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A Review of Secondary Technology Education Teacher Needs in Virginia

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A REVIEW OF SECONDARY TECHNOLOGY EDUCATION TEACHER NEEDS IN VIRGINIA

by

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ABSTRACT

A REVIEW OF SECONDARY TECHNOLOGY EDUCATION TEACHER NEEDS IN VIRGINIA

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Technology education teachers can have varied pre-service training experiences, thus their needs for classroom support may vary greatly. Perkins V requires evidence-based research to justify the use of funding for professional development. This researcher sought to support Virginia's secondary technology education teachers, professional organizations, and the Virginia Department of Education's Technology Education Specialist by providing research to determine professional development needs. This three-phase qualitative study used a survey, documents review, and focus groups to triangulate data to provide information about the research questions. The research questions focused on teachers' educational background, technology program goals, and issues specific to secondary technology education teachers.

The study found that support on classroom management and pedagogy was the greatest need. Additionally, technology education course offerings need to be simplified and information from the state on career clusters needs to be coordinated and concisely organized. Teacher concerns also included student safety, overcrowding, students with individualized education programs (IEPs) with no aides, and the epistemology of technology education.

This thesis is dedicated to the idea that you can make your dreams come true. While playing with a Mickey Mouse chalkboard, a small and beautiful little blonde girl would teach her teddy bears. When asked about who she wanted to be, the answer was never a teacher, a mentor, or a leader. “I am a professor” was always the answer. Writing and teaching as a professor has always been my dream. All who aspire should reach their dreams. The completion of this thesis represents a culmination of a five-year old’s dream dedicated to using hard work and perseverance to realize a desired outcome. May everyone feel this joy.

ACKNOWLEDGMENTS

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To my students, I completed this work to improve your experiences. I often don't remember your faces, but my life is filled with purpose because of your willingness to listen, interact, and learn from our shared experiences. Every day, I hope to become a better instructor. Your kind words and encouragement allowed me to be myself and share the learning process with you. The completion of this dissertation has taught me more than I could ever had anticipated. I have learned that I am stronger because of the kindness and support of others. I have learned that I am more capable because of my personal drive to see others accomplish a growth in knowledge. I have learned that teaching is the most rewarding and emotionally profitable experience that one can have. Thank you for listening and learning with me and especially, laughing at my corny jokes.

My heart fills with the light of sharing this completed accomplishment with you all. Thank you to all those who have encouraged me through this process. May the work we have done come back to you ten-fold.

NOMENCLATURE

CTE: Career and Technical Education

CTERS: Career and Technical Education Reporting System

CTSO: Career and Technical Student Organization

ESSA: Every Student Succeeds Act

IA: Industrial Arts

IRB: Institutional Review Board

ITEEA: International Technology and Engineering Educators Association (formerly ITEA: International Technology Education Association)

NAEP: National Assessment of Educational Progress

NAEP-TEL: National Assessment of Educational Progress Technology and Engineering Literacy

NTPS: National Teacher and Principal Survey

ODU: Old Dominion University

PCRN: Perkins Collaborative Resource Network

PD: Professional Development

PLTW: Project Lead the Way

QR Code: Quick Response Code

RQ: Research Question

SCED: School Courses for the Exchange of Data

SCHEV: State Council of Higher Education for Virginia

SEDF: Secondary Enrollment Demographics Form

SIAEP: Standards for Industrial Arts Education Programs

SPSS: Statistical Package for the Social Sciences

STEAM: Science, Technology, Engineering, Arts, and Mathematics

STEL: Standards for Technological and Engineering Literacy

STEM: Science, Technology, Engineering, and Mathematics

STL: Standards for Technological Literacy

TET: Technology Education Teachers

TSA: Technology Student Association

USB: Universal Serial Bus

USDOE: United States Department of Education

VCCS: Virginia Community College System

VDOE: Virginia Department of Education

VERSO: Virginia's Educational Resource System Online

VTEEA: Virginia Technology and Engineering Education Association

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CHAPTER 1

INTRODUCTION

The mission of the U.S. Department of Education (n.d.) is to “promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access” (para. 1). The mission statement continues to include priorities for the department’s funding such as establishing policies, collecting data, disseminating research, focusing national attention on educational issues, and prohibiting discrimination (U.S. Department of Education, n.d.). The teacher is a key component of creating student achievement. Teachers are responsible for instructional strategies, creating a connection between children and their community, and serving as a mentor for students and parents among many other tasks.

With the massive information available on the Internet, why do teachers matter? If students can access facts and information at the touch of a button, what is the importance of a teacher? According to Gilbert (2014), “The basic premise (of emotional intelligence), in a nutshell, your ‘softer skills’ such as dealing with yourself and others at an emotional level, are far more valid in today’s world than IQ alone” (p. 48). In other words, having information does not make people smart, but understanding the information creates a more intelligent and productive society.

Teachers also help students discern between good and bad information. Information on the Internet is not labeled with good, bad, true, or false (unless reviewed by others on the web). Any user of the web can add information to the Internet by creating their own webpage. Knowing and understanding the facts and how to interpret them are skills which teachers are charged to teach.

Also, schools and teachers serve as an introduction to society. “Schools are, at one level at least, tremendously sociable places” (Gilbert, 2014, p. 49). While artificial intelligence (AI) applications can bring forth information, the user must discern the value and implementation of the knowledge. “Your (the teachers’) actions (or lack of them…) directly impact on the actual physical architecture of the brains of young people in your care on an hourly basis” (Gilbert, 2014, p. 72). As the brain experiences new learning, new connections are being made physically to the brain cells. An experiment conducted in 2012 studies the connection between brain function and brain anatomy using magnetic resonance imaging (MRI) to view the number and type of synaptic connections and changes in long-term neural activity patterns in relation to learning experiences (Zatorre et al., 2012). Neuroplasticity, a change in the structure of the brain, has been evidenced when new learning experiences were encountered by taxi drivers involved in spatial navigation and musicians who were asked to discriminate melodies (Zatorre et al., 2012). While the changes cannot be “pinned” to learning because correlation does not mean causation, the idea that the brain changes when new knowledge is learned rather than retrieved creates a greater understanding of the need for teachers. Teachers help students interpret, discern, and apply new information.

Diverse Teacher Training

Because teachers develop instruction, help create and inform community norms, and can change the structure of children’s brain and their development, understanding what teachers need is imperative to supporting these crucial components of our society. Teacher educators are often asked to provide workshops and professional development opportunities for teachers and the preparation depends upon their needs. This research focused on determining the needs of secondary technology education teachers in Virginia. Teachers in Virginia have many different pathways to certification and licensure including 1) an approved teacher preparation program, 2) reciprocity for out-of-state candidates, and 3) alternative licensure through endorsement coursework or experiential learning (Virginia Division of Teacher Education & Licensure, 2012). The source of teachers' knowledge base according to the U.S. DOE (2023) report, *Preparing and Credentialing the Nation's Teachers: The Secretary's 13th report on the Teacher Workforce*, was extremely varied. According to the 2023 report*, Preparing and Credentialing the Nation's Teachers:* The Secretary's 13th report on the teacher workforce, "In academic year 2019–20, 601,467 students were enrolled in teacher preparation programs, and 152,939 of them completed their programs (nationally)" (p. 30). The number of total enrollees in traditional teacher preparation programs declined between 2012-13 and 2019-20 in Virginia by 48% which contrasted with the alternative programs in Virginia which increased by 1% (U.S. Department of Education, 2023b, pp. 3-4). Teachers who are prepared in an undergraduate technology education program have four years to develop skills in epistemology, pedagogy, and assessment specific to the discipline.

According to Litowitz (2014) who completed a survey of the 24 technology undergraduate programs in the United States, the post-secondary technology education teacher preparation curriculum, "would align quite well with the *Standards for Technological Literacy*" (p. 83). Courses in the undergraduate technology education teacher preparation programs were distributed evenly in core areas of general education, professional studies, and technical studies but were not consistent with each other (Litowitz, 2014). Preparation through a traditional technology education teacher preparation program provides specific skills which align with the *Standards for Technological and Engineering Literacy* (ITEEA, 2020). Knowing that teachers are trained differently leads a researcher to ask: how are teachers trained and what do they need to learn to achieve educational excellence as the U.S. Department of Education's mission states?

Focus on Technology Education

The President of the United States stated, "Now more than ever the innovation capacity of the United States—and its prosperity and security—depends on an effective and inclusive STEM education ecosystem" (Executive Office of the President of the United States: Office of Science and Technology Policy, 2018, p. v). STEM education is the interdisciplinary study of science, technology, engineering, and mathematics. The "T' in STEM is a crucial component of the integration model. Technology is the "modification of the natural environment, through human designed products, systems, and processes, to satisfy needs and wants" (ITEEA, 2020, p. 8). Technology education can help the learner to "…use, understand, and evaluate technology as well as to understand technological principles and strategies needed to develop solutions and achieve goals" (National Assessment Governing Board, 2018, p. xvi). To create a stronger America, the U.S. President charged the legislative branch to review science, technology, engineering, and mathematics (STEM) education activities, assessments, and investments to ensure they are effective in pursuant of the America COMPETES Reauthorization Act of 2010 (42 U.S.C. §6621). The *Charting the Course* vision provided three goals for STEM education: 1) Build strong foundations for STEM literacy, 2) Increase diversity, equity, and inclusion in STEM, and 3) Prepare the STEM workforce for the future (Executive Office of the President of the United States: Office of Science and Technology Policy, 2018). This research focuses on the needs for goal #1 of the federal plan to build strong foundations for the secondary technology education teacher. The call from the President for the effective implementation of STEM and thusly, technology education, emphasized the importance of determining the needs of technology education teachers and this research. As human designed tools become more influential in our society, teaching students how to discern impacts, understand the implementation, and develop applications for these tools can create a more technologically literate society.

Virginia Sample

Limiting the study to the needs of secondary technology teacher needs in Virginia was an attempt to represent the population of STEM and more focused technology teachers to a small and manageable sample size. According to *A Strategic Review of Technology Education* (Reed, 2017), "Technology Education is the primary delivery method for true inclusion of technology and engineering in the (STEM) movement" (p. 1). This review of technology education in Virginia highlighted the needs of the profession but did not delve into the needs of the teacher.

Education has a rich history in the United States, with its roots in religious teachings and apprenticeships. However, for a long time, education was considered a private responsibility. Not until the tenth amendment to the Constitution was passed, did education become a state function (Prakken, 1976). The passing of the tenth amendment in 1791 marked a turning point in the development of education in the country. While education was a national imperative, states were responsible for developing the learning institutions and creating student learning opportunities. Every state creates their own licensure requirements which makes studying teacher backgrounds extensive. In order to streamline the study, the population was limited to Virginia. Future studies may need to compare state's regulations for teacher education and training, but this study can begin the process at reviewing the educational backgrounds of teachers and how that affected the needs of the teachers. Also, the job outlook in every state varies according to resources and industrial needs. "In Virginia alone, there are projected to be more than 1.2 million job openings by 2022 in Career Pathways associated with Technology Education" (Office of Career, Technical and Adult Education, 2017, p. 6). With 1.2 million job openings, technology education students are a large component of the future needed workforce. The needs of secondary technology education teachers should be addressed to support students entering the STEM specific workforce.

PROBLEM STATEMENT

Teachers come into the classroom with diverse educational training which makes creating support for these teachers a difficult task. The first step in this process is to determine the educational background or training previously experienced by the teachers. In other words, what do the teachers know? After understanding their background, the teachers need to share how they determine program goals and how the teachers gather curriculum support materials. The final step should be to ask teachers directly about their classroom issues. Understanding the teachers' needs can help determine the best practices for supporting them.

PURPOSE OF STUDY

The purpose of this study was to collect data on secondary technology education teacher's educational backgrounds, program goals, and support needs in Virginia. This study was designed to research the goals for the technology education classroom, major issues confronting the secondary technology teacher, and their previous training experiences. Findings and recommendations will inform supporting entities on best practices for classroom technology education teachers.

RESEARCH QUESTIONS

This study collected data to research the following questions:

1. What is the educational background of secondary technology education teachers in Virginia?

2. What goals are emphasized in secondary technology education programs in Virginia?
3. What are the major issues confronting secondary technology education teachers in Virginia?

BACKGROUND, SIGNIFICANCE, AND THEORETICAL FRAMEWORK

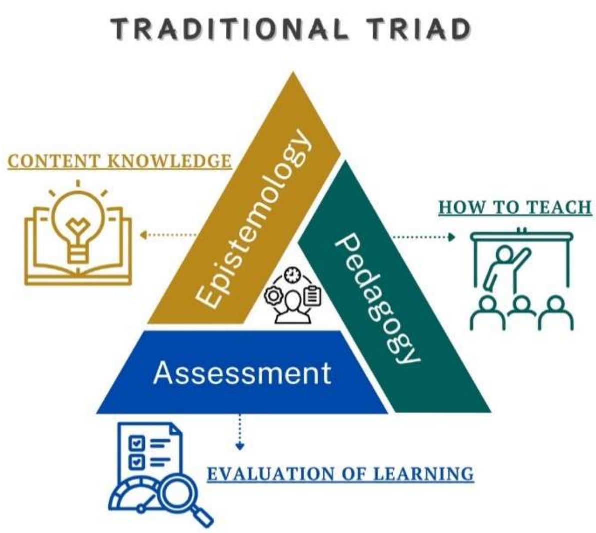
The connection between teacher learning and student achievement was recognized by the federal government which created funding for technology education teacher professional development through *Every Student Succeeds Act (ESSA) of 2015*, the *Carl. D. Perkins Career and Technical Act (Perkins V) of 2019*, and *America COMPETES Reauthorization Act of 2010*. In the ESSA, Section 2245, the Secretary (of education) was empowered to award grants to state educational agencies or nonprofit organizations to support STEM educators (2015, p. 152). *Perkins V, section 124b*, provided financial support for training of Career and Technical Education teachers (2019, p. 58). In the *America COMPETES Act*, *Title V, Science, Technology, Engineering, and Mathematic Support Programs*, *Subtitle B*, "STEM training grant program", the purpose of the program was to implement programs at higher education to integrate STEM courses and teacher education (2010, p. 41). "Key Federal actions needed to achieve this objective (STEM literacy) include making federal support for STEM educator 'upskilling' and professional development, including CTE and college preparatory teachers and educators working in both formal and informal settings a priority" **(**Executive Office of the President of the United States: Office of Science and Technology Policy**,** 2018, p. 14). These are examples of support for STEM and thusly technology education teacher training at the federal level.

Research that teacher learning positively affects student achievement is elusive since correlation does not mean causation. A meta-analysis of nine studies conducted to determine if teacher professional development affected student learning determined "that teachers who receive substantial professional development—an average of 49 hours in the nine studies— can boost their students' achievement by about 21 percentile points" (Yoon et al., 2007, p. iii). All factors of change in the classroom cannot be measured and managed such as teacher motivation, changes in school climate, and changes in student attitudes due to maturity but could be correlated to the changes in achievement (Yoon et al, 2007). Providing teachers with educational support emphasizes the importance of providing knowledge, content, and skills to students.

Understanding the epistemology (content knowledge), the pedagogy (how to teach), and assessments (evaluation of learning) is essential to being an effective teacher (Knight et al., 2014). Knight et al. (2014) state that the learning sciences use a design discipline that occupies a "middle space" where epistemology, pedagogy, and assessment are intertwined as illustrated by Figure 1. The teacher's understanding of all three areas allows instruction focused on the process of learning instead of narrower goals (e.g., providing the correct answer on a test). This "sweet spot" between epistemology, pedagogy, and assessments is where the instructor can use higher level teaching methods.

Figure 1

The Traditional Triad (Knight et al., 2014, p. 25)



Epistemology represents the information or knowledge base that needs to be transferred to the learner. Assessment represents how the instructor will evaluate if the learner has developed an understanding of the content presented. Pedagogy represents classroom management and how the knowledge is shared. These components are important for teachers to learn about in order to develop skills to become an effective practitioner (Knight et al., 2014).

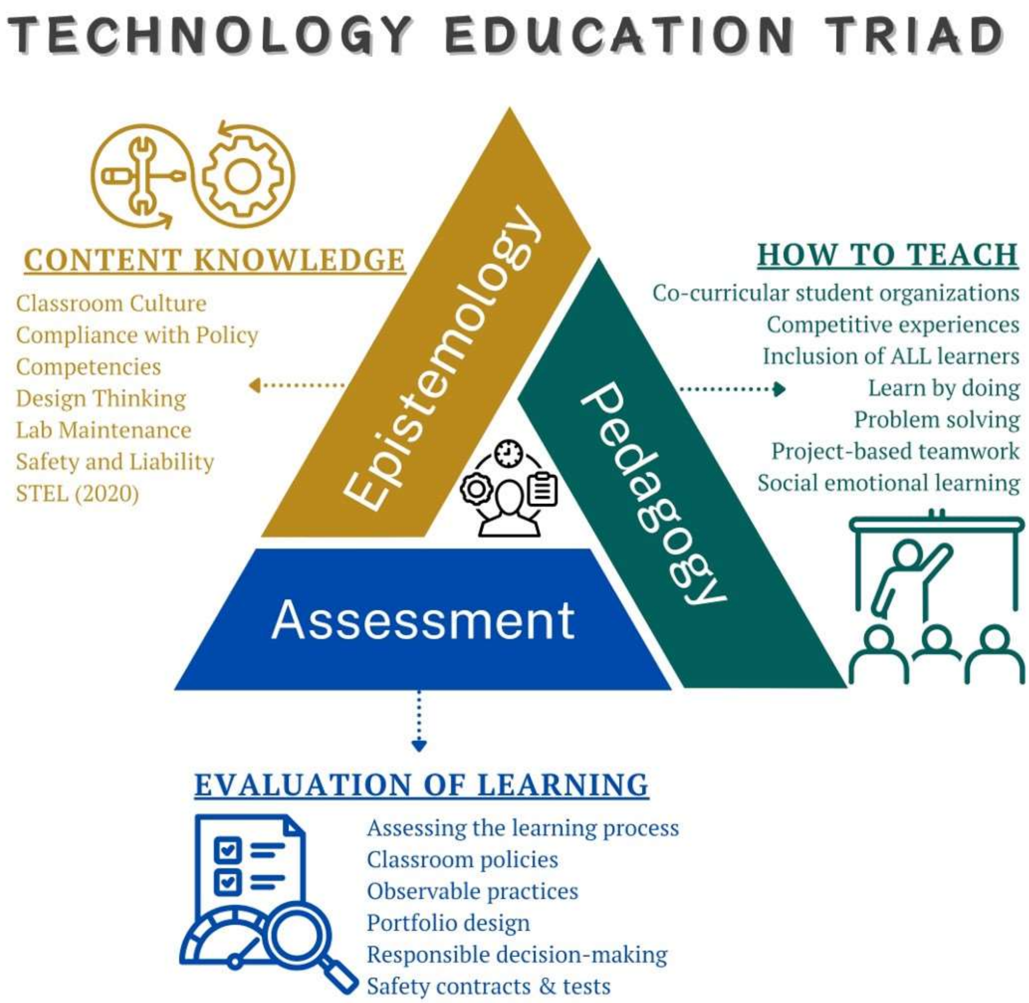
Significance to the Content

Since the United States (U.S.) does not have a national curriculum, each state offers courses structured by their state department of education. Technology education is offered as an elective in most states as one of seven specialty areas of career and technical education (CTE). The seven CTE specialty areas are agricultural education, business and information technology, family and consumer sciences, health and medical sciences, marketing, technology education, and trade and industrial education. Technology education offers a career and technical education program to teach about problem solving, socio-cultural impacts of technology, and design.

The triad of teaching for technology education is unique to the discipline, see Figure 2. Technology education uses design thinking to teach about the human designed world (STEL, 2020). Technology education teachers use tools and machines to teach these concepts. The use of tools and machines makes the technology education pedagogy include unique aspects of teaching such as the inclusion of social emotional learning in order for students to learn how to work in teams and the inclusion of students with individualized education programs (IEPs). Technology education epistemology requires the knowledge of safety, liability, machine repair, competency based education, and active learning. Technology education assessment requires the learner to be evaluated throughout the process instead of evaluating the product. Allowing the student to fail while testing designs is recognized in the discipline as part of the process of learning. Evaluating a failed product of learning requires alternative methods of assessment.

Figure 2

The Technology Education Triad



Technology education instructors teach their students that they can learn through failure and be assessed by their learning process and not the product of their inventive and creative work. When given a problem to solve, student work should not be graded by the success or failure of the product but rather by the process and documentation of the learning through the problem-solving process. “Failing together created shared experiences and conversations between teachers and created opportunities for peer, coach, and administrative support for creative and risky technology integration practices" (Scharber et al., 2021, p. 633). Evaluating the process of learning instead of the product allows the learner freedom to learn from their failures. Assessing the process of learning frees the instructor from focusing on the end result or product of student learning.

Instructors who teach students how using the "middle space" has "interpretive flexibility" and provides for understanding trade-offs and impact of content which may have answers which are determined by the perspective of the learners (Knight et al., 2014). Curriculum changes as technology develops and allows students an opportunity to change their perspective (or "correctly" answer) based on a method of discourse and exploratory methods (Knight et al., 2014). The "sweet spot" of the technology education triad, see Figure 2, is very different from the traditional triad, see Figure 1, due to these unique teaching methods, management skills, and assessment strategies which allow students to see success in the process of learning and not the product.

Legislative Origins of Technology Education

The "manual labor movement" began in 1825 to provide support to citizens who could not afford the private schools to become educated for the workforce. Originally created by the Swiss, the phrase "manual training" was used by Robert Owen and William Maclure to describe their utopian socialist community which trained children to develop a trade (Prakken, 1976). The term "manual arts" was used by Charles A. Bennett in 1894 to establish a specific program that was mechanical and manipulative in nature (Herschbach, 2009). Manual arts signaled a transition from generalized workforce training to a specified curriculum which provided academic and cultural education.

Over time, schools evolved to become more than just places of learning about religion. Schools became places where students could develop practical skills. For instance, in 1854, Cokesbury Manual College established a woodworking shop to keep young men “out of mischief” and enable them to develop skills with tools (Prakken, 1976). The Cokesbury Manual College was one of the earliest examples of machines and tooling being taught formally in schools.

In 1862, the Morrill Act provided for the establishment of state agriculture and mechanical arts colleges (Prakken, 1976). The bill was signed into law by Abraham Lincoln and helped to establish universities such as the Hampton Institute in Virginia which catered to helping freed slaves gain workforce skills. In 1914, Congress established a commission to study the promotion of industrial education called the Commission on National Aid to Vocational Education. This commission brought forth many recommendations which culminated in the creation of the Smith-Hughes Act of 1917 (Prakken, 1976).

The Smith-Hughes Act channeled federal funds to state boards for vocational education. The funding continued even during the depression and World War II. After World War II, the GI Bill of Rights was passed to provide military who returned from the war with vocational training. In 1958, the National Defense Education Act provided $60 million for training and developing vocational schools (Sredl, 1964). The Vocational Education Act was passed in 1963 to address the high rate of unemployment and increase funding for vocational education. The Vocational Education Act was renamed the Carl D. Pekins Act in 1984 to honor a U.S. Representative from Kentucky who served on the committee of education and labor for seventeen years. The Perkins Act continues to fund career and technical education programs today. The passage of the Smith-Hughes Act in 1917 which later evolved into Vocational Education Act of 1973 and then the

Carl D. Perkins Act of 1984 provided federal funding for industrial and manual arts education and promoted the growth of the discipline (Loucks, 1991).

Philosophical Origins of Technology Education

Historical philosophers such as John Dewey had great influence on the discipline as well. Dewey published *Democracy in Education* in 1919 which established him as a proponent of teaching skill-based education which focused on problem solving “to bring out their (students’) intellectual and moral content” (Loucks, 1991, p. 1-4). Dewey wanted students to use conflict to solve problems, question existing aims of education, and teach reflection and ingenuity (Pouwels & Biesta, 2017). In 1922, Frederick Bonser, a leader in industrial arts, promoted the idea of industrial arts at the elementary school level which focused on the study of tools and machines to study industry (Sredl, 1964). The transition of manual arts to industrial arts evolved as free schooling began being implemented throughout the United States. After World War I, Frederick G. Bonser wrote extensively about the purpose of industrial arts focusing on elementary schools. Bonser felt the primary emphasis of industrial arts should be focused on intelligence and cultivated taste (Prakken, 1976).

Professional organizations also aided in the development of the discipline as well. In 1926, the American Vocational Association (AVA) was formed with many of its members being industrial arts educators (Sredl, 1964). In 1941, the American Industrial Arts Association (AIAA) was formed from a subcommittee of the AVA. “Industrial arts, in contrast to vocational education was part of general education” (p. 1-10, Loucks, 1991). According to Loucks, the industrial arts programs developed pre-vocational skills for elementary students and skills needed for jobs in high school students (1991). The AVA and later AIAA provided support for the discipline which developed curriculum materials and networking connections for leaders in the discipline. Even though industrial arts was a part of K-12 mainstream curriculum, the discipline changed to an elective course in the 1950s. In the 1950's, industrial arts activities declined due to 1) decrease in school budgets, 2) increase in student academic work required, 3) 3) decrease in clock hours of industrial art instruction and 4) increase in counseling pupils away from industrial arts (Sredl, 1964).

Today, education serves a variety of purposes in our society, including the development of critical thinking skills, socialization, and personal growth. Education also plays a critical role in promoting social and economic mobility. Trends in skill-based education can often be traced to involvement of military in wars. The War of 1812 brought about rapid growth in cities and the need to educate workers for factories. By 1830, the first school dedicated to improving workforce education, the General Society of Mechanics and Tradesmen, was established in New York City (Prakken, 1976).

