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Attitudes of Virginia Technology Education Teachers toward the Effectiveness of Their Curriculum

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ATTITUDES OF VIRGINIA TECHNOLOGY EDUCATION TEACHERS TOWARD THE EFFECTIVENESS OF THEIR CURRICULUM

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SIGNATURE PAGE

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CHAPTER I

INTRODUCTION

In the closing decades of the twentieth century, technology education was added to many secondary school courses of study (Wicklein, 1997; Zuga, 1991). Consistent with that trend, Virginia replaced its industrial arts curriculum with a technology education curriculum in 1992.

In the opening years of the twenty-first century, some important developments in technology education included the initial publication of the *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (2000), *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (2003), and two of their addenda, *Realizing Excellence: Structuring Technology Programs* and *Planning Learning: Developing Technology Curricula* (2005). These documents were produced by the International Technology Education Association (ITEA). By 2007, the ITEA's Center to Advance Teaching in Technology and Science (ITEA-CATTS) developed the *Engineering byDesign*™ (*EbD*™) model program based upon the *STL* and *AETL* (International Technology Education Association [ITEA], 2007). Note that the ITEA has been renamed the International Technology and Engineering Educators Association (ITEEA) and CATTS is now called STEM Center for Teaching and Learning™ (STEM CTL™).

Although these significant contributions to technology education program content and curriculum development have taken place, the content contained within Virginia's technology education competency listings still vary from the *STL*

(ITEA, 2007; Virginia's Career and Technical Education Resource Center [V-CTE-RC], n.d.b), and the structure of the Virginia curriculum has not been updated in over twenty years. Finally, Beddow (2009) concluded that although Virginia was an ITEA-CATTS consortium participant state in 2008, which included access to the *EbD*™ curriculum, it had not been adopted in Virginia.

Consequently, this study seeks to determine from the technology education teacher's perspective whether the current Virginia technology education curriculum framework is helpful and effective at developing technological literacy for all students. The conclusions of this research should support Virginia technology education curriculum decision makers in the need to modify the curriculum.

Statement of the Problem

The problem of this study was to determine Virginia technology education teachers' attitudes regarding the effectiveness of their curriculum and resources.

Research Goals

This study seeks to answer the following research questions:

RQ_1: To what extent are the Virginia technology education curriculum and resources being used in the classroom?

RQ_2: How effective are the Virginia technology education curriculum and resources at developing technological literacy in students?

RQ_3: Are there portions of the Virginia technology education courses that do not support current technologies in these areas?

RQ4: Is the Virginia technology education curriculum relevant for 21st century technology education classes?

Background and Significance

This study arose from the implementation of technology education within Virginia. The rise of technology education, as “a field of study … has evolved over the past fifteen to twenty years from industrial arts programs” (ITEA, 2007, p. 3). Per the National Academy of Engineering’s Committee on Technological Literacy (2002), secondary school is a natural place to work on increasing technological literacy. “The study of technology in the K-12 classroom has three distinct forms: (1) a theme in other disciplines, especially science; (2) formal technology education classes; and (3) technician-preparation, vocational, and school-to-career programs” (National Academy of Sciences [NAS], 2002, p. 77). Virginia implemented the second form in middle and high school, formal technology education classes, by transitioning from a state industrial arts curriculum (Industrial Arts Curriculum Council, 1980) to a state technology education curriculum in 1992 (Virginia Council on Technology Education for the 21st Century, 1992). Virginia’s Career and Technical Education (CTE) Resource Center (V-CTE-RC), established in 1982, also contains “curriculum-related publications that address specific courses or programs…. Staff members … design, produce, and distribute the following materials: validated task lists, curriculum frameworks … and administrative guides” (V-CTE-RC, n.d.a, para. 4). The Virginia technology education curriculum, associated V-CTE-RC resources, teacher preparation colleges, and professional development activities guided its implementation within the state.

Following technology education's establishment in Virginia, the ensuing decade saw additional research on technology education teacher preparation and curriculum development (Daugherty & Wicklein, 1993; Petrina, 1998; Rasinen, 2003; Wicklein, 1997; Zuga, 1991). Perhaps the richest series of developments in technology education content and curriculum were during the opening decade of the twenty-first century by the ITEA and its CATTS. The ITEA published the *STL* initially in 2000, the *AETL* in 2003, and four "Addenda" in 2004 and 2005. Then in 2007, ITEA-CATTS developed the *EbD*™ model program curriculum based upon the *STL* and *AETL*.

In 2008, the publication of the Virginia technology education programs and courses did not alter the curriculum or associated resources (Virginia Department of Education [VDoE], 2008), nor did it incorporate a decade and a half's worth of research and development. In recent years, with the VDoE emphasis shifting back to career clusters with associated pathways and program of studies (POS), technology education falls in the science, technology, engineering, and mathematics (STEM) cluster and engineering and technology pathway. Per Basham, the program of studies remains largely unchanged for technology education (personal communication, February 27, 2013).

The need for this study, its significance, came from (a) the supporting statements of other researchers, such as the Virginia Council on Technology Education for the 21st Century and ITEEA; (b) the time lapse between research on technology education curriculum development and implementation, and changes to Virginia's curriculum; (c) the gaps in the knowledge supplied by other research studies on various aspects of Virginia's technology education curriculum; and (d) the lack of specific information about the Virginia middle and high school technology education curriculum's effectiveness. The importance of the study is clear from these sources.

Other researchers have recommended that technology education content and curriculum developments be incorporated by the states. The Virginia Council on Technology Education for the 21st Century (1987) recommended research on an appropriate and effective curriculum. This was reiterated in the Virginia curriculum in 1992, noting that it was updated with continuing research and development in technology education. Wulf (2007) notes in his foreword to the *STL* that, "It is not enough to have the standards published. To have an impact, they must influence what happens in every K-12 classroom in America. This will not happen without the development of new curricula" (p. vi). The *STL* does not lay out a curriculum; "it does not specify how the content should be structured, sequenced, and organized. This task is left, as it should be, to individual teachers and other curriculum developers in the schools, school districts, and states" (ITEA, 2007, p. 200). The STEM CTL™ took this a step further by actually providing a model curriculum (*EbD*™) based upon the *STL* and *AETL* and associated research. *EbD*™ was also designed to work within the STEM cluster and pathways (Burke, 2006; Burke, 2007).

There have been more recent studies covering technology education teacher preparation (Fantz, De Miranda, & Siller, 2011); middle school content, curriculum, and classroom practices (Sherman, Sanders, & Kwon, 2010); STEM integration (Basilone, 2011); and the conceptual basis for the curriculum (Rossouw, Hacker, & de Vries, 2011), in the broader national and international settings. Ritz (2012) found that international curriculum issues included implementation of national technology education curricula. The common theme in these studies is implementing and updating technology education curricula. It is worth noting that there have been no significant changes to the Virginia middle and high school technology education curriculum in the two decades since its implementation, particularly in light of the intervening research.

Two studies within the Virginia state context were by Cantu (2011), covering Virginia elementary schools' inclusion of STEM, and Beddow (2009), considering Virginia technology education local supervisors' awareness and implementation of the *EbD*™ curriculum. It is interesting that both Cantu and Beddow noted that alignment with the state curriculum was important to successful incorporation of their subjects. Unfortunately, these studies do not cover the Virginia middle and high school technology education curriculum itself.

Finally, no studies were found that considered the Virginia middle and high school technology education curriculum's effectiveness, or any of the developments from the last twenty years missing from it. Consequently, there is a need for this study and it is important to provide Virginia's technology education teachers and curriculum supervisors and administrators with research on the necessity of updating their curriculum and resources.

