2) Please describe for me any new innovations in agriculture that you see as relevant to students learning. 3) Could you please describe your perceptions of the development and design of the current agricultural education program at CCHS.
The agricultural education program should prepare students to be productive members of their communities and help grow the local economy.	Innovative agricultural education programs should capitalize on the sustainable infrastructure of the community to build their programs (Croom, 2010). One goal of modern agricultural education programs is to prepare students to enter the workforce (Rayfield, 2012; VDOE, 2013; Fishman, 2015, p.12)	How could the design of an agricultural program support community viability?	4) Please describe for me how the design of this program has impacted or could impact the community today and in the future. What else do you think could be done to enhance the program? 5) Please describe to me how community inputs have assisted in the design and development of this agricultural education program.

			6) Please describe for me how this program could or does support the needs of the community through new innovations.
The design and development of an education programs should identify both advantages and disadvantages associated with new content.	Evaluation questions helps to reduce uncertainty about the innovation's advantages and disadvantages (Rogers, 2003). Accounts of what educators face as educational programs are being planned serves as a guide for organizational and social content (Cervero, 2006; Boone, 2006).	What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?	7) Please describe ways that a locally focused program can aide or benefit students' knowledge in the content area. 8) Please describe what you would consider the benefits of a localized agricultural education program. 9) Please describe some limitations that would prevent the program from meeting the educational needs of the agricultural education program.
Education matters because it should meet people's needs academically, informally, and politically.	Relative Advantages and Compatibility with existing content and the Complexity of new content contribute to the attributes of the innovation and the rate of adoption (Rogers, 2003). "Agricultural education programs in the future focus on students, innovative agricultural education teachers, school administrators, and	How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program?	10) Please describe for me your perception of advantages of teaching new and emerging innovations. 11) What are social concerns surrounding teaching new innovations. 12) What are some economic significance surrounding new innovations. 13) Please describe how new innovations

	professionals in the community with particular skills sets needed in agricultural education" (Rayfield, 2012, p. 38).		fit or don't into secondary agricultural education. 14) What are students' needs to be: a. career ready b. STEM ready, and c. college ready. 15) How do you think modernizing agricultural education meets the purpose of agricultural education? 16) Please describe your perceived concerns for teaching new innovations: a. What difficulties may teachers face as they try to integrate new content? b. How do teacher prepare to make these changes? c. What type of support will teacher need to make changes to their programs? 17) Please tell me about what you see as a barrier preventing new innovations from being integrated in secondary agricultural education.
Professional development should contribute, or influence changes made in educational program.	Professional development needs to initiate a teacher's behavioral change through concentrated practices which are continual over a sufficient period of	How has participation in professional development contributed to the innovative agricultural content of this program?	18) Please describe for me ways that professional development has or could help address new innovations in agriculture?

	time (Shoulders & Myers, 2014). Using teachers' detailed descriptions of professional development, an effective model for professional development can be designed (Birman, 2000, p. 29)		19) Please describe for me ways that professional development could be delivered to promote a change in content.

Appendix D

Informed Consent

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Research Project:

A Case Study of How Modern Agricultural Education Programs Must Be Designed

To Support Innovative Agricultural Content

Principal Investigators:

Randall C Webb, Virginia Polytechnic Institute and State University

Donna Westfall-Rudd, Committee Chair, Virginia Polytechnic Institute and State University

I. Purpose of this Research/Project

This is a case study of how modern agricultural education programs must be designed to support innovative agricultural content. The study will consist of interviewing participants who were and currently are involved in the secondary agricultural education program of interest. I will be asked to describe my experiences on the above topic during a one-on-one interview with the principal investigator.

II. Procedures

My participation in the above-mentioned interview will involve sharing with the interviewer my experiences of how modern agricultural education programs must be designed to support innovative agricultural content. This interview will take no more than one hour in total and will take place at a mutually agreed upon place.

III. Risks

The risks associated with participating in this study are minimal.

IV. Benefits

No promise or guarantee of benefits has been made to encourage me to participate. The data collected from me during this study will be used for purposes of collecting data for the interviewer's research. If the interview data collected from me is used, the principal investigator

will provide me with a copy of the written report and discuss the findings with me after the research has been completed**.**

V. Extent of Anonymity and Confidentiality

My identity, and that of any individuals who I mention, will be kept confidential always and will be known only to the principal investigator. The above-mentioned interview will be audio recorded and later transcribed by the principal investigator. When the audio recording is transcribed, pseudonyms, false names will be used for my name and for the names of any other individuals who I mention. Any details in the audio recording that could potentially identify me or anyone who I mention will also be altered during the transcription process. After the transcribing is complete, the audio recording will be stored securely by the principal investigator. This audio recording, all paper and electronic copies of the interview transcript, and this consent form will be erased or shredded promptly after the above-mentioned research has been completed.

It is possible that the Institutional Review Board {IRB} at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.

VI. Compensation

I will not receive any form of compensation for participating in this study.