Professional Influences on Technology Education

One of the most influential events was the Manual Arts Conference of the Mississippi Valley. This conference began in 1909 and met annually by invitation only. This conference created a report entitled Industrial Arts in Modern Education and supported the AVA committee on standards (Herschbach, 2009). The conference played a key leadership role in the development of technology teacher education programs by creating a collaborative forum for the industrial arts movement. The conference was later renamed the Mississippi Valley Technology Teacher Education Conference.

Status of Industrial Arts in the Elementary Schools was a study created by A. H. Edgerton, an assistant professor at Indiana University in the 1920s which reviewed 141 school systems in 19 different states to establish what was being taught and the facilities used (Sredl, 1966). This study and a subsequent study on the status of industrial arts in junior high school established the primary aim or purpose of industrial arts. Another influential study was made by Arthur Feuerstein which compared industrial arts before and after the depression (Sredl, 1964). According to Sredl (1964), Feuerstein's study established the importance of industrial arts by showing the growth and importance of the classes even during the depression era.

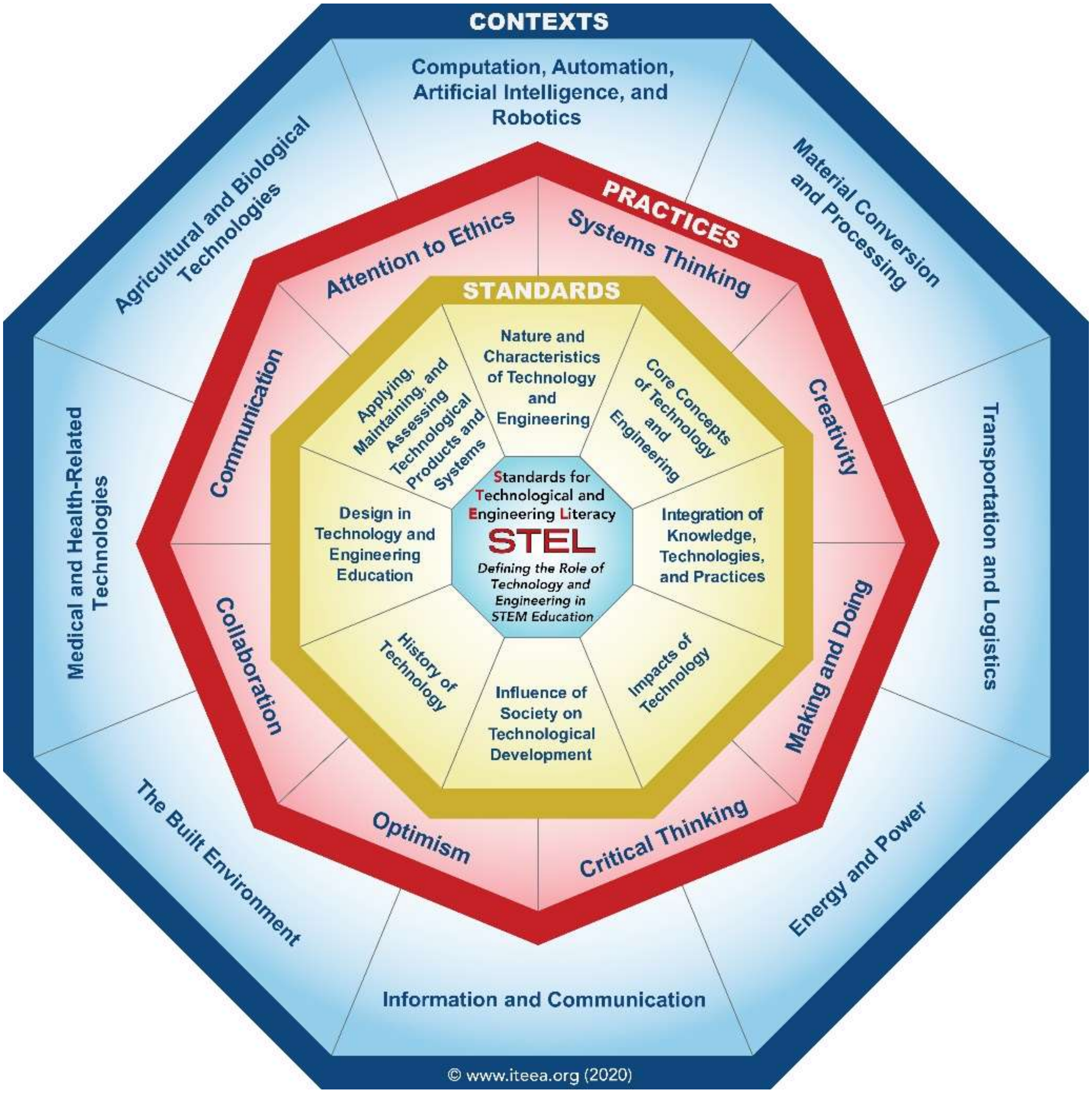
During the transition from industrial arts to technology education, many events influenced the curriculum field. Such an event was created by the industrial arts supervisors from West Virginia for curriculum specialists was the meeting at Jackson's Mill to develop a plan for the transition from industrial arts to create technology education (Lewis et al., 2005). A document of compromise was created at that 1981 conference called the *Jackson's Mill Industrial Arts Curriculum Project* (Sredl, 1966).

Theoretical Framework

In 1994, the Technology for All Americans Project began to research the discipline priorities and the rationale for standards prompted by the publication of *A Nation at Risk: The Imperative for Educational Reform* (Borek, 2008). After six years of work, the Technology for All Americans Project released the *Standards for Technological Literacy: Content for the Study of Technology (STL)* (Loveland, et al, 2020). In the fall of 2019, the STL document was updated after intense review from 30 technology education leaders. The current standards for the technology education discipline is *Standards of Technological and Engineering Literacy (STEL*; ITEEA, 2020*).* See Figure 3 for overview of STEL standards, practices, and contexts.

Figure 3

STEL Graphic Organizer (ITEEA, 2020, p. 11)

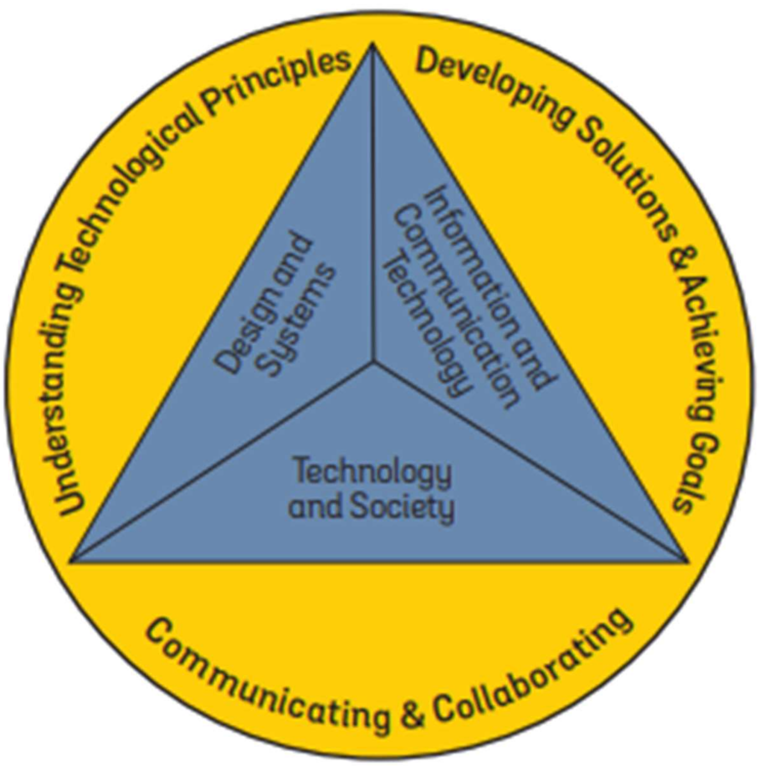


The U.S. does not assess students in career and technical education through standardized tests to determine growth and strength in that subject matter. However, technology and engineering literacy began to be assessed using the "Nation's Report Card" or National Assessment of Educational Progress (NAEP, 2020). In 2008, the National Assessment

Governing Board, which is an independent, bipartisan group appointed by the U.S. Secretary of Education, began developing a framework for the assessment of students' knowledge and skills in technology and engineering, see Firgure 4 (NAEP, 2020). The National Assessment Governing Board articulated the domain of technology and engineering literacy (TEL; i.e., knowledge and skills) that is important for all students, not just those pursuing STEM-related careers (NAEP, 2020). Technology and engineering literacy was assessed through three interconnected content areas of: 1) technology and society, 2) design and systems, and 3) information and communication technology.

Figure 4

NAEP-TEL Framework (National Assessment Governing Board, 2018, p. XVII)



Based on the NAEP-TEL Framework (2018) in Figure 4 and *Standards for Technological and Engineering Literacy* (ITEEA, 2020), Figure 3, the *Technology Education Triad* in Figure 2 represents the epistemology, pedagogy, assessment triad which are unique to technology education and are the foundation of this research. Determining what is needed in the classroom setting for students to successfully learn is imperative to developing support for the teacher. This research used these foundational concepts of epistemology, assessment, and pedagogy to guide the data collection.

LIMITATIONS AND ASSUMPTIONS

The study was limited to:

- Secondary technology education teachers in Virginia, as identified by the Department of Education and, more specifically, affiliated with the Technology Education Programs.
- Self-reported data.
- Participants that had access to a computer and the Internet.
- Participants that had a Google account to complete phase one of the research.
- Documents provided online for the documents review that were open source and unedited by outside users.

The following assumptions were made during the study:

- Technology teachers understand their needs and limitations on what they know.
- The survey questions provided a comprehensive overview of the needs of Virginia secondary technology education teachers.
- Virginia technology education teachers know the goals of their program.
- Individuals who received awards on merit and had extensive classroom experience were representative of an expert secondary technology education teacher.

PROCEDURES

The research was conducted in three phases. This descriptive qualitative study used a survey to gain insights into the research questions, a documents review to examine the curriculum, certification, and regulations regarding technology education, and a focus group of technology education leaders to confirm and clarify any remaining questions regarding the research questions. Phase one and two informed the questions for phase three of the study.

Secondary technology education teachers in Virginia were the identified subjects for this research due to the diverse requirements for teacher licensure in each of the 50 U.S. states. A survey (Appendix A) was created to gather information about technology education teachers and their needs for support based on the Schmitt and Pelley (1966) instrument. The Schmitt and Pelley instrument was used in prior research which created the *Standards for Industrial Arts Education Programs* (SIAP) (Dugger, 1980) and to investigate the status of technology education practice in the United States (Sanders, 2001). According to Dugger (2002), the SIAP "contained the best thinking of the profession on what industrial arts programs should be and how they can be improved at the time of their publication" (p. 96). The information from the SIAP was revised in 1985 to reflect all technology rather than just industrial arts and was later used to inform the document, *Standards for Technology Education Programs* (Dugger, 2002).

The Schmitt and Pelley (1966) instrument was updated for this research using *Standards for Technological and Engineering Literacy* (ITEEA, 2020). The 1966 instrument was used as a basis for this research because the Dugger (1980) and Sanders (2001) instruments were not provided in their publications and the authors have retired. The instrument was re-created using Google forms to provide an easy format for collaboration. Google forms was used on a virtual private network (VPN) provided by Old Dominion University (ODU) to secure privacy of data collected. The survey instrument was validated for content using two technology education experts since field testing was completed by Schmitt and Pelley (1966), Dugger (1980), and Sanders (2001). The technology education experts were provided with the survey prior to distribution to determine if the survey was representative of the questions that should be asked to assess current technology education teacher needs, background, and current program goals.

Requests to complete the survey and a link for the form were sent via the Virginia Department of Education Technology Education Specialist's Listserv (Appendix B), through Constant Contact email list for the Virginia Technology and Engineering Education Association (VTEEA) (Appendix C), through in person requests with a quick response (QR) Code at the VTEEA conference (Appendix D), and through a direct and individual email to Virginia's CTE directors (Appendix E). Survey data was collected automatically to a Google spreadsheet after the submit button was clicked on the online survey form. The spreadsheet was downloaded from the online format and imported to a spreadsheet for qualitative review by the researcher. The Google spreadsheet was password protected to maintain confidentiality of participants.

Once a participant completed the form, an autogenerated response thanked the participant and provided the researcher's contact information if the participant desired to view the results when the research was complete. Participants were offered an additional link to a Google form to request a free lesson plan for their content, grade, and time requirements. After the data was downloaded from the online format, all online data was deleted. The final data was kept on an encrypted universal serial bus (USB) drive for storage during the analysis process.

A documents review was completed on technology education curriculum, teacher licensure requirements, and other governing documents for technology teachers in Virginia. Each research question was explored through online documents and data from the Virginia

Department of Education, U.S. Department of Education, and other online CTE resources. Results from the documents review were compared with information collected from the phase one survey of this study. The themes found in the survey and the documents review were used to construct focus group questions with the intent of confirming and clarifying data from the first two phases of the study.

The third phase of the study was a focus group conducted via Zoom (an online meeting and communication software program) with leaders designated by receiving awards for their work as a technology educator, extensive experience, and involvement in technology education specific professional organizations. The experts included former and current Virginia Technology and Engineering Education Association (VTEEA) board of director members as well as former Virginia recipients of the International Technology and Engineering Educator's Association (ITEEA) teacher of the year award and/or program of the year award and content experts in Virginia. The focus groups were provided a list of questions prior to the meeting as well as the consent form to participate. The focus group conversations were automatically transcribed by the Zoom software for qualitative analysis purposes. The focus group was asked clarifying questions which allowed further details of the research questions to be explored.

POPULATION, SAMPLE, AND SETTING

The population consisted of secondary teachers currently teaching in technology education laboratories as identified by the Virginia Department of Education, Technology Education Specialist. The population consisted of 943 secondary technology education teachers according to Dr. Basham, Technology Education Specialist, Virginia Department of Education, (personal communication, March 3, 2023). The sample consisted of the teachers who self-identified through emails from VTEEA, the VDOE technology education listserv, and their CTE directors. The setting was an online format using a computer, tablet, or mobile device which had access to the internet for all phases of the research.

INSTRUMENTS AND DATA COLLECTION

The "Survey of Technology Teachers in Virginia" instrument (Appendix A) was created from the Schmitt and Pelley (1966) instrument using the Google form software protected by a password to prevent contamination of the data. The survey data was reviewed which led to the identification of themes for specific searches for the documents review. The documents review collected data from governing documents that aligned with the research questions, survey instrument items, and the *Triad for Technology Education* (Figure 2). The data from the survey and documents review provided information for the researcher to develop questions for the panel of experts in the focus group.

The focus group consisted of five volunteers who represented best practices and have received awards designating them as leaders in technology education in Virginia. The five panel members included two current VTEEA Board of Directors members, four Virginians who had received ITEEA's Program of the Year award, two Virginians who received ITEEA's Teacher of the Year award, one teacher educator, and four current technology education supervisors. The focus group provided clarification on the findings from the survey and documents review as well as insights into the support needs of Virginia secondary technology education teachers.

Definition of Terms

Career and Technical Education: "means organized educational activities that—(B) include competency-based, work-based, or other applied learning that supports the development of academic knowledge, higher-order reasoning and problem solving skills, work attitudes, employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of an industry, including entrepreneurship, of an individual;" (Perkins V, 20 U.S.C. 2302, section 3, 5B, p. 5).

Career Switcher: An individual with a career in a profession related to technology that is transitioning into teaching (Ferguson & Reed, 2019).

Content Switcher: Teachers holding a license in one area of education who are working to get licensed in technology and engineering education (Reed & Ferguson, 2021).

Engineering: "is the use of scientific principles and mathematical reasoning to optimize technologies in order to meet needs that have been defined by criteria under given constraints" (ITEEA, 2020, p. 8)

Professional Development: "means activities that— (A) are an integral part of eligible agency, eligible recipient, institution, or school strategies for providing educators including teachers, principals, other school leaders, administrators, specialized instructional support personnel, career guidance and academic counselors, and paraprofessionals with the knowledge and skills necessary to enable students to succeed in career and technical education, to meet challenging State academic standards under section 1111(b)(1) of the Elementary and Secondary Education Act, or to achieve academic skills at the postsecondary level; " (Perkins V, 20 U.S.C. 2302, section 3, 40, p. 11).

STEM: "A term used to group together the academic disciplines of Science, Technology, Engineering, and Mathematics and their associated content, practices, and applications" (ITEEA, 2020, p. 160).

Technology: "Modification of the natural environment, through human designed products, systems, and processes, to satisfy needs and wants" (ITEEA, 2020, p. 8).

Technology and Engineering Education: "The combined disciplinary study of the engineered (human-designed) world, the goal of which is to develop individuals with a breadth of knowledge and capabilities who see the interactions between technology, engineering, and society and can use, create, and assess current and emerging technologies" (ITEEA, 2020, p. 162)

Technological and Engineering Literacy: "is the ability to understand, use, create, and assess the human-designed environment that is the product of technology and engineering activity" (ITEEA, 2020, p. 8).

SUMMARY AND OVERVIEW OF CHAPTERS

Previous studies clearly indicate the need for technology education teachers have not been met by the institutions which prepare teachers (Daugherty, 1998, Moye, 2012, Volk, 1997). A trend has formed which indicates the gap between supply and demand causes the closure of valuable programs creating a lack of services provided to students and parents who clearly want technological literacy skills (Moye, 2012). Students and parents desire the knowledge and skills provided by technology education teachers (Ndahi & Ritz, 2003; Phi Delta Kapan, 2017). Alternative teacher certification means teachers have varied backgrounds and thusly, differentiated needs. Federal funding through the ESSA, America Competes Act, and Perkins V require evidence-based research into the support needs of teachers specific to CTE, STEM, and technology education. This study was designed to research the needs for support of Virginia technology education teachers in order to teach technological literacy skills based on the pedagogy, epistemology, and assessments that provide for technologically literate learners.

Chapter II describes literature which supports the need for this study. The chapter describes the historical information for each research question posed in this study. Chapter III explains the methods and procedures used to conduct research and how the data was analyzed. Chapter IV describes the researcher’s findings. Chapter V includes a summary of the study, conclusions drawn from the data, and recommendations for practitioners and further research.

CHAPTER 2

REVIEW OF LITERAURE

The review of literature provides a historical perspective for this research. Background information pertaining to the research questions (RQs) for this study helped to shape the perspective of this research. Research question one (RQ1) focused on the educational background of technology education teachers including an overview of post-secondary programs in technology education and alternative routes to become a teacher. Research question two (RQ2) focused on goals in technology education programs including the origins of technology education content, standards, and key factors influencing the curriculum such as curriculum events, research, and legislation. Research question three (RQ3) focused on the major issues confronting secondary technology education teachers in the classroom. This review of literature is organized around these three research questions.

RQ1: EDUCATIONAL BACKGROUND

The teacher shortage could be defined as the number of unfilled positions such as in the report, *Teacher Shortage Areas Nationwide Listing 1990–1991 through 2016–2017,* (U.S. DOE, 2016) however, that does not tell the whole story. Many classrooms and laboratory spaces are being left empty when a qualified technology education teacher cannot be found. According to the *Congressional Primer for CTE*, "(T)here is little reliable data on the extent of CTE teacher shortages, as states are only required to identify areas for which there are shortages to ED and do not have to specify the number of empty positions" (Edgerton, 2022, p. 13). The report goes on to state that, "rather than reporting a teacher shortage, a CTE provider (school district) may instead change its program offerings in response to teacher vacancies by eliminating programs of study" (Edgerton, 2022, p. 13). Also, hidden shortages can be found as unqualified staff or substitutes are placed into all classrooms (Santiago, 2002). According to Owens et al. (2014), the size of all teacher turnover in the U.S. was 16% who changed their location while 8% left the profession entirely in 2012. The teachers may be leaving due to the fact that they do not feel qualified to teach the subject for which they were hired (Donista-Schmidt, & Zuzivsky, 2016).

Technology education, specifically, has been labeled as a critical needs area in Virginia since 1998 as reported to the U.S. Department of Education (U.S. DOE, 2016). Unfortunately, the teacher shortage areas database located at https://tsa.ed.gov/#/reports, does not provide a drop-down option for "technology education" as a discipline under the subject matter, "Career and Technical Education." The options for disciplines include titles such as industrial arts, woodworking, business technology education, engineering technology, and technology preparation. A more generalized view of critical needs across the U.S. for technology education was not readily available but this lack of clarity does refer back to Reed who stated, "T1 (Technology Education) needs to clarify its position in STEM with laser-like focus" (2018, p. 20). Data such as reporting teaching shortages through the U.S. Department of Education were unavailable due to the lack of clarification of the name (USDOE, 2023a).

When discussing the teacher shortage, it is imperative to understand how teachers become certified to teach secondary technology education in order to understand the teacher shortage. Each state is responsible for the teacher certification process independent of national norms or requirements. The process of certification varies from state to state. In this research, the focus will be on technology education teacher certification in Virginia. Virginia has two methods of teacher certification: 1) approved post-secondary programs leading to licensure and 2) alternative routes to licensure which is often referred to as the "career switcher" program. Discovering teacher educational backgrounds can help professional develop support for the classroom. Teacher licensure was created to “set the bar” for educators. In other words, a licensed teacher should have an understanding of outlined educational practices.

More teachers are coming from alternative pathways of licensure than traditional teacher training undergraduate programs (U.S. Department of Education, 2023b). According to the *Title II Higher Education Act 2018 Report*, the traditional pathway of university four-year programs for all teacher preparation has gone from 3,602 programs in 2014-15 to 2,976 programs in 2016-17 which indicates a 17% decline over three years (National Teacher Preparation Data, 2018). According to the *Positions and Exits Build-A-Table* from the Virginia Department of Education which can be used to find staffing shortages and vacancies, the technology and engineering education teachers’ shortage in Virginia has increased unfilled positions from 2.3% in 2020-21 to 3.3% in 2023-24 (VDOE, n.d.b). In 2023-24, the statistics reported by the website listed 672.95 full time equivalent (FTE) engineering and technology teachers with 22 unfilled positions. For 2021-22, the table building website listed 596.59 FTE engineering and technology teacher positions with 13.9 unfilled positions. The table building website only lists school years 2021-2024. These FTE positions reported on this website do not agree with the 943 secondary technology education teachers reported by the Virginia Technology Education Specialist (personal communication on March 3, 2023).

Post-Secondary Programs in Technology Education

Volk stated in 1997, “the demise of the technology teacher preparation programs will occur around the year 2005” (p. 69). The profession continues to exist, but the technology education teacher preparation programs have diminished. An analysis of the 2002/2003 *Industrial Teacher Education Directory* published by the Council on Technology and Engineering Teacher Education compared technology education teacher preparation programs with enrollment over 20 students to the 2012/13 *Technology & Engineering Teacher Education Directory* yielded a loss of 40% during the ten-year span (Litowitz, 2014). Prophesies such as Volk's (2019) for the demise of the discipline should be cause for concern.

Currently out of the 37 Virginia post-secondary education institutions that offer state-approved teacher preparation programs, Virginia's sole source for an undergraduate technology education degree at the time of this study was at Old Dominion University (ODU). The undergraduate degree is available in-person or online through ODU Global (ODU, 2024). Virginia Tech recently added an undergraduate technology education program and is accepting applications for the 2024-2025 academic year (Virgnia Tech, 2024).

According to *Career and Technical Education – Technology Education* (8VAC20-23-270), the licensure requirements for a technology education teacher to become certified include an earned "baccalaureate degree from a regionally accredited college or university and completed a major in technology education or 33 semester hours in technology education" (Section 2, 2018). When an undergraduate student goes through a teacher preparation program, the student is provided with an average of 45 credit hours of general education, 33 professional credits, and 44 technical credits for secondary technology education degree (Litowitz, 2014). The VDOE is responsible for listing accredited colleges or universities for each teaching program area. The VDOE technology education website (https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/career-and-technical-education-cte/technology-education) lists two (2) technology education higher education programs. The VDOE technology education program are webpage sates, "There are two universities in Virginia that provide higher education academic support for technology education. These universities offer undergraduate and graduate degrees, and statewide professional workshops/courses" (2024, section 7). The Virginia universities with technology education teacher preparation programs listed are Old Dominion University and Virginia Tech.

Currently in order to become trained as a technology education teacher through the approved programs process, the options available for a student in Virginia would be 1) attend ODU for in-person undergraduate degree, 2) attend ODU online for the undergraduate degree, or 3) attend a community college and transfer to ODU for the content specific courses needed to complete the undergraduate degree. All Virginia state universities have a program which accept two-year community college articulation agreements. The articulation agreement provides pathways which clearly specify requirements for transfer into the four-year degree program (SCHEV, 2010). Each of these options is considered a traditional teacher preparation pathway.

Alternative Routes to Licensure

Alternative teacher certification programs refer to any teacher licensing by a state which does not incorporate a post-secondary undergraduate or master's degree in education (Zeichner et al., 2001). The terms "teaching license" and "teacher certification" are used interchangeably in the profession (Goldhaber et al., 2000). According to Zeichner et al. (2001), the Commonwealth of Virginia created the first statewide alternative teacher licensure program in 1982.

Devier (2019) found, "The 50 states and the District of Columbia reported 122 alternative routes to teacher certification pathways in 2017" (p. 49). Teacher licensure requirements are set by each state's department of education so alternative licensure requirements differ by state and agency. General guidelines for teacher candidates include an academic degree, work experience in the subject area, and mandatory testing such as the PRAXIS (Devier, 2019). Alternative licensure requirements do not require the intensive educational background in pedagogy, epistemology, or assessment training due to the streamlining of the process. The alternative licensure process tends to rely upon industrial experience and content knowledge shortening the four-year degree into the total immersion process in which those knowledgeable in content learn how to manage the classroom, navigate curriculum sources, and determine best practices while in the classroom.