Limitations

The findings of this research were limited by certain factors and conditions. The studies methodological limitations were associated with using an electronic survey to gather perceptions about the state curriculum and resources from middle and high school technology education teachers in the Commonwealth of Virginia. The study was done using an email listing of Virginia middle and high school technology education teachers obtained from the Virginia Technology and Engineering Education Association (VTEEA). The curriculum under consideration was the Virginia technology education curriculum middle and high school program of studies established in 1992. The resources under consideration were the V-CTE-RC resources. The electronic survey was developed based upon a literature review, research questions, and pilot testing. Extending the survey results to the greater Virginia middle and high school technology education teacher population is limited based upon the VTEEA sampling. The conceptual or definitional limitations were primarily associated with the teacher's definition of "curriculum" and determination of the "effectiveness" of the curriculum in developing "technological literacy" in their students.

Assumptions

The assumptions included in this study establish those items the researcher believed to be true and unalterable. The assumptions include the following:

- The goal of a technology education curriculum is to guide and support technology education teachers' instruction resulting in the technological literacy of their students.
- Technology education teachers are teaching technological literacy to their students.
- Student success in technology education class equates to technological literacy.
- Technology educators that are using the Virginia curriculum in their classrooms are in the best position to evaluate its effectiveness and current relevance.

Procedures

The procedural method for collecting data in this study began with identification of a population from which the researcher could gather data. The researcher determined that the perceptions of middle and high school technology educators would provide the best evaluation of the effectiveness and current relevance of the state's curriculum and resources. The population for the study was Virginia middle and high school technology education teachers who are members of Virginia Technology and Engineering Education Association (VTEEA) with email addresses on record.

An electronic survey was developed based upon a literature review, four research questions for the study, and pilot testing of the survey. The researcher emailed the cover letter with a link to the electronic survey to the entire email listing received from VTEEA for Virginia middle and high school technology education teachers. Respondents were asked to complete the survey within ten days. A follow-up email was sent one week after the initial one including the link to the electronic survey. Due to a low response rate, the survey was extended two weeks and two additional follow-up emails were sent. Upon completion of the electronic survey data collection, it was analyzed using descriptive statistical methods to reveal perceptions regarding the Virginia middle and high school technology education curriculum and resources use, effectiveness, and need for updating.

Definition of Terms

This section defines words that have special meaning to the study.

Curriculum: A curriculum is a plan for education (Beauchamp, 1975; Zais, 1976) or learning (Taba, 1962). A curriculum "usually contains a statement of aims and of specific objectives; it indicates some selection and organization of content; it either implies or manifests certain patterns of learning and teaching…. Finally, it includes a program of evaluation of the outcomes" (Taba, 1962, p. 10). Zais (1976) agrees that curricula contain aims, goals, and objectives; content; learning activities; and evaluation.

Technological literacy: "The ability to use, manage, understand, and assess technology" (ITEA, 2007, p. 242).

Technology education: “A study of technology, which provides an opportunity for students to learn about the processes and knowledge related to technology that are needed to solve problems and extend human capabilities” (ITEA, 2007, p. 242).

Overview of Chapters

This research was organized into five major sections. Chapter I introduced the reader to this descriptive study, which was designed to determine Virginia technology education teachers’ attitudes regarding the effectiveness of their curriculum and resources. The research goals included determining the extent to which the curriculum and resources were used; how effective the curriculum and resources were at developing technological literacy in students; if portions did not support current developments in the technology areas; and if the curriculum was relevant for 21st century technology education classes. The studies limitations were associated with Virginia middle and high school technology education teachers who are members of VTEEA and the electronic survey used to gather their perceptions about the Virginia curriculum’s effectiveness and current relevance.

Chapter II, Review of Literature, is organized based upon the problem statement and research question descriptors and covers the Virginia technology education curriculum, including a brief history of curriculum development, and the Virginia industrial arts and technology education curricula; technology education and technological literacy; and technology areas, including the designed world and business and industry technology. Chapter III, Methods and Procedures, contains information regarding the methods and procedures used to collect the study’s data. This includes defining the population for the study, describing the survey instrument’s design, and explaining the methods of data collection. The chapter also introduces the statistical analysis methods used to treat the data and develop meaning.

In Chapter IV, Findings, the survey data are analyzed and the results presented. This chapter discusses the response rate and reports the survey findings grouped in research question order. Chapter V, Summary, Conclusions, and Recommendations, the researcher summarizes the research study by drawing conclusions and making recommendations based upon the data collected.

CHAPTER II

REVIEW OF LITERATURE

This review is organized based upon the problem statement and research question descriptors and covers the Virginia technology education curriculum including a brief history of curriculum development and the Virginia industrial arts and technology education curricula; technology education and technological literacy; and technology areas including the designed world and business and industry technology. The intent of the review is to consider benchmarks and research on education curricula in general and technology education in middle and high school in Virginia in particular.

Virginia Technology Education Curriculum

Virginia technology education curriculum development was based upon the definition of curriculum and the curriculum development process at the time, the introduction of technology education, and the transition from an industrial arts to a technology education curriculum in Virginia.

Curriculum Development

Consideration of curriculum development quickly revealed that it follows closely the definition of curriculum in use at the time. The definition of curriculum has ranged from a program of studies to the entire educational experience including the hidden and collateral, as well as the written, curriculum (Finch & Crunkilton, 1999; Posner & Rudnitsky, 2006; Tanner & Tanner, 2007; Wiles, 2009). Tanner and Tanner (2007) captured this well:

> Curriculum has been variously defined as (1) the cumulative tradition of organized knowledge, (2) the instructional plan or course of study, (3) measured instructional outcomes (technological production system), (4) cultural reproduction, (5) knowledge selection/organization from the culture, (6) modes of thought, and (7) guided living/planned learning environment. (p. 120)

In 1992, when the Virginia technology education curriculum was developed, the definition was course of studies, however aspects of measured instructional outcomes and the collateral curriculum were also included.

Tanner and Tanner (2007) succinctly revealed the roots of curriculum development as follows:

> Curriculum unifies what schools set out to be learned and ways that students can be connected with it in their own lives. The unified conception grew out of the work of John Dewey in his famous Laboratory School at the University of Chicago (1897-1904). During the twentieth century, famous theorists who were also gifted practitioners, such as Ralph Tyler (1949) and Hilda Taba (1962), constructed procedures for teachers and supervisors to follow in curriculum development that were based on Dewey's conception. (p. 2)

Additional insight into Virginia technology education curriculum development came from Ritz (1980), one of the members of the Virginia Council on Technology Education for the 21st Century closely associated with the curriculum's development, who had a model for such work. He related that:

> Analysis of reports and texts in the curriculum area reveal that many proposals have been suggested for models or steps to be taken in educational program development. Those that had the greatest influence on the author have been presented by Tabu (1962) and Zais (1976). Both writers have developed systematic procedures for the development of curriculum. Their models are based on the establishment of foundations, content, and evaluation procedures. (Ritz, 2006, para. 2)

The Ritz model includes curriculum foundations that are the components that influence and control the content and organization of the curriculum (Zais, 1976). They include such components as “(1) definition of the program area, (2) rationale for the study of the program area, (3) content source, (4) content structure, (5) program aim, and (6) program goals are included in the curriculum foundations” (Ritz, 2006, para. 6).

Curriculum content is the second major category of curricular elements in the model.

> It includes the knowledge, skills, and attitudes (values) which educators are interested in conveying to learners. …the content focuses upon the specific information to be transmitted and the means of transmission. In this category are the scope, sequence, and unit specifications. The unit specifications may be further divided into goals, rationales, objectives, activities, and references. (Ritz, 2006, para. 15)

These elements were presented in detail, because the Virginia technology education curriculum reflects most of them, as will be seen later.