VII. Freedom to Withdraw

My participation in this study is entirely voluntary, and my refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled. Similarly, I am free to withdraw from this study at any time without penalty or loss of benefits to which I am otherwise entitled. If I choose to withdraw from the study, any information about me and any data that I have provided will be destroyed. I am also free to choose to not answer any question, or to not complete any activity, and this choice will result in no penalty or loss of benefits to which I am otherwise entitled.

VIII. Participant's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities: to participate in a one-on-one interview of no more than one hour, as described in Section II above.

IX. Participant's Permission

I have read and understand the Informed Consent and the conditions of this study. I have also had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____ Date _____

Signature of Participant

_____

Printed Name

_____ Date _____

Signature of Principal Investigator

Randall C Webb_____

Printed Name

_____ Date_____

Signature of Committee Chair

Donna Westfall-Rudd_____

Printed Name

Should I have any questions about this study or its conduct, or participants' rights, I may contact:

Randall C Webb, Principal Investigator
Cell: 276-733-0884
Email: rcwebb06@vt.edu

Donna Westfall-Rudd, Committee Chair
Office: 540-231-5717
Email: mooredm@vt.edu

IMPORTANT NOTE TO THE PARTICIPANT: This study does qualify as research. It is being conducted for research and in partial fulfillment of the requirements for the degree of Doctor of Philosophy, and it is therefore subject to approval from Virginia Tech's Institutional Review Board. Thank you for agreeing to participate!

Appendix E

Interview Guide

A Case Study of How Modern Agricultural Education Programs Must Be Designed To Support Innovative Agricultural Content

Thank you for taking the time today. I really appreciate it.

Okay. Well, I have a number of questions that I will ask you about your experiences, and I would like you to respond to each one in whatever way you feel is most appropriate. Also, I would like you to describe your experiences in as much detail as possible. . .."

I want to emphasize that I'm interested in learning about your experiences, whatever they may have been for you. There are no right or wrong answers. I want to know about your experiences just as they happened for you.

During the interview, I may write down some things on this note pad/paper. I use it as a way to remember points that I can then follow up with you about later in the interview.

Do you have any questions?

Are you feeling comfortable with the interview?

Would you like to start the interview now?

A. How do members of the case study perceive innovative agricultural content?

I would like to start by having you focus on the changes you have seen in the agricultural industry in recent years.

1) Please tell me about where you learn about new innovations in agriculture, ones that keeps you informed about relevant trends and issues in your professional life.

2) Please describe for me any new innovations in agriculture that you see as relevant to students learning.

3) Could you please describe your perceptions of the development and design of the current agricultural education program at CCHS.

B. How could the design of an agricultural program support community viability?

Now I would like to shift briefly to how could the design of the agricultural program support community viability as it relates to preparing students for the future.

4) Please describe for me how the design of this program has impacted or could impact the community today and in the future.

What else do you think could be done to enhance the program?

5) Please describe to me how community inputs have assisted in the design and development of this agricultural education program.

How would you suggest that these inputs continue to advance the program in the future?

6) Please describe for me how this program could or does support the needs of the community through new innovations.

How could this program do more to support the community?

C. <u>What are the limitations or opportunities found in designing a localized agricultural education program that includes innovative agricultural content?</u>

At this point, I would like to focus on a localized approach to agricultural education and how this type of approach can provide opportunities or limitations in what is being taught in the classroom.

7) Please describe ways that a locally focused program can aide or benefit students' knowledge in the content area.

Job shadowing, internships, Supervised Agricultural Experience,

8) Please describe what you would consider the benefits of a localized agricultural education program.

Student prepared to enter the workforce, post-secondary education then return home

9) Please describe some limitations that would prevent the program from meeting the educational needs of the agricultural education program.

Educators, professional development, and resources

D. <u>How could a local approach present an advantage, compatibility with existing content, and complexity to an agricultural education program.</u>

Relative Advantage

10) Please describe for me your perception of advantages of teaching new and emerging innovations.

11) What are social concerns surrounding teaching new innovations.

12) What are some economic significance surrounding new innovations.

Compatibility

13) Please describe how new innovations fit or don't into secondary agricultural education.

14) What are students' needs to be:

a. career ready

b. STEM ready, and

c. college ready.

15) How do you think modernizing agricultural education meets the purpose of agricultural education?

Complexity

16) Please describe your perceived concerns for teaching new innovations:

a. What difficulties may teachers face as they try to integrate new content?

b. How do teacher prepare to make these changes?

c. What type of support will teacher need to make changes to their programs?

17) Please tell me about what you see as a barrier preventing new innovations from being integrated in secondary agricultural education.

E. <u>How has participation in professional development contributed to the innovative agricultural content of this program?</u>

18) Please describe for me ways that professional development has or could help address new innovations in agriculture?

19) Please describe for me ways that professional development could be delivered to promote a change in content.

Appendix F

School Research Farm

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