While these alternative preparation programs are gaining in popularity, they are not meeting the demands for teachers in Virginia which had a turnover rate of 9.2% for 2008-09 (SCHEV, 2010). According to the *Staffing and Vacancy Report* from the Virginia Department of Education in 2021-22, the Commonwealth has 314.35 unfilled Full Time Equivalency (FTE) teaching positions with 37.08 FTE teaching positions unfilled in the career clusters related to technology education. Virginia House Joint Resolution (HRB) 678 required the State Council of Higher Education for Virginia (SCHEV, 2010) and the Virginia Community College System (VCCS) to study the shortage of classroom teachers in the Commonwealth. The SCHEV report recommendations from the HRB 678 report suggested that programs “reach out to high school students who express interest in the teaching profession and actively recruit these students to teacher education programs at their institutions” (2010, p. 23). Alternative certification programs are usually one year in length, require participants to have a bachelor's degree, require education coursework through a post-secondary education program while teaching, and provide mentors for participants during the school year (Zeichner et al., 2001).

While alternative licensure pathways may encourage more professionals to enter the education workforce, the “feet first” method of on-the-job learning may cause difficulties for some new to the teaching field. The *Longitudinal Investigation of the Relationship Between Teacher Preparation and Teacher Retention* study conducted by Zhang & Zeller (2016) in North Carolina researched the relationship between retention of teachers trained through alternative route certification programs and those trained through traditional four-year teacher preparation programs. The study found that "one-fourth of teacher retention likelihood is explained by teacher preparation" (Zhang & Zeller, 2016, p. 85). By year seven of their study, alternatively licensed teacher retention was roughly 51% lower than those teachers trained in traditional teacher preparation programs (Zhang & Zeller., 2016). Teachers who spent four years studying education in a traditional teacher preparation program were socialized into prioritizing learning and focusing on pedagogy whereas alternatively licensed teachers have little experiential learning about teaching prior to entering the classroom (Zhang & Zeller, 2016).

Much debate has been created over the effectiveness of alternatively trained teachers over traditionally trained teachers. Mentzer et al. (2019) conducted a study that compared Ohio Alternative Educators License (OAEL) with the Licensed Alternative Master's Program (LAMP). According to Mentzer et al., "licensure type was unassociated with the impact on teaching self-efficacy, beliefs about teacher-focused/ student-focused teaching, preferences for inquiry instructional practices, and experiences with student misbehavior" (2019, p. 35). The more traditional LAMP program produced graduates with more confidence in their ability to teach and had more knowledge on educational theory and how to apply these theories (Mentzer et al., 2019). The LAMP study focused on STEM teacher education.

Another study by Goldhaber et al. (2000) focused on 12th grade mathematics and science students' achievements in comparison to teacher licensure. The study determined that student achievement on standardized tests had a 10% increase when the teacher had a standard certification with a background in their content area specifically in mathematics and science. The Goldhaber et al. study focused on students at the end of their secondary education experience where subject matter is taught in separate classes. Very little longitudinal research evidence exists on the efficacy of alternative licensure in comparison to traditionally trained teachers at other grade levels since alternative licensing began in the 1980s.

Research suggests that nearly twice as many career and technical education (CTE) teachers enter through alternative certification as other teaching fields, and many of these CTE teachers have little or no instructional training (Feistritzer, 2009). “Licensing agencies across the United States commonly define any licensure path that does not follow traditional teacher education preparation as an alternative” (Devier, 2019, p. 49). The flexibility in teacher licensure means that teachers can have broad coursework in academics, work experience, and program length. The problem of this study was to research secondary technology education programs and teachers in Virginia to collect data on teacher’s needs for support.

RQ2: PROGRAM GOALS

“Where Mathematics is epistemically predicated upon *proof*, and science upon *interpretation*, Technology—especially for the purposes of Technology Education and classroom learning—could be better defined by locating its epistemic basis firmly in *Transformation*” (Morrison-Love, 2017, p. 26). Providing an epistemological (content based) and ontological (man-made artefacts) philosophy allows the higher education institutions to differentiate technology education from all other technology related programs. Often technology education higher education professionals are building the construct of the curriculum and recruiting for their programs instead of developing the epistemology, assessment, and pedagogy needs of the discipline at the higher education level.

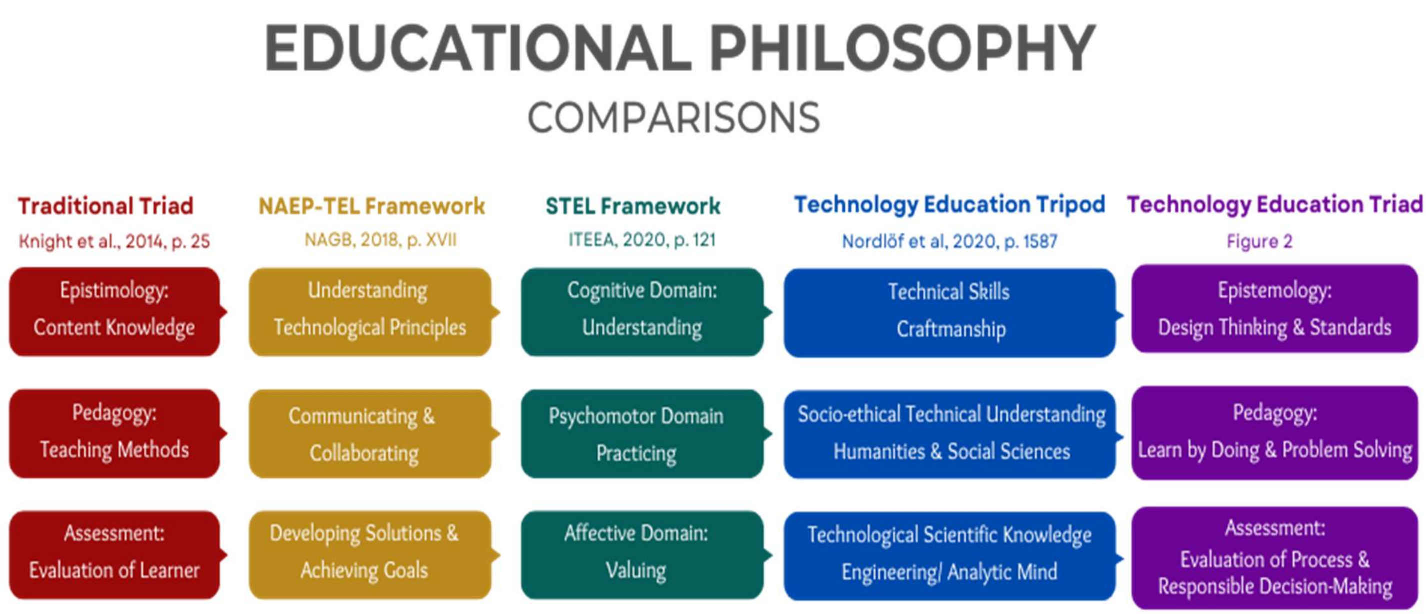
“There is not one single global version of technology education: curricula and standards have different forms and content” (Nordlöf, 2022, p. 1583). Prior to the development of *Standards for Technological Literacy* (ITEA, 2007) and later, *Standards for Technological and*

Engineering Literacy (ITEEA, 2020), the focus of technology education content centered on competency-based education. “The foundation of Technology Education in the United States is attributed to two educational leaders from the 1870s. Calvin Woodward, dean of the Polytechnic School at Washington University in Missouri, created the Manual Training School in St. Louis. Simultaneously, John Runkle, president of the Massachusetts Institute of Technology (MIT), introduced manual training into the curriculum for instructional purposes. Manual training was established to be a general education subject for all students, not vocational training, because Woodward and Runkle believed in actively engaging students in the learning process” (Reed, 2017, p.2). In 1973, the American Industrial Arts Association president, Paul W. DeVore suggested that the discipline reflect the paradigm shift of technological advances in our society to reflect technology as the content base and not merely industrial practice (Moye et al., 2019, p. 90).

As leaders struggle with the identity of our discipline, the decline of technology education teacher preparation programs also undermines the discipline. As DeVore argued, “the solution of the problems of our society requires an educated citizenry” (n.d., p. 15). In order to establish our curriculum as an intellectual discipline, we need to have an identifiable history, have an organized body of knowledge, and relate to activities and the solution of significant problems in society (DeVore, n.d.). Establishing technology education as an intellectual discipline will set our place beside the other academic fields of science, mathematics, language arts, and social studies because every child should study technology. Defining the epistemology of technology education and the philosophy behind the discipline “may then offer a new ground for Technological Education as foundational as ‘proof’ and as rigorous as ‘interpretation’ for vouchsafing its status and importance as a subject area central to contemporary educational provision" (Morrison-Love, 2017, p. 35). According to Nordlöf, the heuristic framework for technology education epistemology is threefold; 1) technical skills (based on craftmanship knowledge tradition), 2) technological scientific knowledge (based on the engineering knowledge tradition), and 3) socio-ethical technical understanding (based on the humanities and social sciences knowledge tradition) (2022, p. 1587). Nordlöf's tripod framework can be correlated to the *Traditional Triad* in Figure 1, the *Technology Education Triad* in Figure 2, the *STEL Graphic Organizer* in Figure 3, and the *NAEP-TEL Framework* in Figure 4, allowing for an expanded viewpoint of technology education, see Figure 5. The comparison shows how the different philosophies of technology education could be correlated. "Models are compromises, in this as in many other cases between ease of use and level of detail. The tripod with its three categories of knowledge is graspable" (Nordlöf, 2022, p. 1601). The three-fold models of technology education philosophies are not endpoints but instead a point which can begin conversations about the intellectual merit of the discipline.

Figure 5

Comparison of Educational Philosophies



"Technology education in the United States, like most disciplines, has a long history of standards but the initial impetus was driven by professional organizations within the field, not outside reports" (Reed, 2017b, p. 2). Under a grant from the National Science Foundation, William E. Dugger, Project Director, and the International Technology Education Association (ITEA) began to create a set of standards for technology education in the 1990's (ITEEA, 2020). The standards project included a curriculum document which defined technological literacy, a structure to study technology, and a call to action called *Technology for All Americans: A Rationale and Structure for the Study of Technology* (Lewis et al., 2005). This document was used to provide a basis for *Standards for Technological Literacy: Content for the Study of Technology* (ITEEA, 2020). "This document signals a desire to transition the practice of technology educators with first emphasis on the nature of technology, design, and the interrelationships with society" (Lewis et al., 2005, p. 13).

Technological literacy is commonly defined as the ability to understand the human designed world (ITEEA, 2020). Teachers in technology education focus on design, problem solving, and engineering. According to *Standards for Technological and Engineering Literacy* (ITEEA, 2020), the study of technology and engineering education is comprised of standards, practices, and contexts, see Figure 3. The standards provide eight core standards with 142 benchmarks for grades K-12. The eight practices were adapted from the 21st Century Skills and from the engineering habits of mind which focus on student-centered practices. The eight contexts or content areas describe the settings where the standards should be taught (STEL, 2020). S*tandards of Technological and Engineering Literacy* are used to develop core curriculum in technology education throughout the U.S. and Virginia.

Since technology education in Virginia is financially supported through Perkins V, the program goals are listed as competencies. According to Perkins V, Section 3, [20 U.S.C. 2302] *Definitions*, 5) Career and technical education B) "include competency-based, work-based, or other applied learning that supports the development of academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of industry, including entrepreneurship, of an individual;" (2019, pp. 4-5). In order for states and school districts to receive funding, the program goals must be competency and career based. Competencies are experiential based and measurable objectives which focus on skills associated with a career pathway (Casey & Sturgis, 2018). In other words, competencies focus on specific skills that can be demonstrated by the learner. Examples from the technology education course, Introduction to Technology and Engineering *8484 Modules,* include: (the student will) demonstrate the safe use of a minimum of three tools; demonstrate types of measuring; and create sketches and drawings (VDOE, n.d.a). The competencies in Virginia CTE courses are correlated to Standards of Learning for English, mathematics, science, and history and social sciences. In the *8484 Modules,* a "Standards Correlation" document contains three columns which contain the course competency (task), Virginia Standards of Learning (SOL) Correlations, and STEL and TSA Correlations (VDOE, n.d.a). An example of a correlation for the measurement competency is "PS.1. The student will demonstrate an understanding of scientific and engineering practices by (b) planning and carrying out investigations • take metric measurements using appropriate tools and technologies" (Board of Education, 2018, p. 8). The verbiage of competencies imply action whereas the verbiage of the standard references a level of understanding. "Competencies are the knowledge, skills, and abilities professionals need in their roles, while standards speak to a pre-defined level of quality or attainment of those competencies" (Martin & Ritzhaupt, 2021, para 1). Competencies include work-based skills and can be applicable across multiple content areas. See Table 1 for a summary of the differences between competencies and standards.

Table 1

Comparison of Competencies and Standards

	Competency	**Standard**
Summary	Experiential learning	Academic knowledge
Construction	Performance levels	Grade based performance
Content	Cross discipline	Focus on single discipline
Evaluation	Continuous rating systems	Categorical rating systems
Focus	Career-based	General knowledge
Organization	Evidence of learning	Time based
Outcomes	Discipline specific skills	Transferrable skills
Verbiage	Action based	Knowledge based

Note. Table created from summarizing Hilger (2023).

Competencies and standards are important to create guidance for teachers so that they can develop instructional materials using the different tools and skills for their students (Hilger, 2023). Technology education laboratories may include many different tools and machines. Some schools may find the community needs focus on agriculture or construction and may build laboratories with more woodworking or metal working machines whereas schools in areas that have industry such as computers or electronics may build laboratories with manufacturing tools such as 3D printers or laser engravers. While school districts may use Perkins V funding to equip laboratories, the state does not require schools to have the same equipment across the

Commonwealth. Standards provide the knowledge base for the students while the competencies provide the flexibility for schools to teach skills for the careers in the community.

RQ3: ISSUES

Topics of research in technology education continue to focus on curriculum and content. According to a meta-analysis conducted on research projects from 1987-1993, Zuga (1994) found 50% of all research completed during that time to be focused on curriculum status, change, and development. The research in recruitment and implementation may be the cause of the decline of our curriculum field (Zuga, 1994). The argument over content continues today as technology education discusses the inclusion of engineering and STEM education (Reed, 2018). In Virginia, the VDOE calls our discipline technology education whereas the VTEEA calls it technology and engineering education.

Nomenclature

With over 200 years of history, the profession of technology education has begun to have a semantics issue with the popularity of the term, “technology.” STEM, engineering education, information technology, instructional design, and educational technology are often interchanged with technology education (Reed, 2018). The change in nomenclature in the discipline from manual arts to industrial arts to technology education has been indicated as an issue with creating and maintaining a consistent curriculum (Litowitz, 2014). Industrial arts, industrial technology, technology education, and technology and engineering education are titles of college programs which train students to teach technology education (CTETE, 2018). An issue for the field of study has been consistency, beginning with the name which may have led to the difficulty of recruiting students. While this is an imperative, the definition of a “technology” education teacher varies. According to Reed (2018), the “T” in STEM education is defined by four major (curriculum) areas: Technology Education, Technical Education, Information Technology, and Instructional Technology. Teachers trained in teaching problem solving, tooling, and critical thinking are considered to be in the area of technology education (Reed, 2018).

Professional Issues

While research on the discipline (Moye, 2009; Moye et al., 2015; Moye & Reed, 2020) and the curriculum (Dugger, 1980; Litowitz, 2014; Sanders, 2001; Schmitt & Pelley, 1966) have been central to identifying issues in the discipline, research on issues facing the technology education teacher is sparse. Williams et al., employed the 2011-12 *Schools and Staffing Survey Teacher Questionnaire* (SASS) to study the technology education teachers' issues in regard to continuing in the profession (2019). The study (n = 50,610) indicated the four largest factors which affected teacher retention and commitment were 1) principal support, 2) student behavior problems, 3) safety, compliance, and federal funding paperwork, and 4) the caseload of students with individualized education plans (IEP) (Williams et al., 2019).

According to the *Documentation for the 2011-12 Schools and Staffing Survey*, the Teacher Questionnaire from 2007-08 SASS question on professional development inquires provided the following options, "(1) Student discipline and classroom management; (2) Teaching students with special needs (e.g., disabilities, special education); (3) Teaching students with limited-English proficiency; (4) Use of technology in instruction; (5) The content of the subject(s) I primarily teach; (6) Content standards in the subject(s) I primarily teach; (7) Methods of teaching; (8) Student assessment; (9) Communicating with parents; (10) Other, please specify" (Cox et al., 2016, p. 30). The list of options in the question for professional development reflect the *Traditional Triad* as illustrated in Figure 1 from Knight et al. (2014).

The SASS question seeks to research the needs and desires for support of teachers in epistemology, assessment, and pedagogy but miss many components which are specific to the discipline of technology education (National Center for Educational Statistics, n.d.a). Options such as machine maintenance, safety, co-curricular competitive experiences, design thinking, developing alternative assessments, and ordering consumables are not listed. In summary, technology education has a unique triad of epistemology-assessment-pedagogy due to the focus on problem solving, active learning, and critical thinking skills as outlined in *Standards for Technological and Engineering Literacy* (ITEEA, 2020). Technology education teacher issues specific to the epistemology, pedagogy, and assessments of the discipline needs more specific research.

SUMMARY

Chapter II describes research literature which supports the need for this study. The chapter describes the research on the educational background of technology education teachers including an overview of post-secondary programs in technology education and alternative routes to become a teacher. Program content goals were researched in regard to technology education programs including the origins of technology education and key factors influencing the curriculum such as curriculum events, research, and legislation. The major issues confronting the technology education profession and curriculum were found through exploration of historical documents, but research was sparse on the issues facing the technology education teachers' providing the classroom experience.

CHAPTER 3

METHODOLOGY

The purpose of this study was to investigate the educational background, teaching goals, and secondary technology education teachers in Virginia needs for support. According to the *Compilation of the Carl D. Perkins Career and Technical Education Act of 2006, as amended by the Strengthening Career and Technical Education for the 21st Century Act (Perkins V Act)(2019*) Section 124b titled “Permissible uses of Funds” states, the state leadership activities shall…(5) “for teachers, faculty, specialized instructional support personnel, and paraprofessionals providing career and technical education instruction, support services, and specialized instructional support services, high-quality comprehensive professional development that is, to the extent practicable, grounded in evidence-based research (to the extent a state determines that such evidence is reasonably available) that identifies the most effective educator professional development process” (p. 58). This research sought to identify the needs of the technology education teacher for compliance with the requirements of the Perkins V Act.

This descriptive research used a three-phase qualitative approach to collect data on trends and characteristics of technology education in Virginia. The research design consisted of a survey, documents review, and focus group. The survey used in the first phase was modified from the 1966 investigatory qualitative survey which was created by Schmitt and Pelley and later updated by Dugger (1980) and Sanders (2001). The online survey collected information concerning all three research questions. The documents review addressed RQ2 (goals of technology education programs) and expanded on the findings from the survey by reviewing state licensure requirements, to collect data on the congruence or inconsistencies in the survey data collected. The focus group addressed research questions two and three and included several questions to refine data on the needs and desires for teaching technology education. The qualitative data used different levels of analysis to clarify findings for the research questions (Plano et al., 2006). The previous studies which guided this research (Dugger, 1980; Sanders, 2001; Schmitt & Pelley, 1966) were all descriptive qualitative studies. The rationale for the three phases of this study provided the survey data to be triangulated with further data from the documents review and focus group data (Creswell et al., 2023). Each phase served to clarify the information collected and verify common themes and information regarding the discipline.

RESEARCH QUESTIONS

The use of this qualitative methods approach addressed the following research questions:

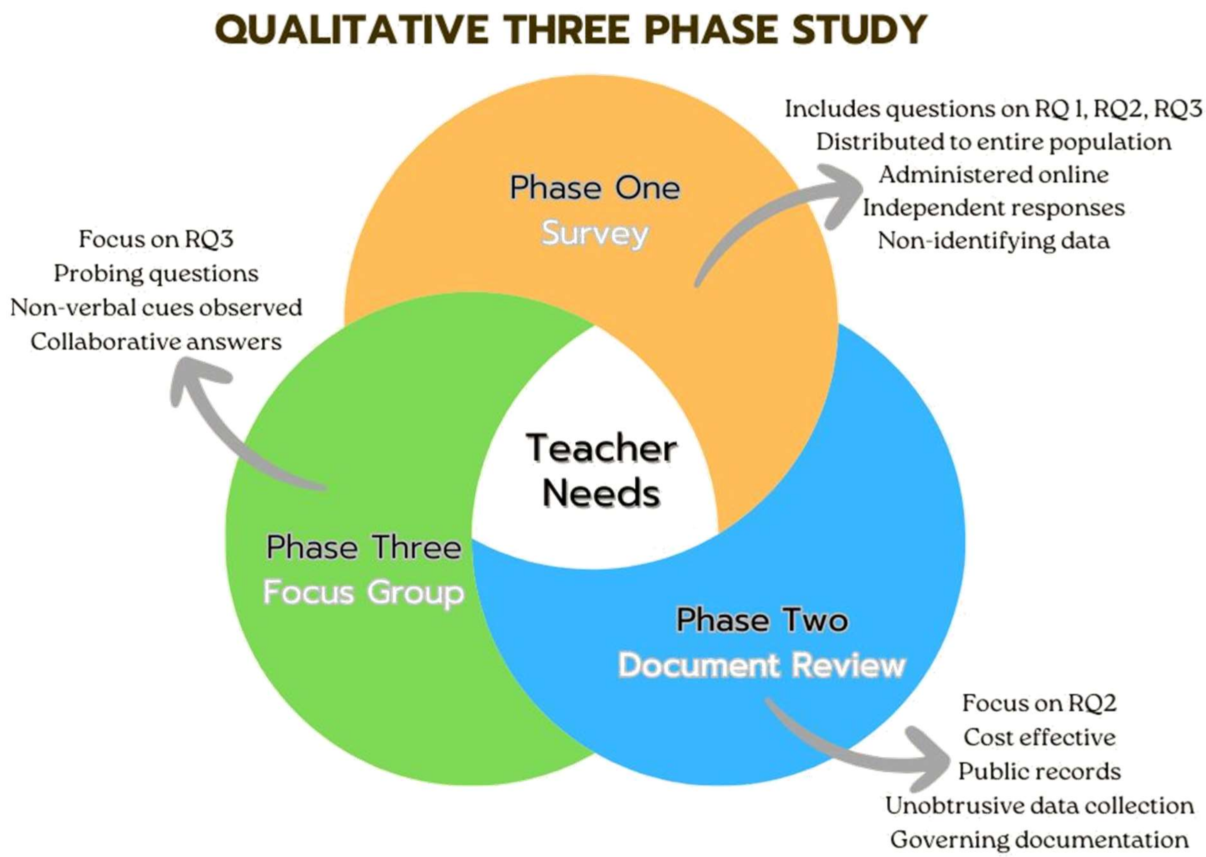
1. What is the educational background of secondary technology education teachers in Virginia?
2. What goals are emphasized in secondary technology education programs in Virginia?
3. What are the major issues confronting secondary technology education teachers in Virginia?

RESEARCH DESIGN

Research was conducted in a three-phase qualitative methods design. The descriptive qualitative design was developed to collect data on secondary technology education programs in Virginia to determine teacher's needs for support. After each phase of data was collected, the researcher worked deductively to review themes (Creswell et al., 2023). The three methods of data collection allowed the researcher to clarify the data collected to describe the current state of technology education in Virginia similar to other (Dugger, 1980; Sanders, 2001; Schmitt & Pelley, 1966) national studies. Figure 6 (*Triangulation of Data*) illustrates how the research questions were focused upon in the multiple phase descriptive qualitative study and includes the benefits of each component of research.

Figure 6

Triangulation of Data



PHASE 1: SURVEY

Instrument

The research survey was refined from a previous qualitative study on the needs of technology education teachers (Schmitt & Pelley, 1966) to collect data concerning all research questions. The survey for this current research can be found in Appendix A. The survey was an adaptation of the Schmitt and Pelley (1966), Dugger (1980), and Sanders (2001) surveys which collected data on technology education teachers' needs. The Schmitt and Pelley (1966) survey instrument was included in the book, *Industrial Arts Education, A Survey of Programs, Teachers, Students, and Curriculum,* but the Dugger (1980) and Sanders (2001) survey instruments were not included in articles summarizing their research. The Schmitt and Pelley (1966) survey instrument was copied and modified due to (1) the creation of alternative licensure which occurred after the previous research, (2) the creation of standards for the discipline which were created after the previous research, (3) the deletion of teaching methods questions which were not part of this researcher's questions, and (4) gender bias and equity changes which were due to new cultural norms. Some of the nomenclature was also changed from the Schmitt and Pelley (1966) instrument to reflect the change in the education profession such as "Industrial Arts" was modified to "Technology Education" and "slow learner" was modified to "special needs student." The instrument for this research was named, *Survey of Technology Teachers in Virginia,* and can be found in Appendix A.

The *Survey of Technology Teachers in Virginia* instrument contained 33 questions; one question to indicate consent and current teaching status, 30 questions which had answer choices, and two open ended questions. The current survey instrument was presented in six sections. The section titles and descriptions of each section are listed below.

1. Purpose of research and voluntary consent

   One question which asked for voluntary participation.

2. About your school

   Six demographic questions which were originally on the principal's form of the Schmitt and Pelley (1966) questionnaire. This information will help collect data on secondary technology education programs in Virginia to research teacher's needs and desires for support. The information will also provide data points to guide the documents reviews.

3. About your professional experience

   Eight questions about teachers' educational background and work experience.

4. About your classes

   Eight questions which collected data about current courses taught and additional duties.

5. Your instruction

   Four questions about comfort level of content and changes in teaching.

6. About your challenges

   Six questions about concerns in the teaching profession, classroom, and management of students including two open-ended qualitative questions which allowed the participant to expand on concerns or issues in teaching.