Ritz (2006) noted that “curriculum development is one of the key factors related to meaningful and successful program improvement” (para. 1). This led to the next two important elements after a curriculum is built: (a) evaluation of its effectiveness and (b) updating it. The processes and models reviewed all had these two elements (Finch & Crunkilton, 1999; Jacobs, 2009; Posner & Rudnitsky, 2006; Ritz, 2006; Tanner & Tanner, 2007; Wiles, 2009). Wiles and Bondi (2007) observed “the dynamic view of curriculum work is that it is an active process involving the continual construction and improvement of school programs” (p. 8). Jacobs (2009) stated “the contention of this book is that we need to overhaul, update, and inject life into our curriculum” (p. 2). The fact that these elements are missing from the Virginia curriculum are raised later.

Two other developments that have impacted the curriculum are competency-based education and standards, and aspects of these are seen in the Virginia curriculum and its associated resources. Finch and Crunkilton (1999) highlighted the following two aspects of competency-based education (CBE): “competencies … are those tasks, skills, attitudes, values, and appreciations that are deemed critical to success in life and/or in earning a living” (p. 259) and “in contrast with a time-based mode, competency-based education uses demonstrated competency as a determiner of student progress toward program completion” (p. 260). Posner and Rudnitsky (2006) stated regarding standards “any lingering doubts about the universality of standards in United States public schools was put to rest in 2002 when the federal government enacted the No Child Left Behind Act” (p. 17). Finch and Crunkilton (1999) also remarked on two laws that have affected elements of the technology education curriculum, The Carl D. Perkins Vocational and Applied Technology Education Act of 1990 (Perkins II) and School-to-Work Opportunities Act of 1994.

Finally, several recent and “progressive” definitions of curriculum have included instruction within it (Finch & Crunkilton, 1999; Tanner & Tanner, 2007; Wiles & Bondi, 2007). If these definitions are adopted, then there are implications for inclusion of instruction in future curricula.

Virginia Industrial Arts Curriculum

The Virginia industrial arts curriculum was the predecessor of the technology education curriculum and is considered here. Many aspects of curriculum development previously discussed are present in the industrial arts curriculum. The Virginia industrial arts (IA) curriculum contains a description of IA; how it can help students; the mission and goals of IA; the instructional objectives; the function of IA in comprehensive education; the description, goals, and standards for the elementary, middle or junior high, and high school programs; student organization (American Industrial Arts Student Association - AIASA); and a model IA curriculum showing the level, goals, and programs (Industrial Arts Curriculum Council, 1977). The second edition contained the mission and goals of IA; the IA articulation model; the description, goals, and standards for the elementary, middle or junior high, and high school plans; student association (AIASA); and IA program of studies showing the level, goals, and program courses (Industrial Arts Curriculum Council, 1980). It is worth noting that the inclusion of the student organization recognizes the “collateral” curriculum and helps remove it from the “hidden” curriculum.

Coincidental with the industrial arts curriculum, Virginia developed competency-based instruction for industrial arts. Ritz and Joyner (1978) in the final report on the development of a competency-based instruction curriculum plan, stated “competency-based instruction can be explained as a process of specifying what makes a person competent in a certain subject or field, and then the teaching of these competencies to the learner” (p. 3). The report contained an implementation plan for competency-based instruction. Subsequently, instructional resource guides were developed for competency-based programs in selected industrial arts program areas. The following quote is from the modern industry program area, “The primary goal of this proposed project was to develop an instructional resource guide for the Modern Industry program according to the approved format adopted by the Virginia Department of Education Vocational Curriculum Development Service” (Ritz, 1984, p. 3). Consequently the curriculum with the associated competency-based resources constituted the industrial arts curriculum plan. Most of these types of curriculum associated resources were transitioned to the V-CTE-RC when it was established in 1982.

Virginia Technology Education Curriculum

Virginia implemented formal technology education classes, by transitioning from a state industrial arts curriculum to a state technology education curriculum in 1992. The 1987 report entitled “Technology Education for

21st Century" by the same council that authored the curriculum that laid its groundwork.

The Virginia technology education (TE) curriculum for K-12 includes an introduction citing the *Technology Report of Project 2061*, a perspective on technology, definitions of technology and technology education including models, the mission, and goals of TE, and a curriculum design for TE showing the levels, learner needs, processes of technology, and outcomes. There are three sections in the curriculum covering (1) TE in early childhood education (elementary school - grades K-5), (2) pre- and early adolescent education (middle school - grades 6-8), and (3) adolescent education (high school - grades 9-12), that include a model; a program showing grade sequence, experience/course, and emphasis (middle and high school only); a description, focus, and requirements; and conceptual framework and delivery to students (high school only) (Virginia Council on Technology Education for the 21st Century, 1992).

The two definitions from the curriculum are as follows: "Technology is the application of knowledge, creativity, and resources to solve problems and extend human potential" (p. 5) and "Technology Education is the school discipline for the study of the application of knowledge, creativity, and resources to solve problems and extend human potential" (Virginia Council on Technology Education for the 21st Century, 1992, p. 6).

The obvious implication is that technology education is the study of technology. Many of the same curriculum development elements considered previously are also present in the technology education curriculum. It is worth noting that the student organization that was present in the industrial arts curriculum is missing from the technology education curriculum.

V-CTE-RC, established in 1982, also contains “curriculum-related publications that address specific courses or programs…. Staff members … design, produce, and distribute the following materials: validated task lists, curriculum frameworks … and administrative guides” (V-CTE-RC, n.d.a, para. 4). These resources, which include course task/competency lists, are similar to the competency-based resources developed for the industrial arts curriculum. These resources along with the curriculum constitute the curriculum plan. It is also worth noting that there were technology education programs and courses documents available on the VDoE technology education web page from 2008 through 2012, however they were removed this year (Basham, personal communication, February 27, 2013).

Technology Education and Technological Literacy

The rise of technology education, as “a field of study … has evolved over the past fifteen to twenty years from industrial arts programs” (ITEA, 2007, p. 3). Bensen (1988) noted that, “Over 30 state industrial education associations have changed their names to include ‘Technology’” (p. 167). Technology education is a “study of technology, which provides an opportunity for students to learn about the processes and knowledge related to technology that are needed to solve problems and extend human capabilities” (ITEA, 2007, p. 242). Technological literacy is the “ability to use, manage, understand, and assess technology” (ITEA, 2007, p. 242). The goal of technology education is to develop student technological literacy.

The last decade of the twentieth century included research on technology education teacher preparation and curriculum development (Bensen, 1988; Daugherty & Wicklein, 1993; Petrina, 1998; Rasinen, 2003; Wicklein, 1997; Zuga, 1991), while the opening decade of the twenty-first century saw the richest series of developments in technology education content and curriculum by the ITEA and its CATTS. Those developments included the initial publication of the *STL* in 2000, *AETL* in 2003, and two of their addenda, *Realizing Excellence: Structuring Technology Programs* and *Planning Learning: Developing Technology Curricula,* in 2005, by the ITEA. The CATTS developed the *EbD*™ model program based upon the *STL* and *AETL* in 2007 (ITEA, 2007).

There have been more recent studies covering technology education teacher preparation (Fantz, De Miranda, & Siller, 2011); middle school content, curriculum and classroom practices (Sherman, Sanders, & Kwon, 2010); STEM integration (Basilone, 2011); and the conceptual basis for the curriculum (Rossouw, Hacker, & Vries, 2011), in the broader national and international settings. Ritz (2012) found that international curriculum issues included implementation of national technology education curricula. The common theme in these studies is implementing and updating technology education curricula.

Two studies within the Virginia state context were by Cantu (2011), covering Virginia elementary schools' inclusion of STEM, and Beddow (2009), considering Virginia technology education local supervisors' awareness and implementation of the *EbD*™ curriculum. It is interesting that both Cantu and Beddow noted that alignment with the state curriculum was important to successful incorporation of their subjects.

Finally, no studies were found that considered the effectiveness of the Virginia middle and high school technology education curriculum, or updating it with the developments from the last twenty years. It is worth noting again the importance of evaluation of curriculum effectiveness and updating of curriculum content in the curriculum development and maintenance processes. Consequently, there is a need to study those elements and provide Virginia's technology education teachers and curriculum supervisors and administrators with feedback on the effectiveness and relevance of their curriculum and resources.

Technology Areas

Technologies have been divided into areas using various taxonomies. Two were considered for use in this study: the seven categories of technologies from the *STL* and the sixteen Career Clusters™.

The Designed World

The *STL* breaks the designed world into medical technologies (standard 14); agricultural and related biotechnologies (standard 15); energy and power technologies (standard 16); information and communication technologies (standard 17); transportation technologies (standard 18); manufacturing technologies (standard 19); and construction technologies (standard 20). Most Virginia technology education teachers are familiar with the *STL* and the designed world taxonomy, making it useful for considering the current range of technologies.

Business and Industry Technology

"Virginia has adopted the nationally accepted structure of career clusters, career pathways and sample career specialties or occupations" (VDoE, n.d., para. 1). There are sixteen Career Clusters™. Although technology education is in the STEM cluster, all of the clusters need to be used to capture business and industry technology.

> A Career Cluster is a grouping of occupations and broad industries based on commonalities. Within each career cluster, there are multiple career pathways that represent a common set of skills and knowledge, both academic and technical, necessary to pursue a full range of career opportunities within that pathway…. Based on the skills sets taught, all CTE courses are aligned with one or more career clusters and career pathways. (VDoE, n.d., para. 2)

Many Virginia technology education teachers are familiar with the Career Clusters™ taxonomy because of its use in Virginia and the V-CTE-RC. A taxonomy that captures the range of current business and industry technologies, and is familiar to study participants, is helpful when asking them to identify current technologies.

Summary

Chapter II, Review of Literature, was organized based upon the problem statement and research question descriptors. The first section covered the

Virginia technology education curriculum. The brief history of curriculum development included the relationship between curriculum definition and curriculum development; highlighted a development model by Ritz (1980); emphasized the importance of curriculum evaluation and maintenance; covered competency-based education and legislative requirements including standards; and the potential impact of curriculum definition changes incorporating instruction. The Virginia industrial arts and technology education curricula were also examined in this section with their accompanying resources. The next section addressed technology education and literacy. It reviewed the rise of technology education, its definition and goals, research and development associated with technology education content, and curricula on the international, national, and Virginia state fronts. The section also followed the establishment of significance approach covering (a) the supporting statements of other researchers; (b) the time lapse between research on technology education curriculum development and implementation, and changes to Virginia's curriculum; (c) the gaps in the knowledge supplied by other research studies on various aspects of Virginia's technology education curriculum; and (d) the lack of specific information about the Virginia middle and high school technology education curriculum's effectiveness. It concluded that the research was necessary to provide Virginia's technology education teachers and curriculum supervisors and administrators with feedback on the effectiveness and relevance of their curriculum. The final section considered two technology area taxonomies, the seven *STL* technology categories in the designed world, and the sixteen Career Clusters^{TM} in business and industry, for use in the study.

Chapter III, Methods and Procedures, contains information regarding the methods and procedures used to collect the data. This includes defining the population for the study, describing the instrument's design, and explaining the methods of data collection. The chapter also introduces the statistical analysis methods used to treat the data and develop meaning.

CHAPTER III

METHODS AND PROCEDURES

This chapter covers the methods and procedures used in this descriptive survey study designed to determine Virginia technology education teachers' attitudes regarding the effectiveness of the Virginia technology education curriculum and supporting resources. Those methods and procedures include defining the population for the study, describing the instrument's design, explaining the methods of data collection, and addressing the statistical analysis methods used to treat the data and develop meaning.

Population

The researcher determined that the perceptions of middle and high school technology educators would provide the best evaluation of the effectiveness and current relevance of the state's curriculum and resources. The population for the study was Virginia middle and high school technology education teachers who are members of Virginia Technology and Engineering Education Association (VTEEA) with email addresses on record. The population email listing was obtained from VTEEA. There were 156 Virginia middle and high school technology education teachers in the population.

Instrument Design

An electronic survey was developed based upon a literature review and four research questions for the study covering (1) the use of the Virginia technology education curriculum and resources in the classroom, (2) the effectiveness of the curriculum and resources at developing technological literacy in students, (3) any missing curriculum support for current technologies, and (4) curriculum relevance for 21st century technology education classes. The survey was designed to measure attitudes regarding the Virginia technology education curriculum and resources from the sample. It included closed-form, scaled, forced response and open-form, free response items regarding the research question descriptors. The survey was pilot tested with several members of the population to ensure the clarity, utility, and validity of the questions and revised based upon their feedback. The pilot testing feedback indicated (a) that the technology education curriculum in use by the teacher should be identified by where it was developed, at the state (Virginia), local (school system/school), or personal (teacher) level; and (b) that many teachers do not know what a curriculum should contain and consequently consider the CTE-RC contents the state curriculum. (None of the pilot test members had the 1992 state curriculum, nor did they consider the CTE-RC to contain the state curriculum.) See Appendix A for a copy of the survey.

Methods of Data Collection

The researcher emailed the cover letter (Appendix B) with a link to the electronic survey to the entire email listing received from VTEEA for Virginia middle and high school technology education teachers. The cover letter email provided the survey purpose, addressee response encouragement, human subject protection measures, and the notice of agency. The email also included electronic survey instructions. Respondents were asked to complete the survey within ten days. A follow-up email was sent one week after the initial one including the link to the electronic survey. Due to a low response rate, the survey was extended two weeks and two additional follow-up emails were sent. The electronic survey collected the data anonymously and provided aggregated responses to the researcher. The number of individuals from the sample completing the survey will determine the response rate.

Statistical Analysis

The electronic survey response data received by the researcher were organized by question. The closed-form, scaled, forced response answers were converted to interval data where appropriate. Similar open-form, free response answers were summarized and clustered. The data were tabulated indicating the number of responses and frequency of answers. Missing responses within the surveys were assigned zero points and included in a “None (Skipped Q)” category for statistical purposes. The responses were analyzed using descriptive statistical methods to reveal perceptions regarding the Virginia middle and high school technology education curriculum’s use, effectiveness, and need for updating.

Summary

Chapter III covered the methods and procedures for this descriptive survey study. The methods and procedures included the population, survey instrument design, methods of data collection, and statistical analysis of the survey responses. The sample was Virginia middle and high school technology education teachers who are members of VTEEA with email addresses on record. The instrument design was based upon the research question descriptors and addressed survey question types and pilot testing. The methods of data collection consisted of an email to the sample containing a link to the electronic survey that collected and reported the data upon completion of the survey period. Statistical analysis of the question response data using descriptive methods will be accomplished after being organized, converted, summarized, and tabulated.

In Chapter IV, Findings, the survey response data are analyzed and the results presented. This chapter discusses the response rate and reports the survey findings grouped by research question order.

CHAPTER IV

FINDINGS

The problem of this study was to determine Virginia technology education teachers' attitudes regarding the effectiveness of their curriculum and resources. An electronic survey was used to gather data on those attitudes from Virginia middle and high school technology education teachers who are members of the VTEEA. This chapter reports the results of the survey including the response rate and findings grouped in research and survey question order.