Specific modifications between the Schmitt and Pelley instrument and this researcher's instrument are listed in the table in Appendix F, *Modifications of Schmitt & Pelley Survey,* for each question between the surveys. The table is divided into five sections, separated by a title bar in gray. The table sections include demographics, research question one, research question two, research question three, and deleted questions from the Schmitt and Pelley instrument. The table has four columns which identify the topic of the question, the question number from the Schmitt and Pelley instrument, the section and question number from this researcher's instrument, and the modification made between the instruments. The table allowed the researcher to review for clarity and determine complete coverage for all research questions. The table also allowed for the deletion of duplication content for questions in the collection of data.

Population

The target population is secondary technology education teachers in Virginia. The sample used in this study included technology education teachers identified by the Virginia Technology Education Specialist in the Virginia Department of Education and self-identified participants in the VTEEA membership database. The Technology Education Specialist maintains an email listserv which compiles contact information from the Secondary Enrollment Demographics Form (SEDF) biannual report. The SEDF is required for the use of Perkins funds and submitted electronically to the Career and Technical Education Reporting System (CTERS User's Manual, 2022). All school districts in Virginia are required to submit an SEDF in order to continue receiving funding from Perkins V. Additionally, teachers were identified for the sample from the Virginia Technology and Engineering Education Association (VTEEA) Constant Contact list of technology educators as self-reported to the organization. These additions to the sample were pursued because some email users create blocks for bulk communication pathways such as the VDOE Listserv. The request from the VTEEA Constant Contact list was sent after the request from the VDOE Listserv to serve as a follow up and reminder as well as a method to seek additions to the sample.

To refine the data on the survey, the first question on the survey asks, "Do you agree to the terms as stated above and want to voluntarily participate in this research study and are you currently teaching technology education in Virginia?" If the participant clicks "yes", the survey begins on a new page. If the participant clicks "no", the survey is electronically submitted and displays a thank you message to the participant for their time, preventing the participant from completing the survey. The Google form is set to "Limit to one response. Respondents will be required to sign into Google." This setting created a limitation by only allowing computer users with Google accounts. The setting eliminated the need for collection of identifying data which may bias the research. As of February 2023, Google had over 274.49 million unique visitors with 61.4% of the market share in the U.S. (Bianchi, 2023). Google offers free online software tools such as word processing, spreadsheets, and email which are used by many school districts. Google also sold hardware such as Chromebooks to schools. In 2017, more than half of U.S. students used Google products in schools (Krutka et al., 2021). Google's form software includes the ability to directly transfer data to a spreadsheet, analytic software, the ability to receive notices when forms are completed, and the ability to link forms to additional documents after the submission of the form. The reason for the use of the Google's form software was the ease of use, accessibility, and cost.

According to the Virginia Technology Education Specialist, the VDOE Listserv contains 943 members (personal communication, March 3, 2023). The sample was a self-selection sample since the participants were asked to voluntarily complete the form (WSU, 2020). A free lesson plan was offered to participants after the completion of an additional short survey which requested subject matter, length, and grade level. The free lesson plans were compiled from the researcher's own original work, online sources, and VTEEA's repository.

While every technology teacher in Virginia may have had an equal chance to be included in the sample, there is a potential bias if a teacher has a filter on their email inbox, does not check their school email regularly, or the participant does not have a Google account. In order to eliminate bias, the researcher attended the VTEEA Summer Conference opening session and awards dinner in person. The researcher and VTEEA door attendants handed out business cards with QR codes for the survey to participants who attended the two events.

With 943 members (L. Basham, personal communication, March 3, 2023) population, to determine the significant sample size, a generic two tailed t-test was used with G*Power software (version 3.1.9.4) with a significance level of .05, a sample size of 289 was required to accurately represent the population size with a margin of error of 5.9% (2019).

Data Collection

Using Google forms software, the survey instrument was created using the web-based application software. A VPN provided by ODU was used on the researcher's personal laptop while using the online software to ensure privacy of the data. A link to the survey instrument was sent electronically with an email request explaining the needs for the research, researcher contact information, time requirements, and potential benefits/risk to the participant copied from the institutional review board (IRB) approval form (see Appendix G). The email request was sent to Dr. Basham, Virginia's Technology Education Specialist with a message request to post to the Technology Education Listserv maintained by Dr. Basham. The same email request was sent one week later to Dr. Wu-Rorrer, who maintains the Constant Contact email list for VTEEA to send to the users. The emails contained a link to the survey instrument for collection of data. Once the participant completed the survey and clicked submit, the data was imported into a Google spreadsheet and the researcher received an automatic notification of new data. The survey instrument responses were recorded automatically to the spreadsheet database and an automated message was sent after completion of the survey to participants which stated,

> "Thank you for completing this survey. The results of this study may be used in reports, presentations, and publications; but the researcher will not identify you. To obtain your free technology education lesson, click https://forms.gle/CPntbZjU63mMMuf59 to complete the request form. For more information about this study, please contact M.

Kathleen Ferguson at *(email address and phone number removed for confidentiality)*

Your time is greatly appreciated!"

After two requests for completion of the survey through each format (Technology Education Listserv and VTEEA Constant Contact list emails included as Appendices B and C), the researcher reviewed the data for completeness. If the population was not properly represented, the researcher made additional attempts to collect data which included attending the professional conference for secondary technology education teachers in Virginia to make personal requests for survey completions and emailing all Virginia CTE Directors to request the dissemination of the surveys to secondary technology education teachers.

After the researcher distributed the survey, the form was closed on December 1, seven months after the initial request, by clicking a button on the Google response page to stop accepting responses. Once the survey instrument was made inactive, data was downloaded from the Google spreadsheet and analyzed to determine specific gaps for the documents review.

PHASE 2: DOCUMENTS REVIEW

The documents review is a crucial aspect of this research, as it involves the systematic analysis and evaluation of existing literature, governing documents, and data relevant to a research questions or topic. Documents reviews can involve a wide range of sources, including scholarly articles, books, government reports, legal documents, and other materials (Creswell, 2009). The primary objective of the documents review was to identify relevant information, data, and evidence that could be used to support or refute the data collected from the survey instrument in phase one of this research. Through careful and systematic documents review, this researcher developed a comprehensive and nuanced understanding of the research topic and research questions. The materials used for the documents review included:

1. Virginia Legislative Code on technology education licensure https://law.lis.virginia.gov/admincode/title8/agency20/chapter23/ (VA - Virginia Administrative Code, n.d.),
2. *A Strategic Review of Technology Education in Virginia* (Reed, 2017),
3. *Standards for Technological and Engineering Literacy: The Role of Technology and Engineering in STEM Education* (ITEEA, 2020),
4. VDOE Career and Technical Education (CTE) website,
5. Virginia course competencies from CTEresource.org,
6. School Quality Profiles from https://www.doe.virginia.gov/data-policy-funding/accreditation-federal-reports/school-quality-profiles (VDOE, 2022c)
7. Perkins Collaborative Resource Network (PCRN) State Profile from https://cte.ed.gov/profiles/virginia (PCRN, 2023) and
8. VTEEA website resources.

A comparison was made to define areas of inquiry needed from the survey data collected. Descriptions and clarifications were noted to add supplemental information from each question in the survey. The notes were used to create questions for the focus group in order to gain new knowledge and compare and contrast data collected from the survey and data collected from the eight documents listed above. The documents review focused on each of the research questions with additional information focusing on questions of clarity for the focus group.

PHASE 3: FOCUS GROUP

Focus groups are a popular research method in the social sciences, widely used to gain insight into the attitudes, opinions, and experiences of study participants (Krueger et al., 2007). This method is often employed to explore complex or sensitive issues, to develop new theories or concepts, or to refine existing ones (Creswell, 2009). By bringing together a small group of individuals with diverse backgrounds and perspectives, focus groups enable researchers to gather rich, detailed data on a particular topic or issue. According to Morgan (1997), focus groups are "a carefully planned series of discussions designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment" (p. 2). The purpose of a focus group is to explore a particular topic or issue in depth, using open-ended questions and group discussion to uncover the underlying attitudes, beliefs, and values of participants. Focus groups are often used in conjunction with other research methods, such as surveys or interviews, to provide a more complete picture of a particular phenomenon (Morgan, 1997). Used in conjunction with surveys and documents reviews, focus groups are a valuable research method that can provide researchers with a wealth of detailed, qualitative data on a particular topic or issue (Creswell, 2009). By bringing together diverse perspectives in a permissive, non-threatening environment, focus groups enable researchers to gain a deeper understanding of the attitudes, beliefs, and values of study participants.

Focus group participants were recruited for this research using a purposive sampling technique. The inclusion criteria were individuals who have taught technology education for more than ten years and above all, had leadership experience within Virginia technology education through recognition from their peers, and were willing to participate in a 90-minute focus group session. The researcher aimed to recruit a diverse group of participants in terms of age, gender, and ethnicity to ensure that the data captured a broad range of perspectives on the topic.

Two focus group sessions were to be conducted, each consisting of no more than five participants to allow for all participants to have time to express opinions. Each focus group session was 90 minutes and moderated by this researcher. The focus group sessions were conducted using Zoom meeting software. The Zoom sessions were recorded with permission of the participants requested prior to the beginning of recording. Zoom software automatically transcribed the conversations from the audio recorded during the sessions. Participants were not required to have the software downloaded on their computers. Participants did need a computer, a microphone, a web camera, and an internet connection.

Before the start of the focus group session, the participants were emailed a consent form (Appendix H). The participants were asked to read and return the consent form prior to participation with their signature. The consent forms were received electronically. A Zoom link was sent via email once the participants agreed verbally or via email to participate. The day prior to the focus group meeting, a reminder was sent reminding the participants of the meeting date with a slide show that included: the purpose of the study, the confidentiality of their responses, their rights as participants, an overview of the study, and the questions to be asked.

At the agreed meeting time, Zoom was opened, and the researcher introduced themselves and the purpose of the research. Recording began after a verbal acknowledgement of agreement to be recorded and to consent to the research being conducted was given by each participant. The participants were then asked to introduce themselves and share their experiences and opinions on the topic of interest. The moderator used a semi-structured interview guide with a set of questions to facilitate the discussion and ensure that all relevant topics were covered.

The interview guide contained open-ended questions that allowed participants to share their opinions, experiences, and perceptions in their own words. The questions were formulated after the data from the instrument survey and the documents review were compared. The questions created opportunities to understand discrepancies between data collected on teacher surveys and the documents review. The focus group was used to clarify information provided in phase one and two and provide a clear picture of the needs of the secondary technology education teachers in Virginia. Planned focus group questions were:

- Introductions:

  Please briefly share your experience and qualifications as a technology educator.

- Question 1: Data Acquisition:

  How do you receive data on the number of licensed technology teachers and their types of licensing (e.g., provisional, professional)?

- Question 2: Educational Background:

  According to the phase one survey, only 43.8% of respondents stated they hold degrees specific to industrial arts or technology education. Do you note differences in teachers who were not traditionally trained vs. a traditionally trained technology education teacher? If so, what are the differences?

- Question 3: Educational Background:

  Do you note differences in a teacher who is a career switcher vs. a content switcher? If so, what are the different needs?

- Question 4: Program Goals:

  What information about the technology education goals from the VADOE are teachers in your school division provided?

- Question 5: Program Goals:

  Please describe any professional development being offered on VERSO, *Standards for Technological and Engineering Literacy* (ITEEA, 2020), Engineering by Design (ITEEA, 2011), and/or other program materials.

- Question 6: Teacher Issues:

  After reviewing the response rate from the phase one survey, how do you suggest information be obtained from and provided to teachers?

- Question 7: Teacher Issues:

  What do you think are the major issues secondary technology education teachers confront?

- Question 8: Adding Clarity:

  The VDOE and CTE Resource Center have started organizing information around Career Clusters, but the Virginia Administrative Code and licensure are organized around the seven traditional CTE specialty areas. What are some recommendations for making the VDOE and CTE Resource Center clearer?

- Question 9: Adding Clarity:

  What could the VDOE, VTEEA, teacher preparation programs, and other stakeholders do to help secondary technology education teachers?

The moderator encouraged participants to build on each other's responses and explore different viewpoints. The moderator consciously asked for responses from each participant in order to obtain all perspectives for the questions. At the end of each focus group session, the participants were told how to contact the researcher with any questions and they were thanked for their time and participation. The use of purposive sampling ensured that the researcher captured a diverse range of perspectives, while the semi-structured interview guide provided a flexible and open-ended approach to exploring participants' experiences and perceptions (Morgan, 1997). The insights gained from the focus group were used to provide insights and clarification of data for the research questions.

SUMMARY

Creating conclusions from qualitative data can become subjective and biased without clarification from several sources. The use of three phases in this qualitative study allowed the researcher to triangulate data which represented the teachers, governing documents, and experienced professionals in the discipline. The phase one survey provided an opportunity for all secondary technology education teachers to participate in determining the needs of their profession. Phase two allowed the researcher to understand the governing documentation and reports which directed the state to provide for the needs of secondary technology education teachers. Phase three of this study allowed the researcher to clarify data and fill in gaps collected through the first two phases. The triangulation of all three phases of this research provides a methodology which allows for the elimination of personal bias, lack of participation and small sample size, and the clarification of data.

CHAPTER 4

FINDINGS

In 1983, the National Commission on Excellence in Education published a research-based report called, *A Nation at Risk: The Imperative for Educational Reform*. This report publicized the indicators of risk for high school student low success rate including illiteracy rates, standardized test scores, and low "higher order" intellectual skills. "The Commission found that not enough of the academically able students are being attracted to teaching; that teacher preparation programs need substantial improvement; that the professional working life of teachers is on whole unacceptable; and that a serious shortage of teachers exists in key fields" (National Commission on Excellence in Education, 1983, p. 122). In other words, the report implicated that the cause of student failures was due to the lack of good teaching.

The recommendations of the Commission called for educational reform in content, standards and expectations, time devoted to learning the New Basics, teaching, and leadership and fiscal support (National Commission on Excellence in Education, 1983). "When that report, *A Nation at Risk*, appeared, it did not do what President Reagan had hoped in terms of opening the door to prayer in school and school choice, but its fiery rhetoric did catch the attention of the national press, where it provoked a national discussion about the quality and purpose of public education" (Borek, 2008, p. 572). According to Pipho (2000), *A Nation at Risk* created high expectations for students and teacher and led states to enact laws creating programs for teacher certification. The report created three distinct reform movements in education: 1) the era of excellence movement in the early 1980s, 2) the restructuring movement in the late 1980s, and 3) the standards movement beginning in 2000 (Hunt, 2008). The "era of excellence movement" increased high school graduation requirements, created longer school days, and enhanced teacher certification requirements. During the “restructuring movement,” site-based management was encouraged with the “flattening” of organizations to reflect more business-like structures. The “standards movement” emphasized the results of mandates such as state standards for academics and state assessments for teacher certification (Hunt, 2008). The *No Child Left Behind Act (NCLB)* was signed into legislation in January 2002 by President George W. Bush. The passage of NCLB required student testing to determine if schools were making adequate yearly progress (AYP) making “high stakes testing” the performance assessments for school. This scrutiny has created a demand for research-based support to improve schools.

PHASE 1: SURVEY

The research project was approved by the institutional review board (IRB) on June 12, 2023 (see Appendix G). The survey was distributed in person at the VTEEA conference using QR codes distributed on business cards and online through emails from the state technology education specialist, VTEEA, Virginia TSA, and the Commonwealth’s local CTE directors. The survey data was self-reported and required a digital device to complete. The incentive of a free technology education lesson plan (see Appendix I) was provided with the completion of the survey. Once the survey was completed, a link was provided to a Google form which requested specifics about the lesson requested including length of time, grade level, instructional area, and equipment available for the lesson. The lesson was sent via the request within seven days of receipt. The survey contained six sections with 30 multiple choice answers and two open ended questions.

Distribution through the VDOE Listserv

After receipt of the IRB approval, an email request for distribution of the survey was sent to Dr. Basham, Virginia Technology Education Specialist on June 16 (see Appendix B). Dr.

Basham maintains a Virginia Technology Education Teacher (TET) Listserv of teacher emails which are identified in the Secondary Enrollment Demographics (SEDF) form submitted by every school district twice a year: fall due on October 1 and end of year to be submitted on the last day of school. Access to the SEDF information was not available for the researcher to send individual emails to teachers. Emails from a group such as a Listserv may not pass through firewalls or be read by recipients since they are not personally sent. The survey was distributed by Dr. Basham on June 29 to the Virginia Technology Education listserv. Twenty-six (26) surveys were completed between June 30-July 16 after the distribution of the survey from the TET Listserv.

A second email request to complete the survey was sent by Dr. Basham through the Virginia Technology Education listserv on September 11. This request was sent to coincide with the beginning of schools. According to Virginia Administrative Code 22.1-79.1, *Opening of the School Year; Approvals for Certain Alternative Schedules*, Section A. "…school shall be no earlier than 14 days before Labor Day" (2023, Para. 1). Thirty (30) surveys were completed between September 11- November 19.

Distribution through the VTEEA

On June 28, a request was sent for distribution of the survey to the VTEEA officer in charge of the Constant Contact list for VTEEA. Constant Contact is an email marketing platform which allows group emails to be received that would usually be filtered through firewalls. Due to the proximity in date to the VTEEA conference, the decision was made to distribute the survey in person at the conference, July 17-20 prior to an email to the entire VTEEA membership.

On July 17 and July 18, the researcher attended the Virginia Technology and Engineering Education Association (VTEEA) summer conference to solicit participation in the research survey. The VTEEA summer conference is the annual professional conference endorsed by the VADOE specifically for technology education teachers. Bright green business cards with a QR code and a link for the survey were distributed to technology teachers at the opening general session dinner and the awards dinner. After the completion of the opening session dinner, the researcher met and solicited participation for the survey from conference attendees. The next evening prior to entering the Awards Dinner, held at the Virginia Air and Space Museum, all participants were greeted by VTEEA officers who provided the request cards and personally requested the participants to complete the research survey. Four surveys were completed between July 17-August 8. On August 8, the survey was sent to the VTEEA general membership electronically through the VTEEA Constant Contact software. Eleven (11) surveys were completed between August 8-September 1.

Distribution through Virginia Technology Student Association

On August 26, a request was made to BJ Scott, Virginia Technology Student Association (TSA) state advisor, to distribute the research survey to advisors of the student organization. TSA is a co-curricular student organization which provides leadership and competitive event activities for secondary technology and engineering education students. The TSA state advisor maintains an email list of all technology education teachers who participate with the co-curricular organization. Participation with the co-curricular organization is required by *Career and Technical Education Student Organizations* (8VAC20-120-160), “A career and technical student organization shall be an integral and active part of each secondary career and technical program offered” (Section B, 2012). A phone conversation was held on August 28 with the state TSA advisor to request the distribution of the research survey to the Virginia TSA advisors. The survey was electronically distributed to teachers on September 1. Twenty (20) participants completed the survey after the email was sent from the Virginia TSA state advisor, requesting teachers to complete the form.

Distribution Final Attempt

On November 16, after noticing that only 91 surveys had been submitted, the researcher decided to send a newly formatted email (see Appendix E) which focused on why research is important for teachers to 220 CTE directors in the Commonwealth of Virginia. Using the *Alpha CTE Administrators Directory* located online at https://www.doe.virginia.gov/home/showpublisheddocument/28020/638271746596370000, an email was Bcc'd to the CTE directors in Virginia requesting the directors to forward the newly formatted email to secondary technology education teachers. Sixteen (16) surveys were completed after November 17.

On December 11, 2023, the survey was closed to respondents. The total number of surveys completed were 107 (Table 2). While 107 is only an 11% return rate for the 943 technology education teachers in Virginia, the survey information will be used to form clarifying questions for the focus groups in phase three of the research. The researcher sent the survey through four different sources electronically (state technology education specialist, VTEEA, state TSA advisor, and CTE supervisors) and met personally with technology teachers at their professional conference to encourage participation. While the return rate was discouraging, the rate represented typical participation in state events from technology education teachers in Virginia experienced by the state's professional organization, VTEEA. As the *VTEEA Historical Membership Report - Quarterly* document illustrated, only approximately 25% of secondary technology education teachers participate in the professional organization annually (n.d.). The quandary of participation was also evident with CTE directors. One program manager specific to technology education "shared (the survey request) with the 84 technology education teachers" (personal communication, September 4, 2023) which resulted in only a 12% response rate after several requests from their direct supervisor. After seven months of data collection and requests, the researcher felt due diligence had been made to represent the secondary technology education teacher population. The sample return rate of 107 surveys representing a population size of 943 teachers created a margin of error of 8.92% with a confidence level of 95%.

Table 2

Phase One Survey Response Rate

Date	Survey Sender	Recipients	Data Received	Responses
June 29	VA Technology Education Specialist	Listserv of Technology Education Teachers (TET) in VA	June 29-July 16	26
July 17	Researcher (in person with QR codes)	VTEEA Conference Participants	July 18-July 20	4
August 8	VTEEA BOD	VTEEA members and contacts from TET Listserv in VA	August 8-August 17	11
September 1	Virginia TSA state advisor	VA TSA advisors	Sept 2-Sept 8	20
September 11	VA Technology Education Specialist	TET Listserv in VA	Sept 11-Sept 18	30
November 17	Researcher	CTE Supervisors	Nov 19-Nov 28	16
			Total Responses	107

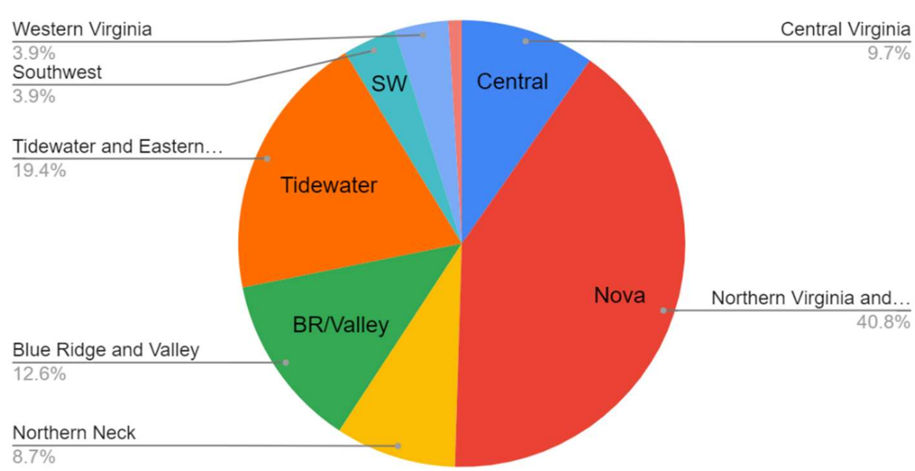
Demographics of Participants

According to *Program Requirements* (8VAC20-120-120), "Career and technical education programs must be provided in middle and secondary schools. The middle school must include a minimum of one career and technical offering. Each secondary school shall provide a minimum of three career and technical program areas to include a minimum of 11 course offerings" (2012, Section C). Virginia has 129 school districts with 329 high schools for the 2022-23 school year (U.S. News and World Report, 2024). Each school district is required to offer CTE programs according to the VAC (8VAC20-120-120, 2012).

The 106 data entries represented forty-two unique locations (county or cities) out of a possible 136 choices (95 counties, 38 independent cities, regional schools, private school, and other). The data collected represented 31% of the total counties and municipalities in Virginia. Virginia is divided into eight superintendent regions for VDOE purposes: 1) Central Virginia, 2) Tidewater and Eastern Shore, 3) Northern Neck, 4) Northern Virginia and Middle Peninsula, 5) Blue Ridge and Valley, 6) Western Virginia, 7) Southwest, and 8) Southside. The distribution of these counties and municipalities into each of the superintendent's regions can be found at https://www.doe.virginia.gov/about-vdoe/virginia-school-directories/virginia-public-school-division-staff-listing-by-region. The survey participants represented all of the Superintendent's regions with Northern Virginia representing 41% of the population. See Figure 7 for the regional distribution.

Figure 7

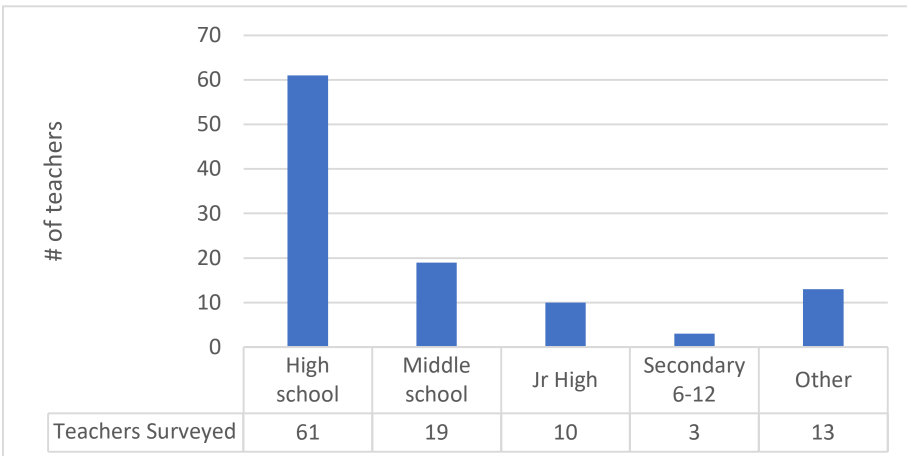
Distribution of Teachers Respondents by Region



The majority, 68, of the participants taught high school. For the distribution of surveyed teachers and their grade levels taught, see Figure 8, Teachers surveyed. Only three participants taught in a combined middle and high school which is labeled as secondary school on the figure.