Response Rate

The survey population listing provided by the VTEEA was resolved to 156 valid email addresses of Virginia middle and high school technology education teachers. The survey period of ten days was extended by two weeks and two additional follow-up emails were sent in an attempt to improve the response rate. Sixty-one teachers responded. The survey response rate was 39.10 percent (Table 1). This did not provide a significant sampling of the study population. Consequently, these findings are limited to the respondents.

Table 1

Survey Response Rate

Number Emailed	Number of Responses	Response Rate (%)
156	61	39.10

Report of Survey Findings

The findings are grouped in research and survey question order. The four research questions for the study cover (1) the use of the Virginia technology education curriculum and resources in the classroom/laboratory, (2) the effectiveness of the curriculum and resources at developing technological literacy in students, (3) missing curriculum support for current technologies, and (4) curriculum relevance for 21st century technology education classes.

Curriculum and Resource Usage in Classroom/Laboratory

The first six survey questions were designed to answer Research Question 1: To what extent are the Virginia technology education curriculum and resources being used in the classroom? Survey Question 1 indicated that a technology education curriculum was available to 91.80 percent of the respondents (Table 2).

Table 2

Technology Education Curriculum Availability (Q1)

Response	Number	Percent (%)
Yes	56	91.80
No	05	08.20

Survey Question 2 was used to establish what technology education curricula were available by determining the level (state, local, or personal) at which it was prepared. The 57 responding teachers indicated that 31 (54.39 percent) were using curricula prepared at the state level, while 14 (24.56 percent) and 12 (21.05 percent) were using curricula prepared at the personal and local levels respectively (Table 3). It is noteworthy that 45.61 percent of the responding teachers or their schools had to prepare their schools' technology curriculum themselves.

Table 3

Technology Education Curriculum Preparation Level (Q2)

Response	Number	Percent (%)
State (VA)	31	54.39
Local (School/System)	12	21.05
Personal (Teacher)	14	24.56
None (Skipped Q)	04	-----

Survey Question 3 asks how frequently the curricula are used in preparation for technology education class. The 57 teachers reported that 98.24 percent used the curriculum in preparation for teaching classes (Table 4). One respondent (1.75 percent) indicated he/she never uses the curriculum. The reason selected in Survey Question 4 was it is no longer available and CTE-RC (Verso) does not contain the curriculum.

Table 4

Curriculum Used In Preparation for Class (Q3)

Response[a]	Number	Percent (%)
1 – Always	23	40.35
2 – Often	28	49.12

(continued)

Table 4. *Curriculum Used In Preparation for Class* (continued)

Response[a]	Number	Percent (%)
3 – Seldom	05	08.77
4 – Never	01	01.75
None (Skipped Q)	04	-----

Note. [a]M_1=1.72, n_1=57

Survey Question 5 asked about the use of Virginia's instructional resources available from CTE-RC in preparation for technology education classes. The 61 teachers reported that 96.72 percent used instructional resources in preparation for class (Table 5). There were only two respondents (3.28 percent) that never used the instructional resources.

Table 5

Virginia's CTE Resource Center Used in Preparation for Class (Q5)

Response[a]	Number	Percent (%)
1 – Always	14	22.95
2 – Often	28	45.90
3 – Seldom	17	27.87
4 - Never	02	03.28

Note. [a]M_2 = 2.11, n_2 = 61; t (116) = -2.85*, * p < .01

Survey Question 6 was designed to determine the reason for never using the instructional resources (only two such responses to Survey Question 5). However, there were six comments on the instructional resources (CTE-RC) that ranged from a lack of awareness (1) to the contents being too generic and broad to be useful in instructional planning and individual student tailoring (5) (Table 6).

Table 6

Reason V-CTE-RC Not Used (Q6 Open-Form)

Response	Number
The contents are too generic and broad to be useful in instructional planning and individual student tailoring.	5
Wasn't aware of them.	1

Regarding Research Question 1, based upon the answers to Survey Questions 1 through 6, the 61 responding teachers reported that 56 (91.80 percent) had a technology education curriculum available and used it in preparation for class, while 59 (96.72 percent) used the instructional resources (CTE-RC) in preparation for class. However when identifying what technology education curricula are being used, only 31 (54.39 percent) teachers considered the state to have prepared their curriculum, while 26 (45.61 percent) indicated they or their school had to prepare their curriculum.

Curriculum Usage in Developing Technological Literacy

Survey Questions 7 through 9 were designed to answer Research Question 2: How effective are the Virginia technology education curriculum and resources at developing technological literacy in students? Survey Question 7 asked teachers to identify the philosophical foci of their technology education classes to determine if developing technological literacy was included. The 61 responding teachers indicated that 91.80 percent try to develop technological literacy in their students through their technology education classes (Table 7). Some of the other technology education class foci not included in Survey Question 7's taxonomy are reported in Table 8.

Table 7

Technology Education Class Philosophical Focus (Q7)

Response	Number	Percent (%)[a]
1-learn industrial technologies	34	55.74
2-learn trade skills	29	47.54
3-prepare for employment	43	70.49
4-technological literacy	56	91.80
5-other	14	22.95

Note. [a]Percentage of the 61 respondents that selected the response focus. Participants could select more than one foci.

Table 8

Other Philosophical Foci (Q7 5-other Open-Form description)

Response	Number
STEM	2
Industry certification testing (A+, Network+)	1
Critical Thinking, problem solving, IDEATE!	3
Life skills, becoming life-long learner, civic and community (TSA)	1
Apply science and math	3
Confidence by relating basic skill to larger projects	1
Measurements, use of internet as a tool	2
Integration with SOL objectives in content areas	1

Survey Question 8 sought to determine whether the curriculum and resources support the development of a technological literacy focus. The 56 teachers who selected technological literacy as a class focus reported that 80.35 percent agreed the state produced technology education curriculum and resources supported that focus (Table 9). The four teachers that disagreed, indicating that the curriculum and resources did not support the technological literacy focus, provided their reasons in Survey Question 9 and are reflected in Table 10.

Table 9

Curriculum and Resources Support of Technological Literacy (Q8)

Response[a]	Number	Percent (%)
1 – Strongly Agree	13	23.21
2 – Agree	32	57.14
3 – Undecided	07	12.50
4 – Disagree	03	05.36
5 – Strongly Disagree	01	01.79
None (Skipped Q)	05	-----

Note. [a]*M* = 2.05, *median* = 2, *mode* = 2, *n* = 56

Table 10

Reason Curriculum and Resources Do Not Support (Q9 Open-Form)

Response	Number
There is a fine line between studying technology and technological literacy. Being able to satisfactorily use Microsoft Word and Excel is technological literacy, understanding how GPS satellites orbit is studying technology.	1
The Course Task/Competency Lists do not clearly reflect the ITEEA technological literacy	1
Show me in the supplied resources that tech lit is covered. It is covered in the list of standards but in specific to each task. Again too broad to be useful.	1
It's more geared toward industry certification. Also, workforce readiness is something that should be taken out, it's a waste of time. Also, we have way too many competencies.	1

Regarding Research Question 2, based upon the answers to Survey Questions 7 through 9, the 61 responding teachers reported that 56 (91.80 percent) had developing technological literacy in their students as a focus of their technology education classes and 45 (80.35 percent) of them considered that the curriculum and resources supported that focus.

Missing Curriculum Support for Current Technologies

Survey Questions 10 and 11 were designed to answer Research Question 3: Are there portions of the Virginia technology education courses that do not support current technologies in these areas? Survey Question 10 used the designed world taxonomy from the *STL* to identify technology categories with missing curriculum/resource support for currently used technologies. The 24 (39.34 percent) responding teachers identified technology categories with missing curriculum support. All technology categories had some responses (four to ten) indicating missing curriculum/resource support (Table 11), including the other technologies category elaborated upon in Table 12.

Table 11

Technology Categories Missing Support for Current Technologies (Q10)

Response	Number	Percent (%)[a]
1-medical	10	41.67
2-agricultural and related biotechnologies	10	41.67
3-energy and power	05	20.83
4-information and communication	06	25.00
5-transportation	06	25.00

(continued)

Table 11. *Technology Categories Missing Support for Current Technologies* (continued)

Response	Number	Percent (%)[a]
6-manufacturing	04	16.67
7-construction technologies	05	20.83
8-other	06	25.00

Note. 24 of 61 respondents (39.34%) answered Q10.
[a]Percentage of the 24 respondents to Q10 that selected the response category. Participants could select more than one category.

Table 12

Other Technology Categories (Q10 8-other Open-Form description)

Response	Number
Modeling & Simulation and Digital Visualization.	1
These major areas of technology are well supported; however the course that I am responsible for teaching does not specifically involve any of the above choices.	1
Workplace Readiness Skills	1

Survey Question 11 was intended to capture the specific technologies missing from curriculum/resource support documents within the Survey Question 10 technology categories. Only eight of the 24 respondents to Survey Question 10 answered Survey Question 11. The eight responses identify four specific current technologies missing from (3) or not appropriate in (1) curriculum/resource support documents: medical (3), agricultural use of GPS (1), energy and power (1), and communication where color theory is not appropriate and should be omitted (1) (Table 13).

Table 13

Current Technology Missing Support (Q11 Open-Form)

Response	Number
I have developed my own materials particular to my student population and not sought support from the CTE Resource Center. I use CTE Resource Course Task Lists/Objectives/Guidelines only. Pre/Post test based on these task lists have been developed by a consensus of instructors in my county (Henrico) this year and are being implemented per HCPS directives.	1
I do not feel that any course is adequately supported with the exception of the trades. That is what happens when you do not have subject matter experts writing curriculum. There are tons of links for the instructor to find help.	1
4-[information and communication] most classrooms do NOT have the ability to truly teach color theory, nor do we have the ability to print the products the students produce.	1
We are required to administer the Workplace Readiness Skills exam, but have no concrete curriculum or resources. We would love to have sample tests or released items, or specific preparation materials for the exam.	1
[1-]medical	1
1[-medical]. Not much of the current breakthroughs in medical technology is addressed. 2[-agricultural and related biotechnologies]. Nearly none of the new methods such as using GPS to plow fields are touched upon in the current curriculum dealing with agricultural.	1
1-[medical] I do not teach medical, but I have not seen anything in the CTE curriculum supporting it.	1
#3[-energy and power] Show me in the supplied resources that tech lit is covered. It is covered in the list of standards but is specific to each task. Again too broad to be useful.	1

Regarding Research Question 3, based upon the answers to Survey Questions 10 and 11, the 24 (39.34 percent) responding teachers reported that curriculum/resource support was missing for current technologies. Eight responses identify four specific current technologies missing from (3) or not appropriate in (1) curriculum/resource support documents: medical (3), agricultural use of GPS (1), energy and power (1), and communication where color theory is not appropriate and should be omitted (1).

Curriculum Relevance for the 21st Century

Survey Questions 12 and 13 were designed to answer Research Question 4: Is the Virginia technology education curriculum relevant for 21st century technology education classes? Survey Question 12 asked whether the technology education curriculum and resources are dated and in need of revision. The 61 responding teachers indicated that 27 (44.27 percent) agreed with the need for revision, 21 (34.43 percent) were undecided, and 13 (21.31 percent) disagreed with the need for revision (Table 14).

Table 14

Virginia Technology Education Curriculum Needs Revised (Q12)

Response[a]	Number	Percent (%)
1 - Strongly Agree	07	11.48
2 - Agree	20	32.79
3 - Undecided	21	34.43
4 - Disagree	12	19.67
5 - Strongly Disagree	01	01.64

Note: [a]M = 2.67, n = 61

Survey Question 13 sought to determine whether responding teachers desired access to the *Engineering byDesign*™ courses and curriculum, a 21st century product of the ITEEA's STEM Center for Teaching and Learning. The 60 responding teachers reported that 41 (68.34 percent) agreed they would seek access, 14 (23.33 percent) were undecided, and five (8.34 percent) disagreed and would not seek access.

Table 15

Desire Access to Engineering byDesign™ Courses and Curriculum (Q13)

Response[a]	Number	Percent (%)
1 - Strongly Agree	13	21.67
2 - Agree	28	46.67
3 - Undecided	14	23.33
4 - Disagree	04	06.67
5 - Strongly Disagree	01	01.67
None (Skipped Q)	01	-----

Note: [a]M = 2.20, n = 60

Regarding Research Question 4, based upon the answers to Survey Questions 12 and 13, reported that 27 (44.27 percent) of the 61 responding teachers agreed with the need for curriculum revision and 41 (68.34 percent) of the 60 responding teachers agreed they would seek access to the *Engineering byDesign*™ course and curriculum, a 21st century product of the ITEEA's STEM Center for Teaching and Learning.

Summary

Chapter IV reports the findings of the study survey. The problem of this study was to determine Virginia technology education teachers' attitudes regarding the effectiveness of their curriculum and resources. An electronic survey was used to gather data on those attitudes. The survey population consisted of 156 Virginia middle and high school technology education teachers who are members of the VTEEA. The 61 teachers who responded to the survey resulted in a response rate of 39.10 percent. This did not provide a significant sampling of the study population. Consequently, the findings were limited to these respondents' attitudes.

The report of survey findings were grouped into research question and associated survey question order. Survey Questions 1 through 6 were designed to answer Research Question 1: To what extent are the Virginia technology education curriculum and resources being used in the classroom? Those survey responses revealed that 56 (91.80 percent) of the 61 responding teachers had a technology education curriculum available (Q1) and used it in preparation for class (Q3), while 59 (96.72 percent) used the instructional resources (CTE-RC) in preparation for class (Q5). However when 57 of the teachers identified the technology education curriculum they use, only 31 (54.39 percent) considered the state to have prepared their curriculum, while 26 (45.61 percent) indicated they or their school system prepared their curriculum (Q2).

Survey Questions 7 through 9 were developed to answer Research Question 2: How effective are the Virginia technology education curriculum and resources at developing technological literacy in students? Those survey responses revealed that 56 (91.80 percent) of the 61 responding teachers focused on developing technological literacy in their students through their technology education classes (Q7) and 45 (80.35 percent) of them agreed the curriculum and resources supported that focus (Q8).

Survey Questions 10 and 11 were designed to answer Research Question 3: Are there portions of the Virginia technology education courses that do not support current technologies in these areas? Those survey responses revealed that 24 (39.34 percent) of the 61 responding teachers considered curriculum support missing for currently used technologies (Q10). Eight survey respondents identified four specific current technologies missing from (3) or not appropriate in (1) curriculum/resource support documents: medical (3), agricultural use of GPS (1), energy and power (1), and communication where color theory is not appropriate and should be omitted (1) (Q11).

Survey Questions 12 and 13 were developed to answer Research Question 4: Is the Virginia technology education curriculum relevant for 21st century technology education classes? Those survey responses revealed that 27 (44.27 percent) of the 61 responding teachers agreed with the need for technology education revision (Q12) and 41 (68.34 percent) of the 60 responding teachers agreed they would seek access to the *Engineering byDesign*™ courses and curriculum, a 21st century product of the ITEEA's STEM Center for Teaching and Learning (Q13).

In Chapter V, Summary, Conclusions, and Recommendations, the research study is summarized. Also in this chapter, the study's conclusions are drawn and recommendations are made based upon the research data and findings reported.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides a summary of the study. It also draws conclusions by answering the research questions based upon the study's findings. Finally, the researcher makes recommendations based upon the results of the research and the need for additional studies in the future.