Figure 8

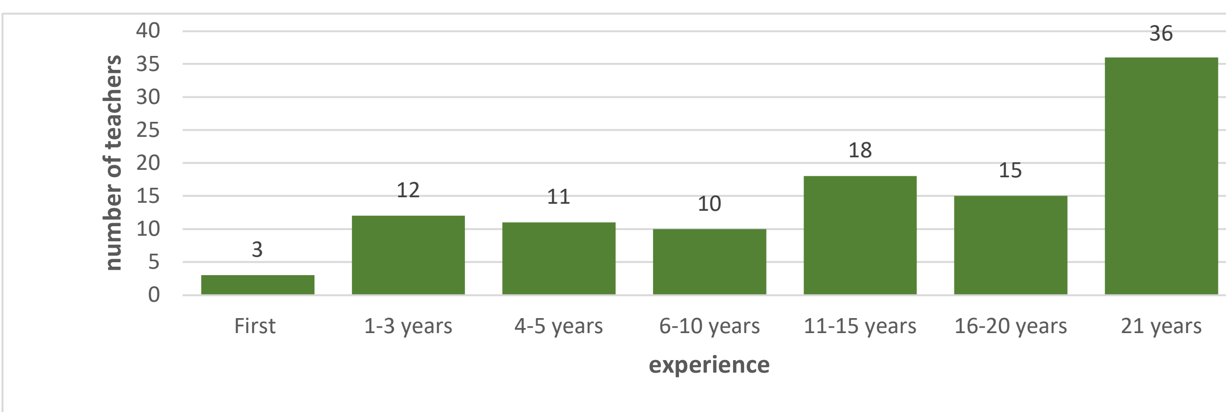
Distribution of Teachers Surveyed by School Type



The majority (34.3%) of respondents had 21 years or more of teaching experience while only three teachers who were new to teaching responded. Figure 9, teacher experience in the technology education classroom, shows the distribution of survey participants' time in the technology education classroom.

Figure 9

Experience in the Classroom



RQ1: Educational Background

Every survey participant had a degree. The smallest amount, 1.9%, had an associate degree, 39% had a bachelor's degree, 57.1% had a master's degree, and 1.9% had a doctorate. Sixty-three (60%) of participants hold a degree in education while 6.7% hold a degree in engineering, and 6.7% hold a degree in industrial technology or occupational and technical studies, and 8.5% hold a degree outside of education. Having a degree specific to the discipline had 43.8% of the participants with technology education or industrial arts. Table 3 compares the degree held with the type of license held.

Table 3

Distribution of Degrees and Certification Types

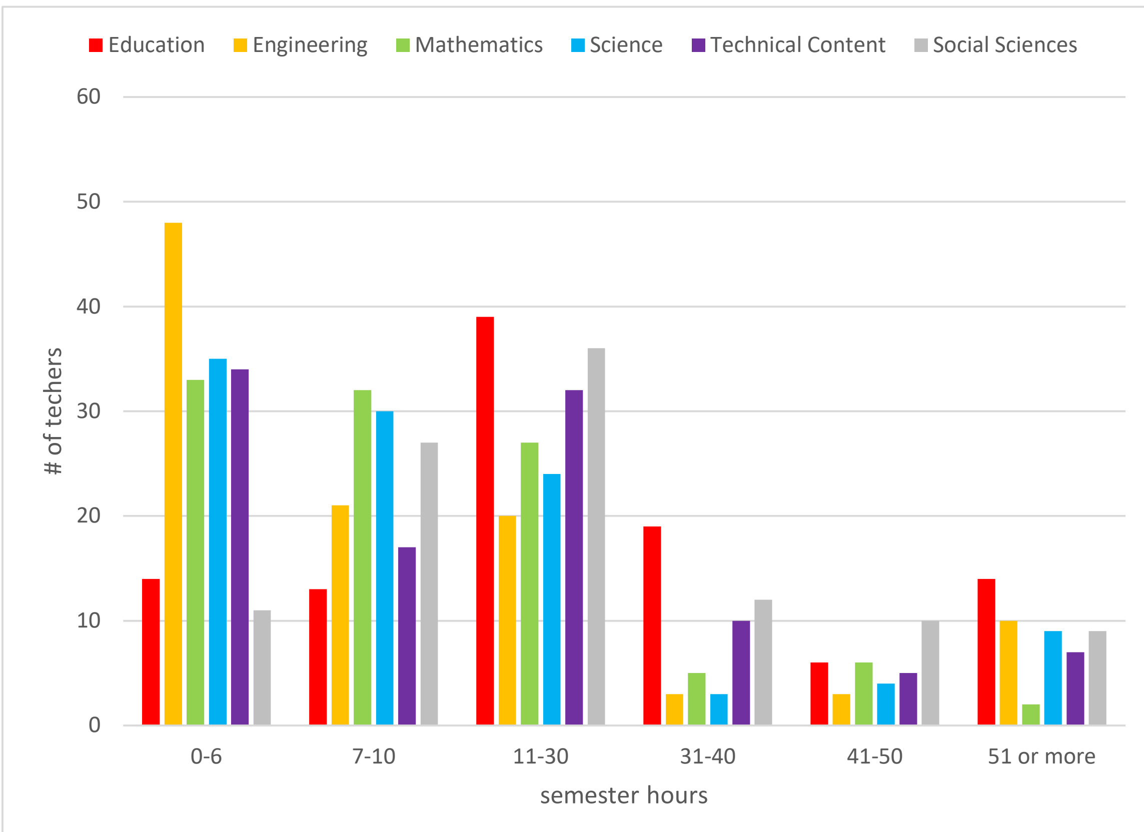
Degree	CTE-Technology Education	Postgraduate Professional	Collegiate Professional	Provisional	Technical Professional	Other	None	Total
Associate's	1				1			2
Bachelor's	20		13	5	1	2		41
Master's	23	23	9	3	1		1	60
Doctor's		1		1				2
Total	**44**	**24**	**22**	**9**	**3**	**2**	**1**	**105**

Course work is also a good indication of educational background. Education is a core component of classes for teachers and 13% of the participants had 0-6 course hours in education while 45.7% of the participants had 0-6 course hours in engineering. While 21.9% did not have formal training in education prior to entering the classroom, 9.5% of the participants received training from a professional conference prior to entering the classroom with 3.8% receiving training from the Department of Education. The course work for education, engineering, science, mathematics, and social science is illustrated in Figure 10, *Course Work Hours by Subject Area*.

According to Figure 10, the majority of survey participants did not complete coursework in engineering, mathematics, or science. The participants surveyed completed the majority of their coursework in education. With 55.2% received formal teacher training specific to CTE or technology education prior to entering the classroom, the coursework in education is fundamental to learning about classroom management, discipline, and instruction.

Figure 10

Course Work Hours by Subject Area



Teachers' certification indicates the completion of approved requirements for qualifying educators to work in classrooms. *Conditions for Licensure* (8VAC20-23-40), sets forth how teachers get qualified to teach in Virginia (2012). Note that the teachers with the majority of learning hours focused on education content whereas engineering provided the largest group of participants with 0-6 course hours. The distribution of Figure 10 illustrates the dwindling of coursework after 30 hours. The majority of participants spent less time completing coursework after 30 hours were completed.

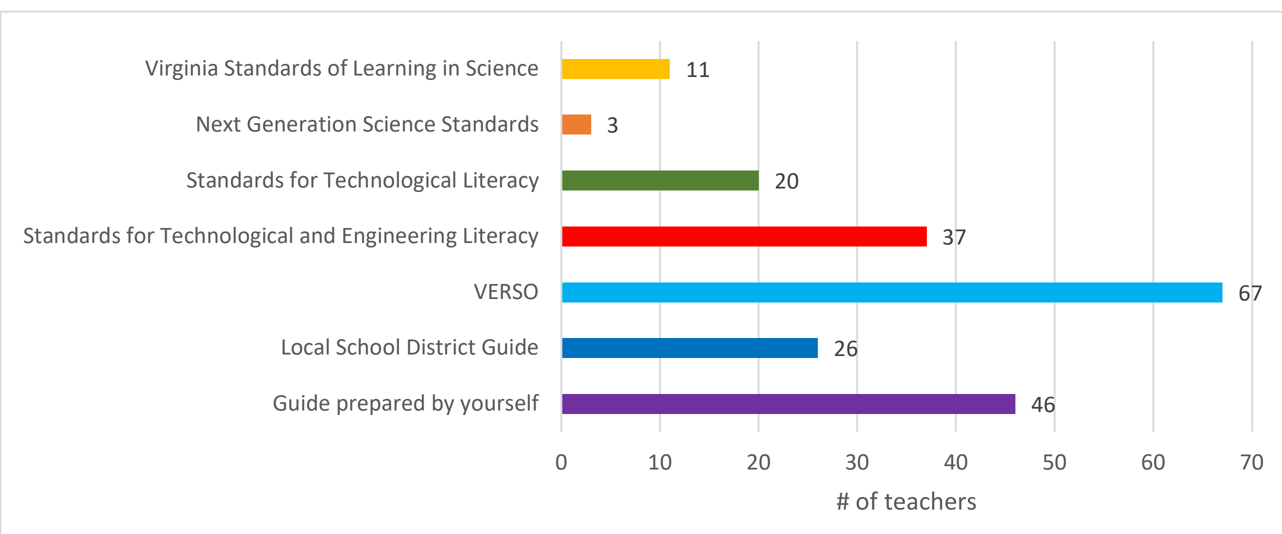
RQ2: Program Goals

The majority (91.6%) of participants focus on problem-solving skills most every day whereas 40% spend little (once a semester) to no time on career pathways. The Technology Student Association (TSA), a required component of the Commonwealth's curriculum, received weekly or daily attention from less than 18% of participants. Safety received weekly or daily focus from 73% of participants and workplace readiness skills received attention from 59% of participants.

The source of program goals came from varied sources according to Figure 11. Participants could choose multiple sources for curriculum. Participants prepared their own guide 42.9% of time for instructional content in their technology education course. The majority of participants, 65%, used VERSO as a source of program content. VERSO is Virginia's Educational Resource System Online provided by Virginia's CTE Resource Center.

Figure 11

Curriculum Source of Surveyed Programs

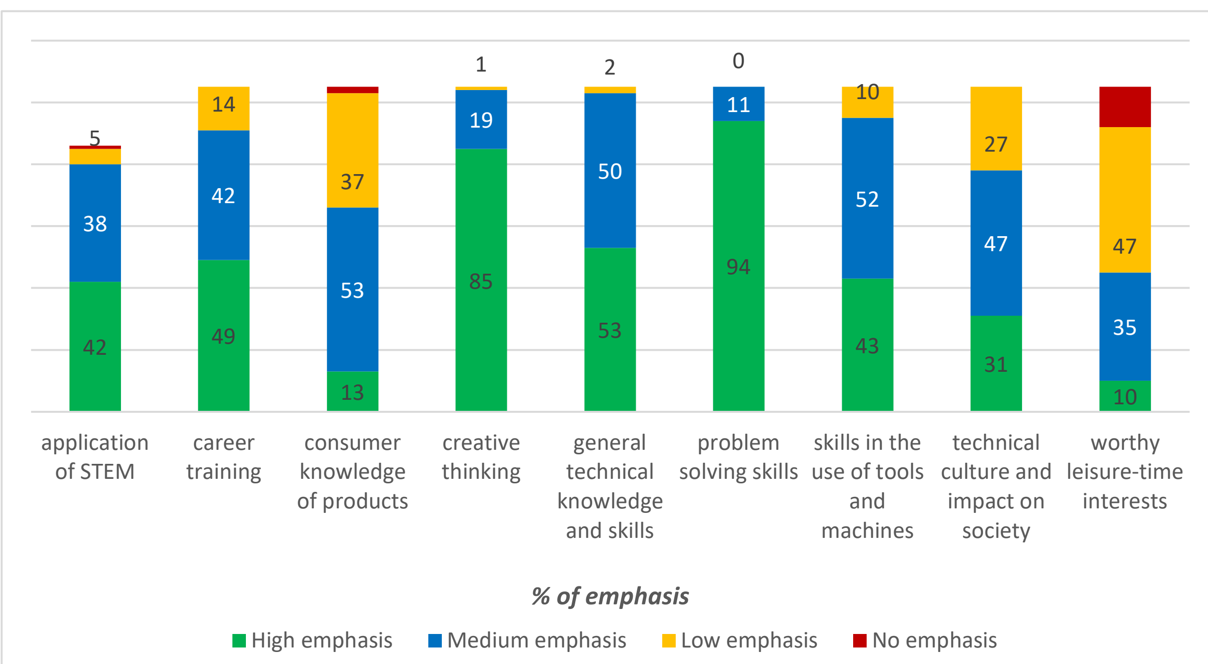


The CTE Resource Center was established in 1982 and funded by the Carl D. Perkins Act. While standards are recommended as the basis of the discipline, 54.2% of participants used ITEEA's standards as a source for educational content which includes the current *Standards for Technological and Engineering Literacy* (ITEEA, 2020) and the *Standards for Technological Literacy* originally published in 2000 (ITEA, 2007).

When asked which program goals should be emphasized, the participants put a high emphasis on creative thinking (81%) and problem-solving skills (90%), see Figure 12. The participants suggested a low or no emphasis should be placed on worthy leisure-time activities (57%) and low emphasis on consumer knowledge of products (37%) in the technology education classroom. This Figure also shows emphasis on the topics in *Standards for Technological and Engineering Literacy* (ITEEA, 2020), problem solving skills and creative thinking, whereas career-based skills such as consumer knowledge of products was a low priority.

Figure 12

Topics Emphasized by Teachers



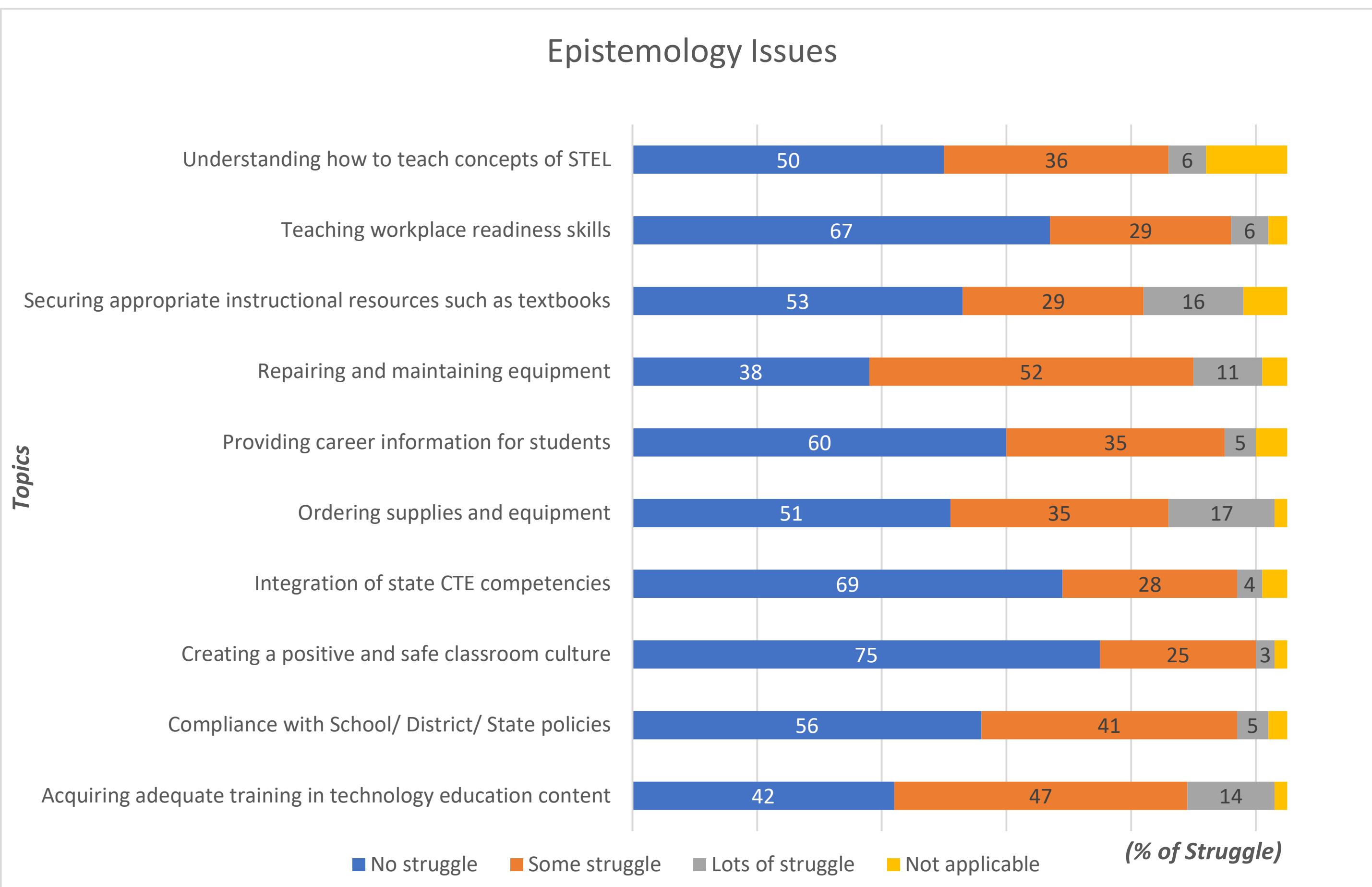
RQ3: Issues

Participants were asked about epistemology, assessment, and pedagogy issues. The participants were asked to rank issues on a Likert Scale of no struggle to lots of struggle for issues. The issues were gathered from Figure 2, *The Technology Education Triad*.

In epistemology, see Figure 13, participants reported the least struggle with creating a positive and safe classroom culture (71%) and integrating state CTE competencies (66%). The majority of participants, 60%, reported some or lots of struggle with repairing and maintaining equipment and 58% of participants reported some or lots of struggle with acquiring adequate training in technology education content.

Figure 13

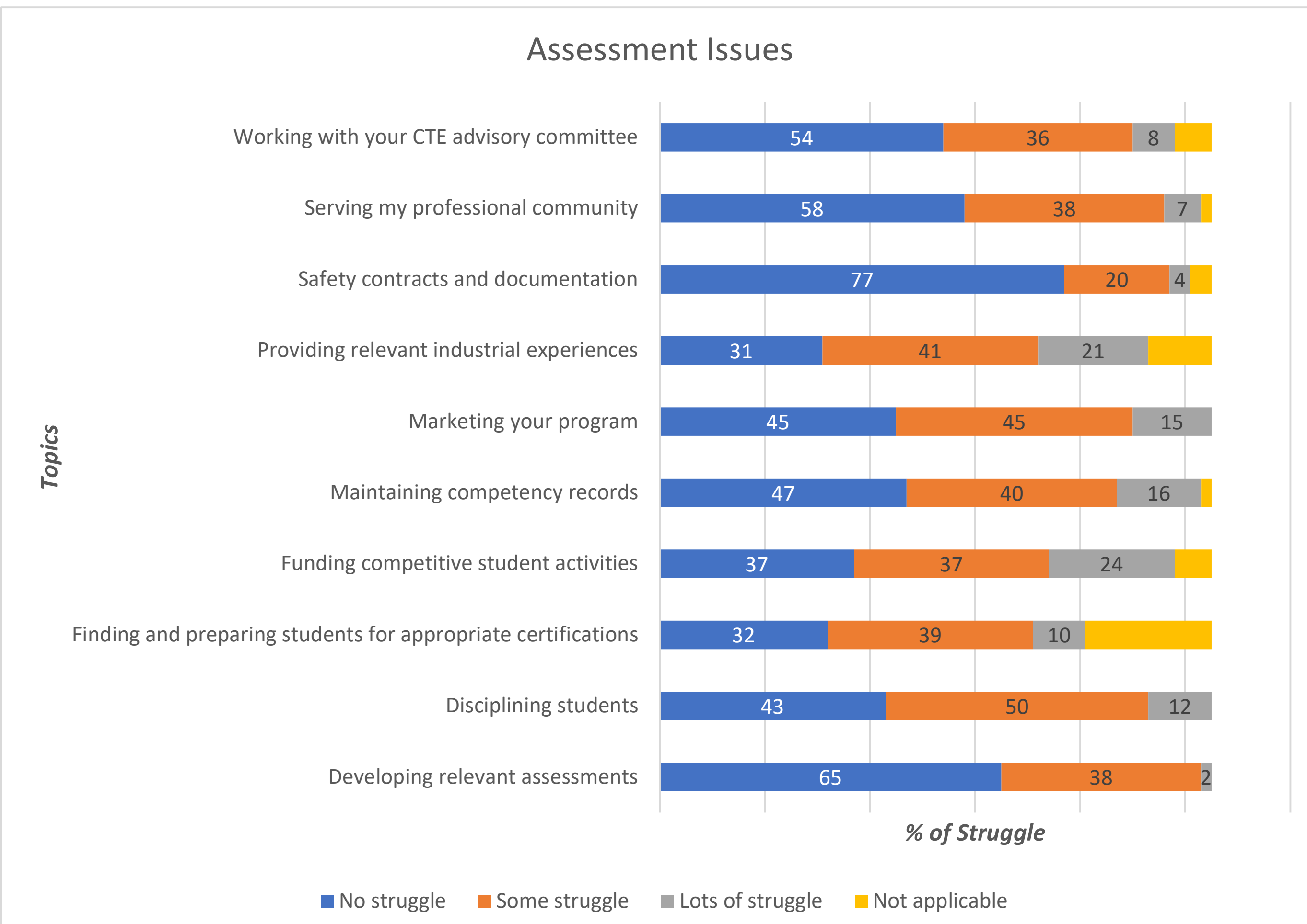
Teacher Concerns with Content



In the area of assessment, see Figure 14, a majority of participants reported no struggle with developing relevant assessments (62%) and safety contracts and documentation (73%). Few participants reported that providing relevant industrial experiences (11%) and finding and preparing students for certifications (23%) were not applicable for their classes. About half of participants reported some struggle with disciplining students (48%) and marketing their program (43%).

Figure 14

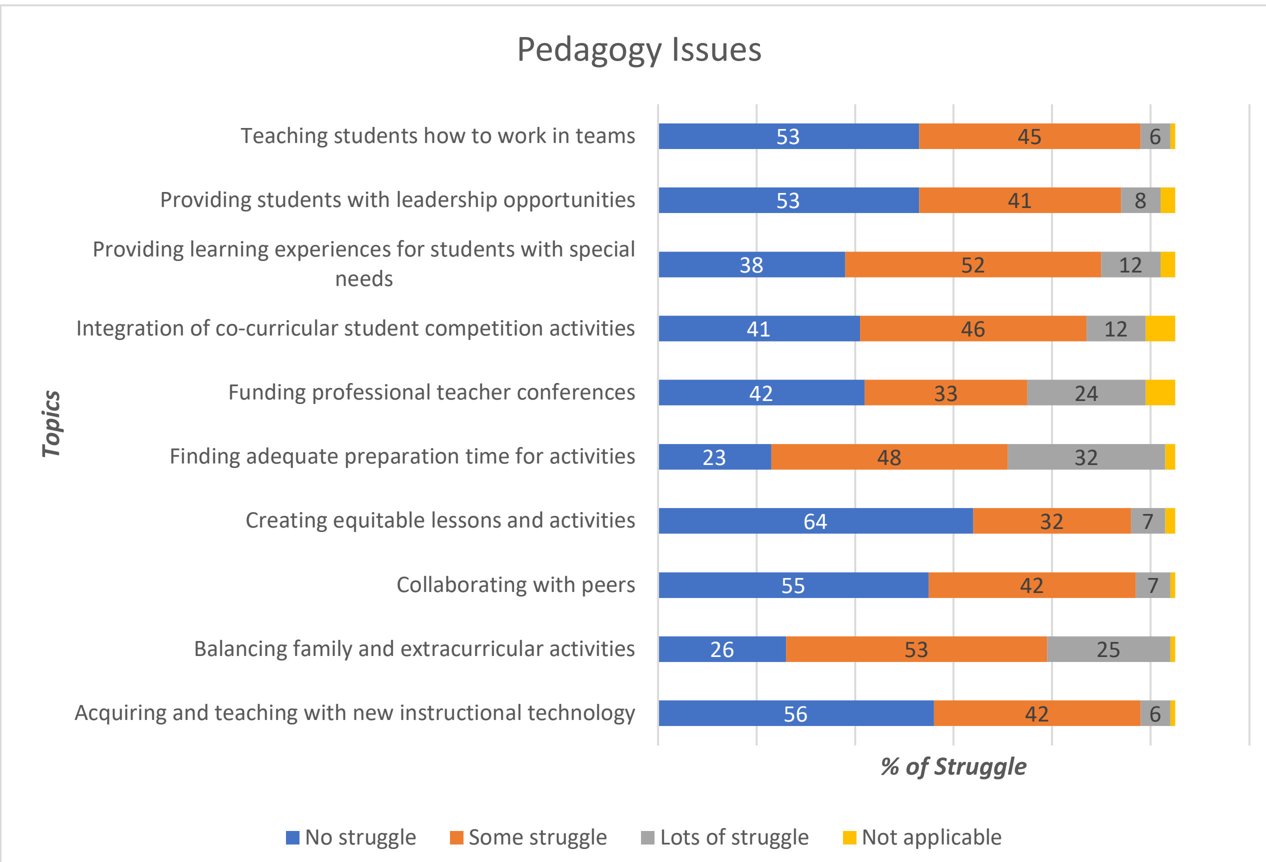
Teacher Concerns with Evaluations



In the area of pedagogy, see Figure 15, 61% of participants reported no struggle with creating equitable lessons and activities. About one third of participants (31%) reported the most struggle with finding adequate preparation time for activities. Some struggle was reported for providing learning experiences for special needs students (50%) and balancing family and extracurricular activities (51%).

Figure 15

Teacher Concerns with How to Teach



Participants were most comfortable teaching design in technology and engineering (75%) and core concepts of technology and engineering (73%). Participants did not indicate any significant issues with teaching core concepts of technology from ITEEA's STEL. Participants indicated that all instructional areas of technology were taught by some teachers for at least two weeks with the most emphasis on problem solving (84%) and engineering (74%). Leatherwork (84%) and agricultural technologies (78%) were not taught by the majority of participants. Instructional areas which participants indicated they needed to learn more were artificial intelligence (22%) and biotechnology (17%).