Summary

The problem of this descriptive study was to determine Virginia technology education teachers' attitudes regarding the effectiveness of their curriculum and resources. The goals of the study were to answer the following research questions: To what extent are the Virginia technology education curriculum and resources being used in the classroom? How effective are the Virginia technology education curriculum and resources at developing technological literacy in students? Are there portions of the Virginia technology education courses that do not support current technologies in these areas? Is the Virginia technology education curriculum relevant for 21st century technology education classes?

The need for and importance of this study, its significance, came from (a) the supporting statements of other researchers, such as the Virginia Council on Technology Education for the 21st Century and ITEEA; (b) the time lapse between research on technology education curriculum development and implementation, and changes to Virginia's curriculum, of twenty years; (c) the gaps in the knowledge supplied by other research studies on various aspects of

Virginia's technology education curriculum, such as ones by Cantu (2011), covering Virginia elementary schools' inclusion of STEM, and Beddow (2009), considering Virginia technology education local supervisors' awareness and implementation of the *EbD*™ curriculum; and (d) the lack of specific information about the Virginia middle and high school technology education curriculum's effectiveness.

The findings of this research were limited by certain factors and conditions. The study's methodological limitations were associated with using an electronic survey to gather perceptions about the curriculum and resources from middle and high school technology education teachers in the Commonwealth of Virginia. Data were collected using an email listing of Virginia middle and high school technology education teachers obtained from the Virginia Technology and Engineering Education Association (VTEEA). The electronic survey was developed based upon a literature review, research questions, and feedback from pilot testing. Extending the survey results to the greater Virginia middle and high school technology education teacher population is limited based upon the VTEEA sampling and the survey response rate. The conceptual or definitional limitations were primarily associated with the teacher's definition of "curriculum" and determination of the "effectiveness" of the curriculum in developing "technological literacy" in their students.

The researcher determined that the perceptions of middle and high school technology educators would provide the best evaluation of the effectiveness and current relevance of the state's curriculum and resources. The population for the study was Virginia middle and high school technology education teachers who are members of Virginia Technology and Engineering Education Association (VTEEA) with email addresses on record. The population email listing was obtained from VTEEA. The survey population resolved to 156 Virginia middle and high school technology education teachers.

An electronic survey was developed based upon a literature review and the four research questions for the study. The survey was designed to measure attitudes regarding the Virginia technology education curriculum and resources from the sample. It included closed-form, scaled, forced response and open-form, free response items regarding the research question descriptors. The survey was pilot tested with several technology teachers to ensure the clarity, utility, and validity of the questions and revised based upon their feedback.

The research data collection was initiated by emailing a cover letter with a link to the electronic survey to the entire email listing received from VTEEA for Virginia middle and high school technology education teachers. The cover letter email provided the survey purpose, addressee response encouragement, human subject protection measures, and the notice of agency. The email also included electronic survey instructions. Respondents were asked to complete the survey within ten days. A follow-up email was sent one week after the initial one including the link to the electronic survey. Due to a low response rate, the survey was extended two weeks and two additional follow-up emails were sent. The electronic survey collected the data anonymously and provided aggregated responses to the researcher. Sixty-one (61) out of the population of 156 Virginia middle and high school technology education teachers responded for a rate of 39.10 percent.

The electronic survey response data received by the researcher were organized and analyzed by research and associated survey questions. The closed-form, scaled, forced response answers were converted to interval data where appropriate. Similar open-form, free response answers were summarized and clustered. Data were tabulated indicating the number of responses and frequency of answers. Missing responses within the surveys were assigned zero points and included in a “None (Skipped Q)” category for statistical purposes. The responses were analyzed using descriptive statistical methods to reveal perceptions regarding the Virginia middle and high school technology education curriculum’s use, effectiveness, and need for updating.

Conclusions

In this section conclusions are drawn regarding the study’s research questions based upon the data collected.

Research Question 1

To what extent are the Virginia technology education curriculum and resources being used in the classroom? The first six survey questions were designed to answer this research question. Those survey responses revealed that 56 (91.80 percent) of the 61 responding teachers had a technology education curriculum available to them (Q1) and used it in preparation for teaching class (Q3), while 59 (96.72 percent) used instructional resources (CTE-RC) in preparation for teaching (Q5). This appears to answer the research question that technology education curricula are available, and along with the associated instructional resources, are being used in preparation for teaching class.

However when 57 teachers identified the technology education curriculum they use, only 31 (54.39 percent) considered the state to have prepared their curriculum (Q2). The reason one teacher gave for never using the state curriculum helps explain this low percentage. The technology education curriculum is “no longer available” and what is available on “Verso” (CTE-RC) is not a curriculum (Q4). It was also noted that 26 (45.61 percent) of the 57 teachers indicated their school system or they had to prepare their curriculum themselves (Q2). This strongly suggests that it is not the Virginia *Technology Education Curriculum K-12* that is being used, but either state instructional resources that are available (though not a curriculum) or a locally prepared technology education curriculum. The conclusion consequently is that the Virginia technology education curriculum is not being used because it is not available, while Virginia instructional resources (V-CTE-RC) are being used because they are all that is available from the state.

Research Question 2

How effective are the Virginia technology education curriculum and resources at developing technological literacy in students? Survey Questions 7 through 9 were developed to answer this research question. Those survey responses revealed that 56 (91.80 percent) of the 61 responding teachers focused on developing technological literacy in their students through their technology education classes (Q7) and 45 (80.35 percent) of them agreed the curriculum and resources support that focus (Q8). The conclusion drawn is that the curriculum and resources do support developing technological literacy in students. However, similar to the caution in the previous research question answer, the curricula referred to are locally developed, while the state's contribution is from the instructional resources in the V-CTE-RC, that some mistakenly consider the state's curriculum.

Research Question 3

Are there portions of the Virginia technology education courses that do not support current technologies in these areas? Survey Questions 10 and 11 were designed to answer this research question. Survey responses revealed that 24 (39.34 percent) of the 61 responding teachers considered curriculum support missing for currently used technologies (Q10). Eight survey respondents identified four specific current technologies missing from (3) or not appropriate in (1) curriculum/resource support documents: medical (3), agricultural use of GPS (1), energy and power (1), and communication where color theory is not appropriate and should be omitted (1) (Q11). The conclusion is that the perception of over one-third of the responding teachers is that technology education courses are missing curriculum/resource support for current technologies. Based upon the specific responses, V-CTE-RC should be updated to include current medical technologies, current energy and power technologies, and GPS use in agriculture; and to remove color theory from communication courses.

Research Question 4

Is the Virginia technology education curriculum relevant for 21st century technology education classes? Survey Questions 12 and 13 were developed to answer this research question. Survey responses revealed that 27 (44.27 percent) of the 61 responding teachers agreed with the need for technology education curriculum and resources revisions (Q12) and 41 (68.34 percent) of the 60 responding teachers agreed they would seek access to the *Engineering byDesign*™ courses and curriculum, a 21st century product of the ITEEA's STEM Center for Teaching and Learning (Q13). A sufficient number (27) of responding teachers feel the state curriculum and resources need revised and an even larger number (41) would seek a current, 21st century curriculum (*EbD*™) to use.

Conclusions regarding an answer to the problem of the study is divided into two parts. The first part is teachers' attitudes regarding the effectiveness of the state's technology education resources. The responding teachers considered the state's instructional resources for technology education in the V-CTE-RC readily available and generally effective.

The second part is teachers' attitudes regarding the effectiveness of the state's technology education curriculum. The state's curriculum is not available, consequently responding teachers perceptions of technology education curriculum effectiveness referred to locally prepared curricula or the contents of the V-CTE-RC. This strongly suggests the need for an updated Virginia technology education curriculum to be made available to schools, colleges, and technology education teachers.

Recommendations

These recommendations include suggestions for implementing the study's findings and conducting additional research studies in light of the study's findings.

Implementation of findings

Although the study's findings were limited to the 61 responding technology education teachers, the following recommendations are made based upon those responses:

- Virginia should update and revise the Virginia technology education curriculum and make it available to Virginia schools and technology education teachers again. This is based upon five teachers not having a curriculum available (Q1), 26 teachers or their schools having to prepare their own curriculum (Q2), and 27 teachers specifically agreeing with the need to revise the curriculum and resources (Q12). The lack of an available state technology education curriculum and/or program of studies bolsters this recommendation. How does Virginia prepare its students to be technological literate with no curriculum or different options provided by separate school systems? There is no Virginia standard for technological literacy.
- Virginia should consider adopting the *Engineering byDesign*™ or *Project Lead the Way* (*PLTW*) curriculum for middle and high school courses. This is based upon 41 teachers that responded they would seek access to *EbD*™ (Q13) and previous research by Beddow (2009) that concluded "a

majority of local supervisors agree that *EbD*™ could effectively address both content standards and integration of STEM concepts" (p. 46). *EbD*™ is based upon the *STL*, *AETL*, and associated research, and works within the STEM career cluster and pathways which Virginia is currently reemphasizing.

Future research

The following recommendations are made for conducting additional research studies in light of this study's findings and limitations:

- A similar study to this one with a population and response rate that would allow generalization to the greater population of Virginia middle and high school technology education teachers. This study was severely limited by the low response rate. A study that could be generalized to the whole state would be more meaningful and compelling to those responsible for the Virginia technology education curriculum.
- A study comparing the Virginia technology education curriculum and resources to the definition, contents, and use of effective national and state technology education curricula should be undertaken. Another conceptual or definitional limitation of the study was associated with "curriculum" and this was confirmed in the survey pilot testing feedback and the responses to Survey Question 2 concerning who prepared the curriculum. A good curriculum model would be beneficial to those responsible for the Virginia technology education curriculum.

- Research on the cost and benefits of adopting *EbD*™ within Virginia. This study found 41 technology education teachers that responded they would seek access to *EbD*™ (Q13). Beddow's (2009) study concluded that "a majority of local supervisors agree that *EbD*™ could effectively address both content standards and integration of STEM concepts" (p. 46). If the benefits outweighed the costs, this might provide a compelling impetus for a relatively quick and inexpensive fix for revising the Virginia technology education curriculum.

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APPENDIX A

VIRGINIA TECHNOLOGY EDUCATION CURRICULUM SURVEY

VIRGINIA TECHNOLOGY EDUCATION CURRICULUM SURVEY

The purpose of this survey is to determine Virginia technology education teachers' attitudes regarding the effectiveness of the Virginia technology education curriculum and resources. The information you provide will be collected anonymously. Participation is voluntary and the information you provide will not be recorded until the survey is saved.

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1. Do you have a technology education curriculum?
_ Yes _ No

2. If "Yes" to question one (Q1), then at what level was the curriculum prepared?
_ State level (Virginia) _ Local level (School System/School) _ Personal level (Teacher's own)

3. If "Yes" to question one (Q1), then do you use the technology education curriculum in preparation for classroom instruction?
_ Always _ Often _ Seldom _ Never

4. If "Never" to question three (Q3), then please tell us why you do not use it (curriculum)?
Answer: _____

5. Do you use Virginia's Instructional Resources (CTE Resource Center) for Technology Education for your course(s) in preparation for classroom instruction?
_ Always _ Often _ Seldom _ Never

6. If "Never" to question five (Q5), then please tell us why you do not use them (resources)?
Answer: _____

7. Please select from the following list of philosophical foci all that apply to your technology education class instruction? (This question allows multiple selections, so please select all appropriate listed answers.)
_ 1-learn industrial technologies
_ 2- learn trade skills
_ 3-prepare for employment
_ 4-technological literacy (Technological literacy is the ability to use, manage, understand, and assess technology.)
_ 5-other (please list and describe _____)

8. If your list in question seven (Q7) included 4-technological literacy, then do the technology education curriculum and Virginia's Instructional Resources (CTE Resource Center) support that focus?

_ Strongly Agree _ Agree _ Undecided _ Disagree _ Strongly Disagree

9. If “Disagree” with question eight (Q8), then please tell us why the curriculum and resources do not support technological literacy?
Answer: _____

10. Is curriculum/resource support missing for current technologies in any of the following list of designed world technology categories (select all that are applicable)? (This question allows multiple selections, so please select all appropriate listed answers.)
_ 1-medical
_ 2-agricultural and related biotechnologies
_ 3-energy and power
_ 4-information and communication
_ 5-transportation
_ 6-manufacturing
_ 7-construction technologies
_ 8-other (please list and describe _____)

11. If any categories were selected in question ten (Q10), then please indicate the category number from above and tell us what current technology is not supported?
Answer: _____

12. Do you feel the Virginia technology education curriculum and resources are dated and the Virginia Department of Education needs to revise them?
_ Strongly Agree _ Agree _ Undecided _ Disagree _ Strongly Disagree

13. Would you seek access to Engineering byDesign™ course and curriculum materials produced by the International Technology and Engineering Educators Association (ITEEA)? (These are K-12 curriculum and instructional materials developed and supported by ITEEA’s STEM Center for Teaching and Learning.)
_ Strongly Agree _ Agree _ Undecided _ Disagree _ Strongly Disagree

If you would be willing to participate in a planning group for revising the technology education curriculum, then please notify us by email at gpatt008@odu.edu and provide your contact information.

APPENDIX B

EMAILED SURVEY COVER LETTER

COVER LETTER (EMAIL)

<<Date>>
<<Email Address>>

<<Greeting Line>>

In 1992 Virginia published the *Technology Education Curriculum K-12* (referred to in the survey as Virginia’s Technology Education Curriculum). In 1982 Virginia’s Career and Technical Education (CTE) Resource Center was established and provides technology education course associated resources (referred to in the survey as Virginia’s Technology Education Instructional Resources). The curriculum and resources have provided the direction for technology education classes for the last two decades. The purpose of our research study is to determine Virginia technology education teachers’ attitudes regarding the current appropriateness of the Virginia *Technology Education Curriculum K-12*.

We are interested in your, a technology education teacher’s, perception of the curriculum and the associated resources including their current effectiveness and relevance. This is your invitation to participate in an electronic technology education curriculum survey. Participation in this study is voluntary. While you may choose not to respond, completing the electronic survey indicates your desire to share your perceptions and actively contribute to this research.

You, as a technology education teacher, are in the best position to evaluate how well the curriculum and resources support your instruction and classes. Your responses will be collected anonymously. The information you provide will be reported only in aggregate form. Consequently, there is little risk to you personally associated with this survey. There are also no direct benefits to you associated with this study. However, in addition to the research report, the results may be provided to the state for feedback on the technology education curriculum. Your completion of the electronic survey indicates you have been informed of the purpose of the study and your role, and that you consent to participate and allow us to use your responses in our study. Please accept our personal thank you for taking the time to complete the survey.

The following is the link to the electronic technology education curriculum survey:
https://www.surveymonkey.com/s/GCLWPM9
Completing the survey will require about ten minutes of your time. Please complete the survey within the next ten days. Thank you in advance for your cooperation and support of this research study, as well as for your contribution to technology education in Virginia.

I am currently a graduate student in the Darden College of Education at Old Dominion University and am working under the advisement of Dr. John M. Ritz.

Sincerely,

Glenn A. Patton
Graduate Student
Old Dominion University
Email: gpatt008@odu.edu

John M. Ritz, DTE
Professor
Old Dominion University