Participants stated that the factor that influenced change in their teaching the most was research and development on their own (46.7%). Influence from professional development from the Virginia Department of Education (1.9%), college course (3.9%), and attending a professional conference that was not VTEEA (4.8%), were factors that influenced change in teaching methods the least.

Teacher Survey Comments

When asked the open-ended question about the most pressing issue as a technology education teacher, the responses varied but most comments focused on student issues such as discipline and classroom management. The overall sentiment of the comments ranged from moderately negative (16) and moderately positive (13). Only three participants had no comments about a pressing issue in teaching.

Lack of Teachers

Some comments focused on the lack of qualified technology teachers such as “empty talent pool,” “Finding MORE teachers IN the field - as a 37-year veteran, there are very FEW if any colleges that produce people to teach in this field. I took over a school that had been idle for 5+ years without a teacher in Tech Ed. In less than 2 years, the program has flourished,” and “We need to start supporting teachers quick or there won't be any left!” The comments reflect the findings of Volk (1997), who stated the lack of teachers would lead to the demise of the discipline and Litowitz (2014) who reported the lack of teacher preparation programs.

Lack of Respect

Several lengthy comments focused on the lack of respect from other disciplines such as "Technology Education is generally viewed as non-essential education, not college preparatory. Parents expect their students to attend a four-year college directly after high school," "I find that lately there is a strong divide between teacher and school admin/CTE Admin Chair regarding the purpose of Certification for CTE Courses and Student Perception with the "Need" of taking a CTE course and its assigned Certification. This gives us the Most headaches around testing time (that and they always schedule the CTE tests at the worst times and taking a CTE Nocti Test for Engineering at the middle of the Semester is ridiculous for students to know all the content needed for that test. I feel like it is a waste of time to do it in the way they have been doing since I started teaching," and "Lack of respect from non-CTE teachers and administrators. Even though we do lots of interdisciplinary lessons together, they still look down on us." These comments have not been reflected in the research. Technology education is not part of the common core in Virginia and not tested with an end of course test such as the Standards of Learning (VDOE, n.d.). The NAEP-TEL tests for technological literacy in students across the nation. Technology education is not a required course of study at the secondary level but at many universities such as ODU require students to take courses about technology in their general education requirements. "It is important for students to understand not only how a technology functions, but also how technology affects society" (ODU, n.d., sect G, para 1). One teacher summed up the respect issue as "technology changing so rapidly & the county doesn't put its energy into the needs of CTE. The Tech Ed coordinator is amazing and she works her ass [*sic*] off to try to make sure its equitable for all schools. The county just doesn't want to support CTE as much as core classes." In other words, the professionals dedicated to the technology education profession are not able to overcome the idea that technology education is not seen as a priority as much as the core courses designated for all students.

Safety

Several comments focused on the concern for safety such as, "Administration phasing out Power Tools due to liability issues and the lack of new teachers without any training on power tools causing them (ADMIN) to do this." One teacher stated, "The attitude of many parents that our classes are unsafe, so the knowledge, self-confidence, and skills their students receive are not worth any risk while trying to produce something." While using tools and machines has been seen as an essential part of the discipline, the large footprint of the laboratory space may be a cause for concern among administrators (Moye & Reed, 2020).

The following comment addressed student behavior and discipline in terms of safety concerns with a specific example:

> "Student accountability: if student exhibits a behavior or disability in which they are a danger to themselves and others around them-they are enrolled and will remain in the class. For example, a student who deliberately put a resistor in to an electrical outlet as an Engineering Explorations student was allowed to come back in Engineering II (and continued to be destructive). Students who fight in CTE rooms are allowed to come back after the suspension and take upper level courses. In a job setting, these individuals would have been fired. Guidance put a student with cerbral palsy in my class and I could not allow him to use the hand tools because he could not handle them safely-that was not fair to him. He also had a history of fighting and they still enrolled him in the class (with sharp tools hanging on tool racks on walls)."

Keeping students safe should be a priority for all teachers. The safety concerns expressed here are reflected in the research (Love et al., 2024; Love et al., 2023; Love 2013). “Safety does not discriminate nor is any instructor, teacher, or visitor immune from potential hazards and resulting health and safety risks inherent in science, technology, engineering, and mathematics (STEM) and career and technical education (CTE) instructional spaces” (Love et al., 2024, p. 52). A national study examining safety factors in STEM and CTE classrooms showed classes with traditional trained technology teacher were 83% less likely to have had an accident occur in their courses (Love et al., 2023). Learning pedagogy, epistemology, and assessment techniques specific to technology education has been shown to make a difference in safety for students.

Teachers Feeling Overwhelmed

Teachers also expressed their concerns for the amount of work required in comparison to the time allocated in their schedule to complete the tasks. One teacher stated their concern as, “Stress of lab management and time. Time covering classes, and doing duties takes time from lab prep and maintenance. I have more than just desks and texts to manage.” Another teacher stated that, “Teacher's administrative, reporting, and "other job-related duties" workload continually increases, while the on-the-clock time provided for these tasks decreases.” According to a study by the Pew Research Center using 2,531 U.S. public K-12 teachers conducted Oct. 17-Nov. 14, 2023, using the RAND American Teacher Panel, 77% of teachers stated their job is frequently stressful and 68% say the job is overwhelming (Lin et al., 2024). The teachers in the survey stated that these factors are the major reasons for the lack of time: 24% often had to perform non-teaching duties such as monitoring school areas, 22% often spent time tutoring outside of class time, and 16% often had to cover for another teacher’s class (Lin et al., 2024). When examining these issues and reviewing the *Technology Education Triad* in

Figure 2, the technology education teacher may have even more issues with time allocation due to the need for safety contracts, competency records for each student, equipment maintenance and repair, and the development of alternative assessments. As one technology teacher stated their major concern was “Having enough professional time to plan and prepare lessons and projects and explore new technologies and equipment.” Technology education teachers are not provided a pacing guide or lesson plans for each course. While the flexibility of competencies allows the teachers to modify their content to the equipment available and community needs, teachers stated the creation of relevant experiential lessons with current technology is time consuming.

PHASE 2: DOCUMENTS REVIEW

After survey data was collected, a review of documents began using a *Strategic Review of Technology Education in Virginia* (Reed, 2017), *Standards for Technological and Engineering Literacy* (ITEEA, 2020), Virginia School Quality Profiles (VDOE, 2022c), the Perkins Collaborative Resource Network (PCRN) State Profile (PCRN, 2023), and VTEEA website resources (VTEEA, 2020), (VTEEA, n.d.). The documents clarified information pertaining to the research questions.

Demographics of Current Teachers

The Virginia Administrative Code *Career and Technical Education – Technology Education* (8VAC20-23-270, 2018) states the requirements for a CTE-technology education endorsement. The regulations do not state the license endorsement required in order to teach specific CTE classes. In other words, what type of teaching endorsement is required to teach Principles of Technology, an applied physics course offered by CORD and CTE teachers or does a teacher need to be endorsed in Project Lead the Way (2024) in order to teach course with the

PTLW notation? No data about technology education teacher's endorsements were found on the VDOE website or CTE Resource Center. On the CTE Resource Center website, the only documents listed were content-specific reports. The title, "Annual Reports" was not active but stated, "The CTE Resource Center publishes a comprehensive annual report of activity—from meetings held at the Center, to curriculum revisions completed, to traffic though the website" (Virginia's CTE Resource Center, n.d., para 3). The webpage did not provide information on where the comprehensive annual report could be located.

A search for other demographic information about teachers from the VDOE website was not available online. The VDOE webpage labeled "Statistics and Reports" lists demographics in the form of a staffing and vacancy report. The link takes the user to a data table builder. The teacher information listed under CTE is categorized by career cluster, not program specialty area. In the VDOE website section "Data and Reports" webpage, "Program Participation Data" webpage, the description states, "The Virginia Department of Education reports a variety of data on public education in the Commonwealth, including but not limited to information on participation in gifted education, advanced programs, Career and Technical Education, Special Education and School Nutrition" (VDOE, 2022b, para 1). However, there is no CTE information listed on this webpage. On the same website, the webpage labeled, "Data Collections," has a section for Career and Technical Education but this webpage only lists the CTERS Manual information (VDOE, 2022a). No data was available on this webpage.

RQ1: Educational Background

The Virginia Administrative Code is law which is written and administered by state agencies as authorized by the Virginia electors in the General Assembly (LIS Help Center, 2023). Secondary teachers seeking an initial license have different requirements than teachers seeking recertification but both types of licenses require a baccalaureate degree from a regionally accredited college or university endorsed by the Virginia Board of Education. According to *Career and Technical Education – Technology Education* (8VAC20-23-270, 2018), technology education endorsement candidates must have a baccalaureate in technology education including classes in 1) the nature of technology, 2) technology and society, 3) engineering, 4) abilities for a technological world, and 5) the designed world. If the candidate's baccalaureate is in the major of architecture, design, engineering technology, industrial technology, or physics, the candidate must have classes in the five topics listed above in addition to a minimum of 15 semester hours of technology education content coursework (8VAC20-23-270, 2018). A list of required CTE outcomes or objectives for each course was not found online.

The Virginia licensure requirements from the *Professional Studies Requirements for PreK-12, Special Education, Secondary Grades 6-12, and Adult Education Endorsements (*8VAC20-23-190), integrated required coursework from regionally accredited college or university is:

1. Human development and learning (3 semester hours),
2. Curriculum and instruction (3 semester hours),
3. Assessment of and for learning (3 semester hours),
4. Foundations of education and the teaching profession (3 semester hours),
5. Classroom and behavior management (3 semester hours),
6. Language and literacy in the content area (3 semester hours), and
7. Supervised classroom experience (150 clock hours in direct teaching) (2021).

These licensure requirements cover all three areas of the traditional learning triad, see Figure 1.

According to the 2020-21 National Principal Survey (NTPS), 38% of public CTE instructors entered teaching through an alternative certification program (Alvarado, 2023). Also nationally, 80.5% of CTE teachers hold a standard teaching certificate. The national information did not break the CTE teachers into specialty areas in order to review degree type. No other sources in the documents review provided information on degrees held by current secondary technology education teachers.

Alternative routes to licensure are set forth by the Virginia Board of Education's *Licensure Regulations for School Personnel*. Described in Virginia's Administrative Code, Virginia has five alternative routes to licensure which are available for individuals who already have significant experience in the field or hold a bachelor's degree. If an individual has a career in a profession related to technology, they can enter a career switcher program which will provide credit for knowledge gained in the field. Individuals with a bachelor's degree can obtain a provisional license which allows a qualified individual to teach for five years while completing the requirements for a license. Endorsements can be added to an individual's license if they pass an academic subject test in the discipline which they are transferring.

Alternative licensure in Virginia requires an earned baccalaureate degree (not necessarily in education), completion of requirements for an endorsement in a teaching area, at least three years of successful full-time work experience, and a qualifying score on the professional teacher's assessment. According to *Alternate Routes to Licensure* (8VAC20-23-90), coursework required for an alternative pathway include:

1. 180 clock hours of instruction, including field experience,
2. A minimum of five seminars which include 20 cumulative instructional hours, and
3. One year of successful, full-time teaching experience with a trained mentor (2021).

Virginia also has reciprocity with several states that allows an out-of-state teaching license to be accepted in Virginia. In 2016, the number of Virginia alternative licenses completed was 396 which was 12% of all teacher programs completed (National Teacher Preparation Data, 2018). This is an increase from 2014-15 when alternative licenses represented 10% of all completed teacher preparation programs.

RQ 2: Program Goals

The VDOE CTE webpage for Technology Education was located at https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/career-and-technical-education-cte/technology-education and contained the following titles: Course Revisions, Safety Best Practice Guide for CTE, Instructional Resources, Career and Technical Student Organization (CTSO), Resources, Technology Education Higher Education Programs, and Virginia CTE Technology Education Listserv (VDOE, 2022d). The CTE program areas webpage of the Virginia Department of Education website states that the technology education program area career clusters include 1) Energy and 2) Science, Technology, Engineering, & Mathematics (VDOE, 2022d). Career clusters are the identifier of course descriptions, competencies, and curriculum on the Virginia CTE Resource Center website.

According to the Virginia Department of Education website, the goals for technology education students in Virginia are:

- Comprehend the dynamics of technology, including its development, impact, and potential.
- Employ the technological processes of problem solving, creating, and designing.

- Analyze the behavior of technological systems and subsystems, including the tools, materials, processes, energy, time, information, and people involved in systems.
- Apply scientific principles, engineering concepts, and technological systems in the processes of technology.
- Discover and develop personal interests and abilities related to a wide variety of technology-oriented careers (VDOE, 2022d, para. 1)

The website states that technology education programs create technologically literate people. The term technology and technologically literate are not defined on the website nor is a source for the definition provided. The systems and subsystems of technology referenced in the above goals are not listed on the website. The goals listed on the webpage are not further defined nor does the website provide a source for more information about the goals.

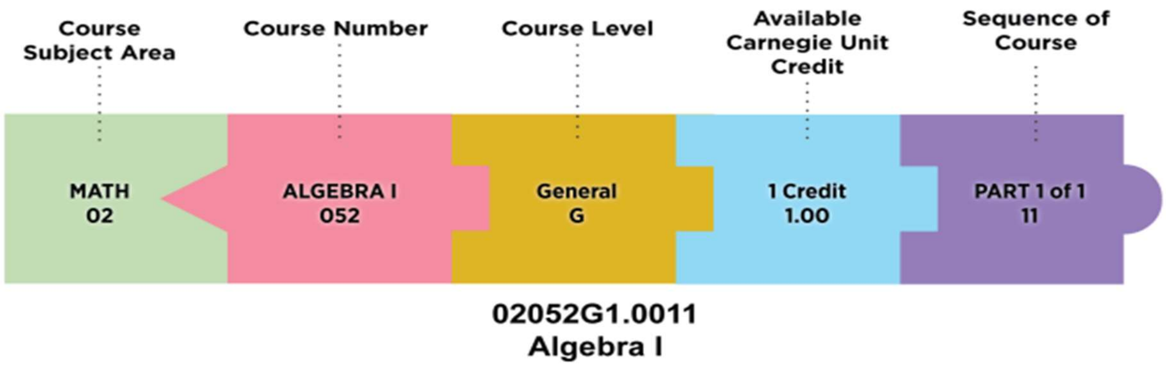
The CTE Resource Center is the source for curriculum materials for CTE courses in Virginia. The Career Clusters webpage contains curriculum frameworks, student competency records, course sequence lists, and credentialing information. The courses are listed by career clusters and not CTE program areas. The educator section webpage has a search bar for finding courses but does not provide a course listing by program area. An instructor must know the course name or code in order to find the information related to the program area. When searching for information in the find function of the CTE Resource Center website, a search for "technology education classes" only brings up a list of courses with the word "technology" in the name. In order to find details about a course, the user must enter a course name, school courses for the exchange of data (SCED) code, or Virginia Assignment Code.

The Virginia Assignment Code is a four-digit code referred to as the "course code" and has traditionally been used by the VDOE to identify courses. The Virginia Assignment Code can be found on the curriculum page of each course. The VDOE Technology Education Course Listing document only lists the four-digit Virginia Assignment Code.

The SCED code is a five-digit code that can be found on the introductory page of each course. According to *Virginia's use of SCED state-specific course codes: A case study,* "the school courses for the exchange of data (SCED), (is) a voluntary, common classification system for prior-to-secondary and secondary school courses" (National Center for Educational Statistics, n.d.b, p. 1). Virginia implemented the SCED code course system in the 2010-11 school year. In the 2016-17 school year, VDOE school divisions were "required to use the SCED course codes in their reporting, and the old state course codes were permanently retired" (National Center for Educational Statistics, n.d.b, p. 1). According to the *National Forum Guide to Understanding the School Courses for the Exchange of Data (SCED) Classification System* (National Forum on Education Statistics, 2023), the SCED code is structured into two parts with four basic elements (SCED Course Code which includes the course subject area and course number), SCED course level, unit credit, and sequence of course, see Figure 16. The SCED code is 12-digits long with the first two digits indicating the course subject area, the next three digits indicating the course number, the next is a letter indicator for the course level, three digits indicating the available Carnegie Unit Credit, with the last two digits indicating the sequence of course. According to the National Forum on Education Statistics, the course code is a five-digit number which includes the subject area (two digits) and the course number (three digits) (2023).

Figure 16

SCED Code Explained (National Forum on Education Statistics, 2023, p. 7)



The VDOE SCED codes are listed for technology education in the CTERS Manual but only include five (5) digits, see Appendix J for examples. The Virginia CTERS Manual provides the five digit SCED codes for courses in each program area. Technology Education has 28 duplicate listings of SCED codes in the technology education course list including 11 courses listed for SCED code “21015.” The duplicate SCED code courses listed were mostly labeled as Project Lead The Way (PLTW) but did not include all PLTW courses in the CTERS document.

When searching for “21015” on the CTE Resource website, 26 results are returned including advertising design which lists SkillsUSA as the CTSO but does not list the program area. Also, four courses (Engineering Essentials (PLTW), Environmental Sustainability (PLTW), Technology Awareness, and Unmanned Aircraft Systems (Advanced)) were listed on the technology education course list on the CTERS Manual but not in the VDOE website list of technology education courses. The SCED code digits designated for subject use nine (9) different codes for technology education courses. See Table 4 for a compilation of SCED subject codes used in Virginia. The Virginia SCED codes did not differentiate between course levels or course lengths.

Table 4

SCED Codes and Categories Used for Technology Education

SCED Code	Category
03	Life and Physical Sciences
05	Visual and Performing Arts
10	Information Technology
11	Communication and Audio/Visual Technology
13	Manufacturing
15	Public, Protective, and Government Services
17	Architecture and Construction
20	Transportation, Distribution and Logistics
21	Engineering and Technology

The VDOE Technology Education website page provides a Word (docx) document with a list of Technology Education courses (VDOE, 2022d). The document lists 85 course names with corresponding course numbers with 18 of the courses designated as "(PLTW)" but no key to this designation was included. Descriptions, links to descriptions, and links to course objectives are not provided in this document. The document does not separate middle and high school courses. A search of the career clusters which were listed for Technology Education of Energy and Science, Technology, Engineering, and Mathematics on the CTE Resource Center website does not include the 28 courses on the Technology Education Course List (see Appendix K). The 28 excluded courses are listed in five additional career clusters (Architecture & Construction, Arts, Audio/Video Technology and Communications, Information Technology, Manufacturing, and Transportation, Distribution & Logistics). One course is listed in the Science, Technology, Engineering, and Mathematics Career Cluster on the CTE Resource Center website which is not on the Technology Education course list (Engineering Essentials (PLTW)).

Virginia’s technology education program area offers 83 courses in middle and high school. See Table 5, for the number of course offerings in other VDOE program areas. In order to find the number of courses in each program area, the researcher transferred the course lists on each program area page to a spreadsheet. The researcher could not locate the data provided by the CTERS reports on how many courses are offered in CTE, number of teachers, grade level offerings, or how many districts have active CTE programs. The number of courses was counted from each program area list of courses, the total number of courses offered by CTE according to these lists was 424. The mean number of courses for all program areas was 53, the standard deviation was 28.3. Technology education had the second highest amount of courses with 20 more course than the mean.

Table 5

Virginia’s CTE Program Area Course Summary

Program Area	# of Courses
Marketing	18
Business & Information Technology	36
Family & Consumer Science	38
Career Connections	39
Agriculture	49
Health & Medical Services	55
Technology Education	83
Trade & Industrial	106

Note. N = 424; Mean = 53; Standard deviation = 28.4.

The VDOE program area webpage located at https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/career-and-technical-education-cte/cte-program-areas lists for each program area: 1) a link to the program area specific webpage, 2) the related career clusters, and 3) specialist's name with contact information (VDOE, 2022d). The program area webpage is missing grade level available for each area and standards and/or competency sources.

The technology education program area offers more courses than the other CTE areas except trade and industrial education. According to this researcher's compilation of data, the total courses offered to Virginia students in CTE was 424. Technology education offers 83 courses at the middle and high school level.

Trade and industrial teachers (T&I) are required to have two years or 4,000 clock hours of full-time occupational experience for their teaching endorsement *Career and Technical Education – Trade and Industrial Education* (8VAC20-23-280). Trade and industrial education prepares students to enter skilled trades which are specific to occupations. While trade and industrial education teachers are focused on one or more specific occupations in their field, technology education teachers are expected to teach all areas offered in the program area.

RQ3: Issues

Research on issues about the technology education profession have been published over many years (Wicklein, 2004, Katsioloudis & Moye, 2012, Moye et al., 2020) but data on issues specific to technology education teachers in Virginia was not found. According to the *Strategic Review of Technology Education in Virginia* (Reed, 2017), the following issues were summarized from the document:

1. National surveys indicate a narrow view of the term, "technology",

2. Technology education teachers are consistently listed as a critical shortage area,
3. Technology education content is "ever changing,"
4. For over 20 years, "compelling studies" have called for all students to study technology, and
5. A high demand is indicated for jobs related to technology education pathways and career pathways (Contemporary Trends and Issues Section).

The number one issue identified in the *Strategic Review of Technology Education in Virginia* (Reed, 2017) was the narrowing of the term, "technology." A search for the term technology education and Virginia brought six different webpages. As an example of the semantics issue, in Virginia, the VDOE has a webpage for six different offices of technology:

1. "Technology in Education" (https://www.doe.virginia.gov/programs-services/school-operations-support-services/technology-in-education),
2. "Technology Education" (https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/career-and-technical-education-cte/technology-education),
3. "Technology Innovations" (https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/digital-learning-integration/technology-in-education/test-2),
4. "Administering Technology in Schools" (https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/digital-learning-integration/technology-in-education/educational-technology-planning/administering-technology-in-schools),

5. "Educational Technology Planning" (https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/digital-learning-integration/technology-in-education/educational-technology-planning), and
6. "STEM Education" (https://www.doe.virginia.gov/teaching-learning-assessment/instruction/science-technology-engineering-mathematics

The six different offices offer a wide range of services. For example, the STEM Education webpage offers engineering design based on the scientific method and is a component of K-12 Standards and Instruction. The Technology in Education webpage focuses on digital learning and focuses on computer science Standards of Learning. The Technology Education webpage is a program area in Career and Technical Education and promotes the development of technologically literate people.

PHASE 3: FOCUS GROUP

The last phase of the research was to meet with focus groups to triangulate data. The focus group questions were created after the survey and documents review were completed. Six technology education experts were asked to participate in the focus group. A phone call was made to each candidate to request their participation in the focus group. After the phone call, a request was made via email. Four (4) of the requested participants were able to meet on Zoom on Friday, February 16 at 1:00 pm. One (1) participant was able to meet on Monday, February 19 at 1:00 pm on Zoom.

Prior to meeting with the focus groups, an email was sent with the consent form (see Appendix H), a Zoom meeting link, a reminder of the meeting date and time, and a slide show (Appendix L) which detailed the nine questions that would clarify the data collected in phases one and two of the research. The questions pertained to data acquisition, RQ1 (educational background), RQ2 (program goals), RQ3 (teacher issues), and adding clarity in the research. The focus group contained two CTE directors, two technology education supervisors, and one adjunct professor in technology education. See Table 6 for focus group attributes. Zoom created a transcript of the meetings within the software. The Zoom meeting on Friday, February 16 lasted for one (1) hour and 52 minutes. The Zoom meeting on Monday, February 19 lasted 39 minutes. The transcript from the meetings were analyzed for content and time spent per topic.

Table 6

Focus Group Attributes

Participant Designation	Position	Years in current position	Teaching Experience in Technology Ed (years)	Other Experience	Undergraduate major
P1	Adjunct Professor in Technology Education	7	20	Weapons technician for Navy	Criminal Justice
P2	CTAE Director	15	9	Woodworking Industry	Industrial arts
P3	Program Manager, Technology and Engineering Education	7	8	Elementary Education	Technology Education
P4	CTE Specialist	9 months	13	Aviation maintenance and computer systems administration for Marines	History and Social Studies
P5	CTE Director	11	15	Principal	Industrial Arts

When the focus groups met, the participants were given an overview of the research topic, methodology, and research questions. The participants were thanked for sending their signed consent form and reminded the focus group would be recorded and transcribed. The participants were then provided with focus group guidelines:

- Consent is given for participation in this focus group,
- Participation is voluntary and may be ended by the participant at any time,
- No compensation will be provided for participation,
- The session will be recorded,
- The transcript of the recording will be analyzed and used to clarify research questions,
- Names will not be used in the description of the data, and
- The session will be limited to 90 minutes.

After the participants were briefed, each participant was thanked for their participation and asked to summarize their experience in technology education. Once introductions were complete, the participants were asked the nine questions sent through the slideshow in their emails. The slideshow was shared in Zoom during the meeting using the “share screen” option.

Descriptive Statistics

The Friday focus group was designated fg1 and Monday’s focus group was designated fg2. Total time for both focus groups was 130 minutes. See Figure 17 for time spent on each question in the focus groups. The focus groups spent the majority of their time adding clarity to the research questions; commenting on transparency needed for the VDOE and the CTE Resource Center as well as how stakeholders could contribute to improvements for teachers. During the discussion of question nine, participants discussed the need for less courses and a simpler structure for the course sequencing. The least amount of time was spent discussing VDOE’s technology education program goals. The participants stated that the goals are embedded in the competencies.

Figure 17

Time Analysis of Focus Groups

Question	Topic	Research Question	Focus Group 1 Duration	Focus Group 2 Duration	Total time on each question
NA	Background		04:03.7	02:18.4	06:22.4
NA	Intro		11:53.7	01:10.9	13:04.6
1	data acquisition		11:44.2	04:23.0	16:07.2
2	educational background	1	09:17.8	03:33.3	12:51.1
3	educational background	1	07:33.6	01:37.0	09:10.6
4	program goals	2	01:57.6	01:16.0	03:13.6
5	program goals	2	10:20.5	01:28.0	11:48.5
6	teacher issues	3	05:54.5	03:27.1	09:21.6
7	teacher issues	3	13:33.4	02:56.5	16:29.9
8	adding clarity		16:42.0	03:51.9	20:33.9
9	adding clarity		12:30.1	09:51.3	22:21.4
	Total time spent	129:64.8	FG1 Mean 09:35.6	FG2 Mean 03:15.8	
	Standard Deviation of Questions	0.002	Standard Deviation of FG1 04:22.7	Standard Deviation of FG2 0.002	

Using NVivo (Version 12, 2017), the transcripts were evaluated for sentiment. The tone of the transcripts was overwhelmingly positive. The references to positive sentiment included 155 data points whereas the negative sentiment had 80 references. See Figure 18 for the sentiment analysis of the transcript. Over 55% of the conversations in the focus groups were moderately positive. The participants spoke positively about the teacher needs and were encouraging about change for the discipline.

Figure 18

Sentiment Transcript Analysis

: Very negative	12.96%
: Moderately negative	19.42%
: Moderately positive	55.54%
: Very positive	12.08%

The first question targeted information about data acquisition. The participants were asked “How do you receive data on the number of licensed technology teachers and their types of licensing (e.g., provisional, professional)?” The question was posed to determine a method to obtain additional data about technology education teacher backgrounds and qualifications. P2, P4, and P5 stated that their districts’ Human Resource department was the source for data on the teacher qualifications. P3 stated that they gathered the data through surveys and meetings locally. All participants stated that the information about teachers and their qualifications was kept at the district level. Information pertaining to teachers was not maintained in a state database for use at the local level.

RQ1: Educational Background

The next question focused on RQ1, teacher educational background. The participants were asked if they note differences in teachers who were *not* traditionally trained vs. a traditionally trained technology education teacher. If so, what are the differences? The supervisors (P2, P3, P4, and P5) expressed a concern for the lack of qualified technology teachers. P5 stated, “There are programs that are shutting down, and also that there are fewer people entering the teaching field in general and specifically technology education.” P3 stated that she developed and taught a 30-hour course for new technology and engineering teachers as well as content switchers to develop skills for the technology and engineering classroom. P2, P4, and P5 stated that they created training locally for teacher training. P4 and P5 stated that they encouraged teachers to attend the VTEEA conference for current professional development as well. The supervisors agreed that the lack of traditionally trained teachers is a challenge. P2 stated, “What we notice with the teachers that are traditionally trained and the ones that are going through the Praxis is that they (not traditionally trained) don't have quite the depth, the breadth of knowledge." The group concurred that traditionally trained technology teachers are flexible and open to teaching any technology education class without hesitation. P3 spoke about the training they had as an undergraduate technology education major which included electronics, engineering, metal working, woodworking, power and transportation, and aerospace. The focus group agreed that the diverse curriculum of technology education teacher programs prepared the educators to be comfortable with any equipment. P4 stated that the difference "comes down to confidence." P4 also stated that traditionally trained technology teachers focus on safety procedures and "aren't afraid to work with equipment." The consensus of the group was that the diverse training of traditionally trained technology teachers creates an educator who has the confidence when asked to teach a new course, and Participant three added "says, give me some equipment and that's all I need."

The focus group was asked a follow up question about RQ1, teacher educational background: Do you note differences in a teacher who is a career switcher vs. a content switcher? If so, what are the different needs? P5 stated, "career switchers have a tougher time…they (switchers) take a great deal more mentoring." All participants stated that the most difficult component of teaching is classroom management but emphasized that content switchers have more skills dealing with students. P3 suggested that career switchers have work based experiences which make them better at the high school level whereas content switchers understand classroom management and are more successful at the middle school level. P1 who was a career switcher and stated that "mainly the issue was getting students motivated to learn about technology." They continued to elaborate that student motivation techniques were the most complex skill to learn as a career switcher. P4 stated that the "organized chaos" of the technology education classroom is difficult for content switchers to understand in terms of classroom management. The movement of students while completing technology education projects is the most difficult "learning curve" for content switchers according to P3. While content switcher teachers enter the classroom with student management skills, the technology education classroom presents unique difficulties due to the active learning style of the content thus proving the most difficult skill for any new teacher (career or content switcher) in technology education is developing classroom management skills for active learning.

RQ2: Program Goals

The focus group was shown an image of the Technology Education goals from the Virginia Department of Education Technology Education website (VDOE, 2022b). The focus group was asked about how information about the technology education goals from the VADOE was distributed teachers in their school division. P1, P2, P3, and P4 stated that they did not even "realize those were on the site." P2 stated that the VDOE website had been recently changed. P3 stated that after reading the goals, they are "kind of indirectly embedded in the (technology education course objectives) goals." P5 stated that the goals are reviewed in the local school district orientation meeting in the fall. P5 added that the VTEEA conference was important for his teachers to attend because "it's imperative that they (all technology teachers) keep up (content knowledge) and they keep their goals current in their classrooms as well."

The follow up question for *RQ2: Program Goals* was to describe any professional development being offered on VERSO, *Standards for Technological and Engineering Literacy* (ITEEA, 2020), Engineering by Design (ITEEA, 2011), and/or other program materials. All participants stated that they offer local training on technology education course objectives, standards, and reporting standards. P2, P3, P4, and P5 offer training at the fall orientation meeting prior to the beginning of the school year. P3 offered their 30-hour training course for up to 40 teachers. They stated that they would be willing to open their course to the Northern region of Virginia, but the course has been full in the past. P2, P3 and P4 stated that they emphasize the *Standards of Technology and Engineering Literacy* (ITEEA, 2020) during the local training. P3 developed a scavenger hunt for the STELs for the first session of the course. P4 provided a new Standards manual to every teacher with their name on it. P4 places a $5 bill in each manual but stated only two people have said thank you for the money. They stated, “A couple just kept the money. They didn’t say anything.”

Besides locally offered professional development, P2 and P4 added that their teachers were trained through Project Lead the Way (PLTW). P4 stated the PLTW’s hands on intensive curriculum training has been productive but they are working to get PLTW to train in their local area instead of sending teachers out of state or offer online learning opportunities. P4 stated that “what I found is they're (teachers) just not getting as much out of it (PLTW training) when they're (teachers) doing the online training. So you know, their kids are suffering. And that's what it's all about trying to make that better for the students and see we [sic] can't get back to some in-person training for them.” P2 and P5 provide funding for their teachers to attend the VTEEA Conference held in July. P2 stated that their district is moving to training provided by Engineering by Design which is offered by ITEEA. P5 stated that their teacher attended Engineering by Design training last summer provided at the VTEEA conference.

RQ3: Teacher Issues

The focus group was shown Table 2 and asked to review the response rate from the phase one survey and to suggest how information could be obtained from and provided to teachers. The researcher clarified this question stating that Perkins V, Section 124. (b) Permissible use of funds (5) “for teachers…professional development that is, to the extent practicable, grounded in evidence-based research." The researcher asked, for suggestion on how to get information from teachers in order to create evidence-based research of teacher issues (RQ3). P3 stated "I can't get my teachers to read my emails. And I even put like little hidden gems in there. We've tried everything. We've tried paying the teachers, you know, for time, you know, to do things. And it's not even about the money anymore. It's just communication overload." P2 stated that communication has been challenging and teachers "push back (when asked to work outside of their classroom) even when we can pay them." P4 mentioned that the problem is all about time. According to P4, "the older you get the less of it you have and many of our younger teachers have their own children." P5 mentioned that "teachers just get overwhelmed." All participants agreed that a personal connection such as visits to the classroom make the teachers more respondent to communication.

On the note of *RQ3: Teacher Issues*, the focus group was asked about the major issues secondary technology education teachers confront. P3 made a list and placed in order of urgency. All participants concurred on these issues, adding comments to each area of concern.

1. Lab overcrowding
    a. Up to 35 students are placed in classrooms
    b. Overcrowding results in injuries
    c. Classes not capped at 20 due to machines deemed non-essential in instruction
2. No aids or support for students with IEPs
3. Lack of site-based administration support
    a. Lack of consequences for discipline
    b. Funding for program consumables

    c. Overpopulation of courses
4. Compensation for teachers based on merit and experience
    a. Salary caps at year thirty (30)
    b. Teachers retire then teach in a different school district
5. CTSO competition dates
    a. TSA is one of the latest
    b. National TSA conference dates occur during change in fiscal year
    c. National TSA conference occurs after some students graduate which means the school system cannot legally send the qualifying students

P2 spoke to the concern of safety in regard to overcrowding while P4 emphasized the lack of dress code. The concerns were often expressed as a precaution to safety. While the list above seems extensive, the focus group's discussion revolved around issues which cause safety concerns for the students to use machines and tools. P2 stated, "…if you look at Maryland (Love et al., 2024), …they've (Love, 2013) had that (call for safety according to regulations) for a number of years. But we (Technology Education) don't really have anything similar to that in Virginia." P4 stated, "the safety aspect is what most of our people (teachers) are more concerned about."

Classroom management and student behavior was a major concern due to its impact on student safety. P5 stated that "(current) student attitudes stink...we (the school) empowered them (students) to stay in their dining rooms in their pajamas (during COVID lockdowns) and they haven't gotten out of that mindset." P1 and P5 stated that student apathy has been a "major contributor" to student discipline and classroom management issues.

P2, P4, and P5 spoke about rising costs in smaller school districts due to cutbacks in local funding. P2 and P4 discussed the rising costs of consumable materials. In smaller school districts the budget is more volatile due to the lack of girth. P2 and P5 discussed the isolation of technology teachers in smaller schools as well. P2 stated many technology teachers are the only teacher for the subject in their school. “Teachers miss just having somebody that they can, you know, discuss their content area issues,” according to P2.

Adding Clarity

The last two questions were asked to provide clarity about the recommendations of support for technology education teachers in Virginia. The focus group was first asked to discuss recommendations on resolving the VDOE and CTE Resource Center organization of materials around Career Clusters with the Virginia Administrative Code and licensure organization around the seven traditional CTE specialty areas. An example was provided from Appendix K which showed Technology Education courses which were listed by the VDOE but not as a technology education course in the CTE Resource Center website.

The participants shared that the CTE Resource Center website had recently “crashed” and is in the process of being rebuilt. When P3 stated trying to find endorsements required for specific courses is like “a scavenger hunt”, the other participants laughed in agreement. P5 stated that VERSO (the course listings with competencies on the CTE Resource Center website) is not user-friendly citing difficulty in trying to find task lists and course numbers. P5 stated, “consequently, I’m not sure it’s (CTE Resource Center website) is being used as much by teachers as it used to be. That’s my gut feeling.” P5 also stated that they have trouble navigating the website themselves. P5 expressed one issue is the databases “need to talk to each other.” P3 stated that the CTE Resource Center website is a “hot mess.” P3 gave the example of being unable to find the student competency records on the website. P5 discussed that there are 17 career clusters and trying to find a list of “tech ed courses is tough to do.”

The participants also stated that the VDOE website lacks transparency. They cited examples such as Perkins information is provided for CTE directors but not shared with program managers. P3 stated that the approved equipment list for Perkins is missing from the VDOE website. P3 had downloaded copies of curriculum materials from past years which they now used to complete paperwork since it cannot be found on the VDOE website. P2 stated that “simplicity would probably be helpful.” P2 cited the lack of information about course sequences makes the assignment of classes difficult and “…I start looking at some of our CTE directors that might not have CTE experience, and it becomes very difficult for them.” P3 shared a document which they created which showed a colorful visual flowchart of course sequences with SCED codes and course numbers. P3 shared that visuals with graphics would help simplify the information.

P4 stated that the issue is a combination of problems, lack of transparency and the need for simplification of the coursework. P4 stated “we just don’t need a whole lot of behind the curtain routine going on that we have to go dig information out.” P2 agreed that courses need to be simplified and transparency is needed. P3 reiterated the need for simplicity and having “intentional courses.” P3 clarified by stating, “it just gets really confusing. If there’s not a graphic or clear pathway.” P5 also expressed the need to “narrow the list a lot.” P5 stated, “there may be a lot of courses that are out of date, aren’t relevant to today’s technology and industry.” P5 explained that technology education teachers do the best job at preparing students for jobs that don’t exist yet.

The focus group wrapped up the session with a question about how the VADOE, VTEEA, teacher preparation programs, and other stakeholders could help secondary technology education teachers. P3 expressed that "it's encouraging to hear that I'm not the only one struggling with some of these things (issues)." P5 stated,

> "I'm going to say this. I mean, they can't fire me. I don't care. VDOE is a train wreck, and somebody needs to go down there and straighten the place out. I don't think they're helpful at all. I don't contact them unless it's a national emergency. I don't rely on the information I get from down there. I don't have much good to say about them right now. I think, as we talked about the web site is a train wreck, too. I just… I'm sorry, I don't. I'm not a fan of them right now and haven't been for several years. That's why I rely on the VTEEA to get information out to our teachers more than anybody else."

P4 expressed the need for teacher involvement in professional organizations. P3 agreed stating that the discipline should encourage work-based learning partnerships. P4 stated that the lack of teacher involvement may be caused by the new 10-year licensure process. P3 agreed that "in seven or eight years, …they (VDOE) should be prepared for that panic." Implying that teachers would be waiting until the end of the renewal cycle to seek out professional development opportunities.

The participants then discussed the need for clarity between SCED codes and course codes and reiterated the need for clarification on courses, course sequencing, and identifying factors. P2 stated there needs to be "more consistent language" with the national education programs. The participants discussed the need for teachers to be informed in a concise and consistent manner. P5 closed the session by expressing their concern at the "dwindling" teacher prep programs pointing out that the technology education program at ODU is the "only show in the state." P5 stated that these teacher prep programs provide activities and information teachers can take back to their classrooms and give their students "relevant, real-life activities that they can use to help make their career choices and to keep learning fun."

SUMMARY

The data on the needs of secondary technology education teachers were collected in three phases of this qualitative study. In phase one, a survey was conducted to determine the demographics of current teachers, their educational background, program goals, and classroom issues. The survey was diligently distributed online and in person but only received a 11% return rate which resulted in a margin of error of 8.92% with a confidence level of 95% (G*Power software, version 3.1.9.4, 2019). The information from the documents review, phase two, was sparse with the majority of information about the program goals but information concerning teacher issues and educational background were largely unavailable. The information collected from the focus groups, phase three, was productive with frank and open conversation about the correlation of federal and state nomenclature, a need for transparency from the state department of education, and a need for the simplification of courses in Virginia. The focus group also shared the work of local school districts in meeting the needs of teachers and proposed a focus on classroom management techniques and issues which caused safety concerns such as IEP students in classrooms without support and overcrowding.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to determine the needs of secondary technology education teachers in Virginia. This chapter summarizes this study, discusses conclusions drawn from the study, and provides recommendations for practitioners and future research based on the study conclusions.

Summary

Research is required to access funds for the support of technology education teacher needs (*America COMPETES Reauthorization Act of 2010, Every Student Succeeds Act, 20 U.S.C. § 6301*, *Strengthening Career and Technical Education for the 21st Century Act (Perkins V)).* Due to the critical shortage of secondary technology education teachers, professionals entering the education field come through several alternative pathways (U.S. Department of Education, 2023b). The varied backgrounds of teachers entering the field create differing needs in pedagogy, epistemology, and assessment (Knight et al., 2014). Teachers who receive substantial support (an average of 49 hours) have increased student success (Yoon et al., 2007).

In order to develop a list of teacher needs, the researcher created a three-phase qualitative study which asked the following research questions:

1. What is the educational background of secondary technology education teachers in Virginia?
2. What goals are emphasized in secondary technology education programs in Virginia?
3. What are the major issues confronting secondary technology education teachers in Virginia?

The three phases of research included a survey, a documents review, and focus groups. The three phases were required to triangulate the qualitative data collected. Each phase informed the following phase and refined the search for more specific data. The limitations of the study included the self-reporting of information on the phase one survey, the voluntary participants, and required access to the computer and the internet in phases one and three. The population of the research consisted of 943 secondary technology education teachers currently teaching in Virginia. The sample size of the phase one survey was 107 which was 11% of the population and created a margin of error of 8.92% with a confidence level of 95%. The phase two documents review was limited to open-source documents which were assumed to be unedited by outside users. The phase three focus group was limited by time availability for participants and the need to limit focus group discussions for consideration of their volunteer time.

CONCLUSIONS

The problem of this study was to identify the needs of secondary technology education teachers in Virginia. The research questions explored the current educational background of secondary technology education teachers, the goals of the technology education programs, and the specific issues pertaining to these teachers in Virginia.

RQ1: Educational Background

Research question one reviewed the educational background of teachers currently in the field using a survey which asked teachers to self-report, a documents review which looked at the current educational requirements for licensing teachers, and a focus group of experts who were asked about their experiences with teachers' and the impact of their educational background since technology education has been a critical needs area since 1998 (U.S. DOE, 2016). The results showed that most CTE teachers may be qualified to teach but may not have knowledge of pedagogy, epistemology, or assessment methods specific to technology education. The study also showed that while the majority of technology education teachers may hold education degrees, traditionally trained teachers may show higher confidence levels in classroom management. This result agrees with the study of Zhang & Zeller who stated teachers who spent four years studying education in a traditional teacher preparation program were socialized into prioritizing learning and focusing on pedagogy whereas alternatively licensed teachers have little experiential learning about teaching prior to entering the classroom (2016).

The study results also identified that qualified teachers, regardless of their licensure path, may not have specialized skills in areas such as engineering, tooling, or equipment repair. The study results showed training may not be available for subject matter content, but teachers may not be motivated to become involved in their community or seek outside support unless motivated by an incentive such as licensure requirements. These results are supported by Mentzer et al. that stated licensure type (and pathway to licensure) was “unassociated with the impact on teaching self-efficacy, beliefs about teacher-focused/ student-focused teaching, preferences for inquiry instructional practices, and experiences with student misbehavior” (2019, p. 35). The impact on student achievement was documented in the meta-analysis completed by Yoon et al. who found that substantial professional development can boost student achievement (2007). Providing resources for teachers was found an important factor in providing for student success.

RQ2: Program Goals

Research question two explored the content taught in secondary technology education classrooms by surveying teachers about their program goals and sources of information. Phase two reviewed the online documents to identify the curriculum resources and phase three asked experts to elaborate on how the teachers are educated about the program goals. The following conclusions are made from the findings reported on the program goals research.

This study revealed that the curriculum materials currently offered by the CTE Resource Center and the VDOE may not be supportive of teacher needs. This may be due to errors in the VDOE and CTE Resource Center website and the lack of clarity for the websites due to conflicting organizational structures using program areas and career clusters.

The Website Grader online program gave the CTE Resource Center website a 77/100 (Hubspot Tools, 2024). The score categories were performance 17/30, SEO (search engine optimization) 30/30, mobile compatibility 20/30, and security 10/10. The Website Grader recognized the “Tap Targets” (interactive elements) and page speed as areas of concern. The Free Website Analysis Tool rated the CTE Resource Center website with an A- overall score with a performance rating of A+, on-page SEO rating an A, links rating C+, and usability rating B (Webimax, 2024). The tool stated the main keywords are not distributed well across the HTML tags. The report also stated that the page strength was very low due to a strong level of backlink activity with over 20,000 backlinks. The tool report also stated that some of the link URLs do not appear friendly to humans or search engines. The report stated the page is OK but could be more usable across devices.

The Website Grader online program scored the VDOE’s Technology Education Program website with a score of 57/100 (Hubspot Tools, 2024). The score categories were performance 7/30, SEO (search engine optimization) 20/30, mobile compatibility 20/30, and security 10/10. The Website Grader listed page speed as a major concern with a score of 37 seconds which is much slower than the “best-in-class webpage” scoring within 5.3 seconds. The online tool also listed image size, minified javascript, minified css (cascading style sheets), descriptive link text, and tap targets are categories of failure. The Website Assessment from BDC scored the VDOE's Technology Education Program website with a score of 78/100 (BDC, 2024). The assessment tool listed accuracy, inconsistencies, backlinks, and reviews as areas of concern. The tool stated that the website had 50% inaccurate listings of links and 2.4 out of five stars average review rating from GoogleMaps with 22 reviews listed for the organization.

The analytic website reviews of the CTE Resource and VDOE technology education program websites corresponds to the study results which indicated that the VDOE may not be reviewing the content and updating their website and the program area webpage may not include important information to teachers such as how to implement program effectively. Also, the CTE Resource center website may not be providing information for technology education courses in an effective manner. Since the CTE competencies and governing documents are located on the websites, the website usability may be causing teachers to avoid their use. The data from this study indicated that the technology education teachers may not be accessing curriculum standards, or their program goals may not be aligned to state CTE competencies. The study also found that the information comparatively between the VDOE website, CTE Resource Center website and CTERS manual contains errors.

The study found the VDOE course list may not contain enough information and teachers may be using old course codes to identify courses. The organizational tool of the SCED code used to identify courses in Virginia may not include enough information with the shortened five-digit code and the duplication of these codes for many different courses. Course sequencing information may not be user friendly as well. While curriculum support materials may be difficult to locate or unavailable from the VDOE, the CTE Resource Center serves as a repository for curriculum materials for CTE programs in Virginia. The organization of this repository uses contrasting systems such as career clusters, shortened SCED codes, and program areas may cause confusion for users.

As organizational materials may need reviewing by agencies, the sharing of data for research purposes also may not be seen as a priority from these government agencies. This result contradicts Perkins V, Section 123 (b), which directs state leadership support and professional development to be "grounded in evidence-based research" (2019, p. 58). Curriculum status, change, and development of the discipline were found in 50% of all research completed in technology education between 1987-1993 (Zuga, 1994). Research using information collected from CTERS could create new insights which could explore areas such as national technology education standards implementation, careers in technology education, and CTSO experiences for students across the Commonwealth.

A repeated theme in the findings about the program goals was that technology education may offer too many courses. The technology education courses may be focused on the technological tool instead of the learning process. Historical philosophers such as John Dewey established the need to teach skill-based education focused on problem solving (Loucks, 1991). Frederick Bosner, after World War I, emphasized that industrial arts (technology education) should be focused on intelligence instead of specific tools (Prakken, 1976). After six years of research in 2000, *Standards for Technological Literacy* (STL; ITEA, 2007) was published to set the framework for the technology education discipline. According to the STL,

> People who are unfamiliar with technology (education) tend to think of it purely in terms of its artifacts: computers, cars, televisions, toasters, pesticides, flu shots, solar cells, genetically engineered tomatoes, and all the rest. But to its practitioners and the people who study it (the discipline), technology is more

> accurately thought of in terms of the knowledge and the processes that create these products, and these processes are intimately dependent upon many factors in the outside world. (ITEA, 2007, p. 9)

In 2019, the ITEEA updated the standards to create *Standards for Technological and Engineering Literacy* (STEL; ITEEA, 2020). The STEL set forth eight standards and eight practices which focus on student-centered practices which can be taught in eight context areas as seen in Figure 3. “The literature shows that STEL provides the content and direction needed to develop valid technology and engineering programs” (Moye et al., 2020, p. 13). The context areas include a focus on topics which teachers in this study indicated they lacked knowledge such as Computation, Automation, Artificial Intelligence, and Robotics and Agricultural and Biotechnological Technologies but the study also found that classroom teachers may not be aware of the updated standards. “Curriculum, more so than funding, is a state and local endeavor in the U.S.” (Moye et al., 2020, p. 43). The change in Virginia courses from 83 courses in technology education programs to more succinct topics that reflect the STEL succinct context areas would require a focus on epistemology and pedagogy instead of products such as geospatial technology, cybersecurity in manufacturing, digital visualization, and unmanned aircraft systems.

RQ3: Teacher Issues

Research question three looked for issues specific to the classroom teacher. Phase one asked teachers about their issues categorically in the areas of pedagogy, epistemology, and assessment. The teachers were also provided an open-ended question to list their concerns for the classroom. Phase two reviewed documents which were used to determine teacher needs. Phase three provided classroom needs from the supervisors’ perspective. While the study produced 38 findings, the themes focused on family and life balance, classroom management, communication, CTSOs, equipment, safety, special needs students, and support. The findings of this study contrast from previous research (Katsioloudis & Moye, 2012, Moye et al., 2020, and Wicklein, 2004) which list insufficient quantities of qualified teachers, administrative support, and understanding of the content as concerns. The difference may be the focus in this study on the teacher instead of a study on the issues in the profession. This focus on teacher needs may provide opportunities for support which can keep professionals from leaving the classroom such as undertaking significant efforts to prepare technology teachers (Wicklein, 2004) and allowing the profession to address these teacher issues (Moye et al., 2020).

The results of this study suggest that balancing family and extracurricular activities may be difficult causing technology education teachers to feel overwhelmed and state that they may have too many responsibilities. Regulations such as *Career and Technical Education Student Organizations* (8VAC20-120-160) require technology education teachers to provide co-curricular student organization experiences (2012). These types of requirements are not made for the general education teacher. Data from this study also suggest that Virginia TSA competitions may not be on effective dates due to the change in fiscal year and payment arrangements as well as issues with students attending a conference after graduation. Another factor which may lead to technology teachers feeling of being overwhelmed may be the need for teachers to repair and maintain equipment.

Classroom management techniques may be the most imperative skill in technology education courses due to active learning which requires different management skills than other content areas. This finding agrees with the 2007-08 SASS survey which identified student discipline and classroom management as the top issue for teachers (Cox et al., 2016). As in the

Technology Education Triad, Figure 2, technology education has a unique epistemology, pedagogy, and assessment techniques. In technology education epistemology, teachers had issues in safety and classroom culture for active learning. The teachers also shared pedagogical issues for providing competitive learning experiences as mandated by state administrative code and social emotional learning required for team-based projects. The technology education assessment tools identified as an area of difficulty evaluate learners' process and allow the learner the freedom to fail (Scharber et al., 2021).

Problem solving, active learning, and critical thinking skills should be the focus of technology education classrooms (ITEEA, 2020). Teaching through active learning requires students to move around the classroom, work in teams, and be graded on the process instead of the product of learning. According to a meta-analysis of 225 studies on scores and failure rates of undergraduate student performance in STEM courses under traditional lecture versus active learning, active learning was seen to increase scores and decrease failure rates (Freeman et al., 2014). Active learning may not be a focus in the alternatively licensed practitioner since the Virginia administrative code, *Alternate Routes to Licensure* (8VAC20-23-90), only requires field experience, five instructional seminars which are not specified, and teaching experience with a trained mentor whereas the *Professional Studies Requirements for PreK-12, Special Education, Secondary Grades 6-12, and Adult Education Endorsements (*8VAC20-23-190), requires a course of three semester hours specific to classroom behavior and management. Career switchers may understand the content but not have skills to motivate or discipline the students. This study found that disciplining students may be the responsibility of the instructor because students may not receive consequences for behavior from support staff or they are apathetic to the learning process.

The study also found that technology teachers may not be provided effective support from outside of their localities such as from VDOE or VTEEA for improving teaching methods. Support for teaching methods in special education populations may be the largest concern. The lack of support for special education students was also reflected in findings of the 2007-08 SASS questionnaire (Cox et al., 2016). Special education students may not have aides attend technology classes since the class is considered an “elective” class. The aides or paraprofessionals have knowledge specific to the student and special education (Blakeslee, 2012) which technology teachers may not know or understand how to effectively modify instruction for special education students.

The concerns for technology teachers often focus upon concerns for safety. While the technology teacher uses tooling which may not be offered in general education classrooms, the tooling may not be recognized by the VDOE when designating caps for student size in classroom due to the use of machinery as a non-essential in instruction. In other words, while tools such as the band saw and drill press may be used in all technology classes, the only classes that have limits to seats by the VDOE are the classes which require machine use. The technology teacher may not be empowered to limit the number of students for their classes even if they can choose the machines or tools to teach competencies. Since students can choose which elective they can take which includes technology education classes, class sizes may not be limited when counselors and administrators schedule students. Limiting class sizes and special populations led to safety concerns from technology teachers.

This study found that technology teacher preparation programs are a valid and effective part of the education process. Unfortunately, the lack of technology teacher preparation programs requires the VDOE and VTEEA to be primary support for technology teachers in Virginia.

Communication from the VDOE and VTEEA has thusly become an imperative for teachers to learn about and acknowledge support.

This study found the VDOE website may not be providing effective communication to teachers. Information required for Perkins implementation may not be available on the website. Also, communication using emails may not be an effective form of communication. Creating personal relationships with in-person communication may be the most effective form of communication.

> In understanding how to foster effective communication, much previous research has taken an individual focus that identifies personal skills, traits, psychological biases, or cognitive capacity limitations as the basis for communication success or failure...However, as a process of mutual exchange and understanding, communication is inherently social—so that who we communicate with is just as important as how we communicate. (Greenaway et al., 2015, p. 171)

Communication from support organizations such as VDOE and VTEEA may not be seen as important because these entities are not included in the teachers' social identity group. In other words, the communication may not be important for technology teachers unless the teachers see the communicator as part of their "team" with shared norms and ideas instead of from a place of authority (Greenaway et al., 2015). For example, communication after school hours and during the summer may not be effective since teachers may not be willing to work outside of their contracted school hours.

While this study may provide insights into the needs for technology teachers, extensive research on technology teachers' issues may not be available. The VDOE collects data from every technology education classroom twice a year using CTERS, but the data may not be used effectively for research. Providing data to a wide array of researchers allows new ways for framing research questions, designing studies, and analyzing visualizing data (Daniel, 2019, p. 101). Data are considered open when a raw dataset is made available on a public repository (Fleming et al., 2021). Open data can 1) enhance the credibility of research by allowing replication of a study, 2) allow for a more equitable environment by allowing researchers access to raw data instead of summary statistics, and 3) expand the potential application and impact of collected data (Fleming et al., 2021). The lack of open data and a data repository for technology education may be creating limited research opportunities for technology education experts.

Technology education experts may be willing to support changes to create a more productive discipline. The technology educators' community in Virginia consists of VTEEA, VDOE technology education specialist, ODU Technology Education program, and Virginia TSA. While the focus of human design, problem solving skills, and critical thinking are primary to the study of technology (ITEEA, 2020), the term "technology" may confuse consumers. Titles for technology education preparation programs have been an issue for creating and maintaining a consistent curriculum (Litowitz, 2014). "Currently, the T in STEM is extremely nebulous. A closer look at each STEM discipline can help define technology (T) and add clarity to the role of technology education" (Reed, 2018, p. 17). While experts are supportive marketing may take additional time away from teachers' work and the nature of technology as "ever changing" may cause difficulties for some teachers to remain current on emerging tools.

For stakeholders in technology education, this study could be used by state, local, and program advisory committees to develop professional development plans for technology education teachers. Committees could look at funding opportunities from *Perkins V, Every Student Succeeds Act, Section 2245*, and the *America COMPETES Act* to provide technology education teacher support. Legislators and state agencies could use these conclusions to provide improvements in resources and improve teacher retention techniques. This analysis could benefit technology education leaders in Virginia when looking at the needs for teachers.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the following are recommendations for researchers and practitioners.

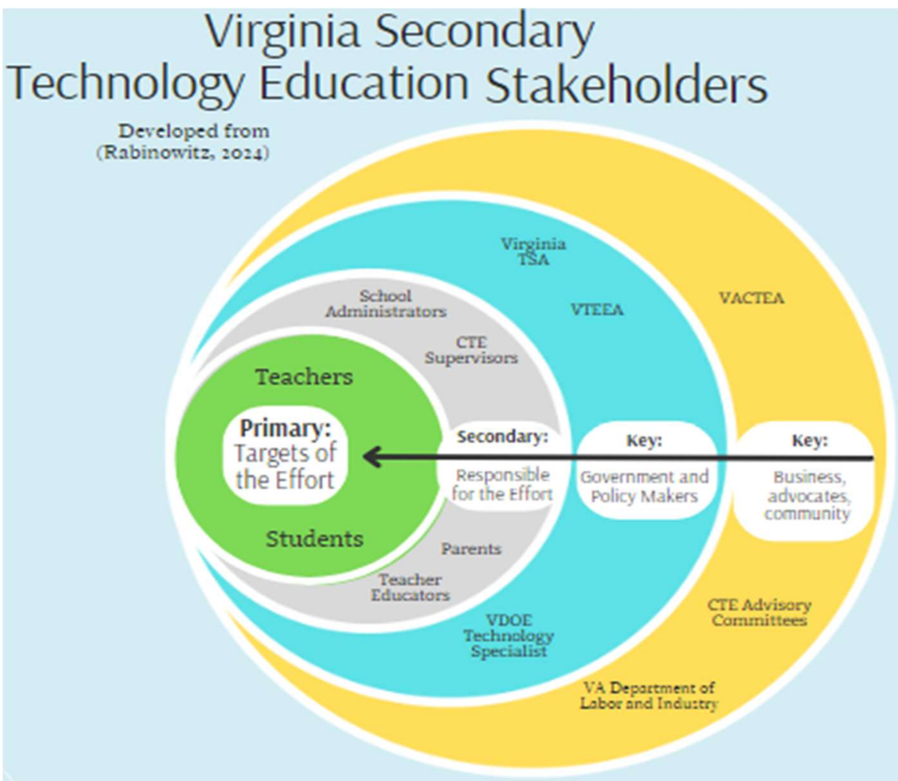
Making Research a Priority

Data collection is an integral part of research. Research helps politicians make decisions about the organization of educational systems, assessments, funding, and curriculum content. A national school board for education was established in 1838 for gathering statistics but Congress abolished the department a year later (Stallings, 2002). Between 1908 and 1975, the formation of a national department of education was introduced in Congress through more than 130 bills (Stallings, 2002). In 1979, President Carter signed a law creating the department. The first secretary of education had six months to set up the department of education by the law (Stallings, 2002). The current mission of the department highlights four topics which include establishing policies, collecting data, focusing the nation on educational issues, and prohibiting discrimination (USDOE, 2023). The Office of Career, Technical, and Adult Education (OCTAE) answers to the Undersecretary of Education. The OCTAE's mission is to administer Perkins, provide assistance to states to improve CTE, and establish national initiatives to help states (USDOE, 2023). In Virginia, data about technology education is collected twice during the school year using the CTERS system. Using this data to create recommendations is imperative to informing politicians, parents, and educators. The following recommendations are suggested to improve communication and data availability in Virginia:

1. The Virginia Department of Education Technology Education Specialist should meet with technology education professionals annually to provide information about current trends and advise on the direction of future research for the discipline.
2. The CTE Resource Center should provide a workshop on how to access, interpret, and use CTERS data for the purpose of research in the discipline.
3. The VTEEA should provide free conference registration for any undergraduate or graduate students who are accepted to present a session about research.
4. The VTEEA should create a foundation which includes all technology education stakeholders, see Figure 18, to meet annually to discuss needs for research, applications of current research, and political impacts in the discipline. The first task of this foundation should be the creation of a repository specific to the discipline.

Figure 18

Technology Education Stakeholders



Education Matters

Epistemology, pedagogy, and assessments are the key to creating a strong discipline (Knight et al., 2014). Technology education teachers have challenges that other teachers do not experience due to the components illustrated in the *Technology Education Triad,* seen in Figure 2. Alternative licensing is imperative to fill positions due to the closures of technology education post-secondary programs as shown in Litowitz (2014). The following recommendations were made to aid the discipline and create opportunities for teachers who did not have the benefit of a traditional four-year teacher training program.

1. Subject matter training should be offered by the VDOE during the school year at least once a month. This training could be offered in the format of in-person classes, podcasts, or a video channel.
    a. The training should be taught by technology education experts.
    b. The training should focus on technology education topics such as: classroom management for experiential learning, safety and providing active learning opportunities for physically challenged students, interpreting and accommodating IEPs, equipment and machine maintenance, the history of technology education, the importance of educational research, and discipline for an active classroom.
    c. The Technology Education Specialist should send a memo to principals requesting time be allotted during professional development to attend and interact with the training.
2. Old Dominion University should offer a technology and engineering endorsement certificate for teachers similar to University of San Diego's STEAM Teaching for Tomorrow's Innovators Certificate (2024). An endorsement such as San Diego's online

STEAM certificate program could provide learning opportunities for experienced and novice teachers and provide a way for teachers to increase their pay. Additional endorsements in Virginia such as the Library Media Add-On endorsement from UVA-Wise allow teachers to enrich their knowledge base as well as possibly adding to their paycheck (2024). The endorsement would include courses that focus on technology education pedagogy, epistemology, and assessments.

3. The VTEEA should explore alternative forms of communication to inform teachers of learning opportunities such as mailing calendars or bimonthly postcards to technology teachers, creating online content which provides “fun” and informative details about the profession, or developing a social media account to make a visual calendar of learning opportunities.
4. A week-long professional development workshop for “new to the field” technology teachers should be sponsored by the VDOE during the first week of October. The workshop should be taught by a technology education post-secondary teacher focusing on the history of technology education, epistemology, pedagogy, and assessment. The VTEEA should provide a week of lesson plans that focus on the STEL. The workshop should be hosted at Virginia universities that have post-secondary technology teacher programs.

Simplification and Clarification

Several factors were found to be sources of confusion for the research. The use of program areas and career clusters has not been found to be cohesive. The Virginia Administrative Code, the VDOE, and the CTE Resource Center do not categorize their information with the same organizational structure. Creating a simpler and more accessible system would streamline access to program goals and help alleviate frustrations for teachers. The following are recommendations for the simplification and clarification of technology education programs:

1. A committee of technology education experts (e.g., Virginia ITEEA teacher or program of the year winners, post-secondary technology teacher educators, parents of Virginia TSA state officers, Virginia TSA state officers, members of the VTEEA Board of Directors, and the Technology Education Specialist) should be created by the VDOE. The committee should meet for at least four times to gather information about the field in Virginia, including the *Technology Education Triad* (Figure 2), learn about current research and funding for programs, and develop recommendations. The VDOE should charge the committee to provide a plan to eliminate courses which focus on the artefact and develop a streamlined set of courses for secondary technology education. The committee would continue to meet annually with an off-set rotation of members semi-annually to continue to serve and support the needs of the discipline.
2. Courses in technology education should focus on the epistemology of the discipline instead of machines or artifacts. The VTEEA should review the courses offered in Virginia and provide recommendations on how to simplify courses in the discipline.
3. The VDOE should provide a workshop on how to meet and focus on industry connections.
4. The VTEEA should invite stakeholders from the Virginia Department of Industry and Labor to present about career opportunities in Virginia at their annual conference.

5. The VDOE should work diligently to clarify the organization of courses and program objectives. The VDOE should use career pathways to organize information and program areas to organize teacher information.
6. The SCED codes should be reinstated to a 12-digit code. The codes should be organized by program area for teacher use. The Virginia Assignment Codes should be eliminated. A crosswalk document should be created for schools to understand the transference to the 12-digit code.

Safety

Student safety should be a priority in all schools. OSHA regulations state that laboratory space should be limited when using a laboratory space. "The Occupant Load Factor of the NFPA 101 Life Safety Code specifies that all 'labs, shops, and other vocational spaces' (National Fire Protection Association, 2024, p. 101-85) (e.g., STEM, CTE, and makerspace areas) in schools must provide 50 net square feet per occupant" (Love et al., 2024, p. 54). In Virginia, some courses are limited in class size but not all technology education courses are limited. Based on safety concerns, the following recommendations are offered to protect students and teachers in technology education classrooms:

1. The VDOE should make a recommendation of limited class size based on tools and machines in the laboratory instead of courses.
2. The VDOE CTE Director or representative should make a presentation to the Virginia Association of Secondary School Principals (VASSP) annual conference about safety regulations in CTE courses.
3. The VTEEA should coordinate with the VDOE special education programs to provide a disability themed conference. The conference should feature a Virginia TSA student with

disabilities as a guest speaker as well as a legal representative about compliance with special needs and experiential learning opportunities. Parents should be invited to give their perspective of the opportunities in electives for special needs students. Representatives from William & Mary Law School's Special Education Advocacy Clinic should be asked to present their work in special education law and the use of tools in classrooms.

4. The VTEEA should coordinate with VASSP to provide a conference themed on student discipline, teacher responsibilities, and administrative support. The VASSP should provide information about discipline techniques that can prevent administrative intervention. An educational lawyer from the Continuing Legal Education (CLE) sponsored by the Virginia Law Foundation should be asked for a keynote address about discipline and safety laws in the secondary classroom.
5. The VDOE should make safety a priority. The program area goals should include a goal about providing a safe environment for students. The VDOE website should have a section which focuses on safety including research on safety, a safety regulations slide show, safety regulations pertaining to the technology education laboratory, and learning opportunities for safety. The VDOE should sponsor a safety learning opportunity bi-monthly.

FUTURE RESEARCH

Research can inform the discipline of the needs of secondary technology education teachers. While this research focused on teacher needs, further research could inform the practitioner about epistemological, pedagogical, and assessment issues. The following are recommendations for further research questions to gather more information about the needs of secondary technology teachers:

1. What are the needs of post-secondary technology education teacher educators?
2. What factors make an effective professional development activity for technology educators?
3. How do secondary technology education teachers use their time?
4. How does experiential learning affect student achievement?
5. What are the different problem solving methods in STEM and how do they affect the learning process?
6. What support is provided for secondary technology education teachers by administrators, paraprofessionals, and school staff and how does it affect student achievement?
7. How has the epistemology changed throughout the evolution of the discipline?

The incorporation of the recommendations and research suggestions could create important changes to support secondary technology education teachers. Teachers who are supported have higher achieving students (Yoon et al, 2007). The trifold model has been used in many technology education frameworks as seen in Figure 5. Modelling research and recommendations around the *Technology Education Triad* in Figure 2 can create specificity to the discipline which would guide future endeavors for the improvement and achievement of students.

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APPENDICES

APPENDIX A: SURVEY

Survey of Technology Teachers in Virginia

The purpose of this introductory page is to give you information that may affect your decision whether to say YES or NO to participation in this research, and to record the consent of those who say YES. Click here to find out more details concerning the research study, benefits, risks, compensation, and confidentiality.

Purpose of Research: To gather information about Virginia technology education programs, teachers, laboratories, and instruction in secondary schools in order to inform the public about teacher's needs and desires.

Voluntary Consent:
By clicking "I agree" on this form, you are saying several things. You are saying that you read this form or have had it read to you, that you are satisfied that you understand this form, the research study, and its risks and benefits. The researcher should have answered any questions you may have about the research. If you have any questions later on, then the researcher should be able to answer them: M Kathleen Ferguson, 804-641-7605.

If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. Tancy Vandecar-Burdin, the current IRB chair, at 757-683-3802, or the Old Dominion University Office of Research, at 757-683-3460.

And importantly, **by clicking "I agree" below, you are telling the researcher YES, that you agree to participate in this study.**

* Indicates required question

1. Do you agree to the terms as stated above and want to voluntarily participate in this research study and are you currently teaching technology education in Virginia? *

   Mark only one oval.

   ◯ I agree and I teach technology education in Virginia.

   ◯ No, I am unable to complete this survey.

About your school

Directions: Complete the following questions regarding your technology education classes, laboratory, and instruction. The survey should take about 15 minutes. Please answer the following questions about your school and facilities.

2. 1. At what school(s) do you teach? *

   This information will be used to access demographic information about your school.

   ____

3. 2. In which county or city does your school resides? *

Mark only one oval.

- ◯ Regional School
- ◯ Private School
- ◯ Accomack
- ◯ Albemarle
- ◯ Alexandria
- ◯ Alleghany
- ◯ Amelia
- ◯ Amherst
- ◯ Appomattox
- ◯ Arlington
- ◯ Augusta
- ◯ Bath
- ◯ Bedford
- ◯ Bland
- ◯ Botetourt
- ◯ Bristol
- ◯ Brunswick
- ◯ Buchanan
- ◯ Buckingham
- ◯ Buena Vista
- ◯ Campbell
- ◯ Caroline
- ◯ Carroll
- ◯ Charles City
- ◯ Charlotte
- ◯ Charlottesville
- ◯ Chesapeake
- ◯ Chesterfield
- ◯ Clarke
- ◯ Colonial Heights
- ◯ Covington
- ◯ Craig
- ◯ Culpeper
- ◯ Cumberland
- ◯ Danville
- ◯ Dickenson
- ◯ Dinwiddie
- ◯ Emporia

- Essex
- Fairfax
- Fairfax City
- Falls Church
- Fauquier
- Floyd
- Fluvanna
- Franklin County
- Franklin-City
- Frederick
- Fredericksburg
- Galax
- Giles
- Gloucester
- Goochland
- Grayson
- Greene
- Greensville
- Halifax
- Hampton
- Hanover
- Harrisonburg
- Henrico
- Henry
- Highland
- Hopewell
- Isle Of Wight
- James City
- King And Queen
- King George
- King William
- Lancaster
- Lee
- Lexington
- Loudoun
- Louisa
- Lunenburg
- Lynchburg
- Madison
- Manassas
- Manassas Park

- Martinsville
- Mathews
- Mecklenburg
- Middlesex
- Montgomery
- Nelson
- New Kent
- Newport News
- Norfolk
- Northampton
- Northumberland
- Norton
- Nottoway
- Orange
- Page
- Patrick
- Petersburg
- Pittsylvania
- Poquoson
- Portsmouth
- Powhatan
- Prince Edward
- Prince George
- Prince William
- Pulaski
- Radford
- Rappahannock
- Richmond County
- Richmond-City
- Roanoke County
- Roanoke-City
- Rockbridge
- Rockingham
- Russell
- Salem
- Scott
- Shenandoah
- Smyth
- Southampton
- Spotsylvania
- Stafford

- Staunton
- Suffolk
- Surry
- Sussex
- Tazewell
- Virginia Beach
- Warren
- Washington
- Waynesboro
- Westmoreland
- Williamsburg
- Winchester
- Wise
- Wythe
- York
- Other

4. 3. Total number of technology education <u>teachers</u> at your school (including you).

Check all that apply.

	0	1	2	3	4	5	6 or more
Part-time	☐	☐	☐	☐	☐	☐	☐
Fulll-time	☐	☐	☐	☐	☐	☐	☐

5. 4. What grade levels do you teach? *

Check all boxes that apply.

Check all that apply.

- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10
- ☐ 11
- ☐ 12
- ☐ Other: ______________________

6. 5. How many students did you teach last school year? *

Mark only one oval.

- This is my first year teaching
- 1-25
- 26-50
- 51-75
- 76-100
- 101-125
- 126-150
- 151-175
- 176 or more

7. 6. How long is your current teaching contract? *

Mark only one oval.

- Not on contract currently
- Long-term Substitute
- 7 months or less
- 8 months
- 9 months
- 10 months
- 11 months
- 12 months

About your professional experience

The following questions pertain to your training for teaching.

8. 1. Highest degree earned *

Mark only one oval.

- No degree
- Associate's
- Bachelor's
- Master's
- Doctor's

9. 2. What was your degree major? *

____

10. 3. If you have a degree in **education**, what was your concentration?

11. 4. Course hours *

Check the approximate number of semester hours you earned (graduate and undergraduate) for each of the following areas. Please estimate using the conversion: 3 semester hours is 1 class, if you took classes on a quarterly system.

Check all that apply.

	0-6	7-10	11-30	31-40	41-50	51 or more
Education (such as curriculum, methods, student teaching...)	☐	☐	☐	☐	☐	☐
Engineering	☐	☐	☐	☐	☐	☐
Mathematics	☐	☐	☐	☐	☐	☐
Science	☐	☐	☐	☐	☐	☐
Technical (such as Manufacturing or CADD)	☐	☐	☐	☐	☐	☐
All others (such as English or History)	☐	☐	☐	☐	☐	☐

12. 5. Did you have formal teacher training prior to entering the classroom? *

Check all that apply.

- ☐ No
- ☐ Content specific classes in technology education
- ☐ Content specific classes in CTE
- ☐ Education courses from a community college
- ☐ Education courses from a university
- ☐ Training from the Department of Education
- ☐ Training from the school district
- ☐ Training from a professional conference
- ☐ Other: ____________________

13. 6. What is your total years of experience teaching technology education (specifically) ? *

Mark only one oval.

- First year
- 1-3 years
- 4-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21 years or more

14. 7. What is your total years of experience in industry ? *

Mark only one oval.

- No more than 6 months of experience
- 1-3 years
- 4-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21 years or more

15. 8. What type of teaching certification do you currently hold? *

Mark only one oval.

- None
- Career and Technical Education-Technology Education
- Collegiate Professional
- International Educator
- One-Year High School
- Online Teacher
- Postgraduate Professional
- Provisional
- School Manager
- Teach for America
- Technical Professional
- Other

About your classes

The following questions pertain to what you teach and how you spend your time at school.

16. 1. *In your opinion*, what degree of emphasis should be placed on the following purposes of technology education in your school? For students to develop an understanding of... *

Mark only one oval per row.

	No emphasis	Low emphasis	Medium emphasis	High emphasis
application of STEM	⬭	⬭	⬭	⬭
career training	⬭	⬭	⬭	⬭
consumer knowledge of products	⬭	⬭	⬭	⬭
creative thinking	⬭	⬭	⬭	⬭
general technical knowledge and skills	⬭	⬭	⬭	⬭
problem solving skills	⬭	⬭	⬭	⬭
skills in the use of tools and machines	⬭	⬭	⬭	⬭
technical culture and impact on society	⬭	⬭	⬭	⬭
worthy leisure-time interests	⬭	⬭	⬭	⬭

17. 2. What courses do you teach?

Please use state course codes where possible.

____

18. 3. What source(s) are used to determine instructional content in your technology education course? *
Please check your MAIN source of content.

Check all that apply.

- [ ] None
- [ ] Guide prepared by yourself
- [ ] Local School District Guide
- [ ] NAEP-TEL
- [ ] Next Generation Science Standards
- [ ] Virginia Standards of Learning in Science
- [ ] Standards for Technological and Engineering Literacy
- [ ] Standards for Technological Literacy
- [ ] VERSO
- [ ] Other: ____________________

19. 4. Please rate your current instructional focus on the following topics in your classes overall.

Mark only one oval per row.

	1 little focus (once a semester)	2	3	4	5 teach every day
Career pathways	◯	◯	◯	◯	◯
Computational thinking	◯	◯	◯	◯	◯
Emerging technology	◯	◯	◯	◯	◯
Problem solving	◯	◯	◯	◯	◯
Safety	◯	◯	◯	◯	◯
Systems thinking	◯	◯	◯	◯	◯
Tools and machines	◯	◯	◯	◯	◯
TSA	◯	◯	◯	◯	◯
Workplace Readiness Skills	◯	◯	◯	◯	◯

20. 5. What non-technology education specific classes do you teach? *
Check all that apply.

Check all that apply.

- [ ] None
- [ ] Art
- [ ] Career Skills (Citizenship)
- [ ] Driver's Education
- [ ] English
- [ ] Financial Literacy (General Business)
- [ ] Mathematics
- [ ] Physical Education
- [ ] Science
- [ ] Social Studies
- [ ] Trade and Industrial Education
- [ ] Other: ______________________

21. 6. How did your non-technology education specific classes affect your technology education classroom experience? *

Mark only one oval.

- ( ) Distracts from my teaching
- ( ) Has no effect
- ( ) Improves me as a teacher
- ( ) Supports my classroom

22. 7. In which of the following duty areas, did you have responsibility this year? *
Check all that apply.

Check all that apply.

- [ ] None
- [ ] Afterschool Club
- [ ] Coach for Athletics
- [ ] Concessions or Student Book Store
- [ ] Field Trips
- [ ] First Robotics
- [ ] Homeroom
- [ ] School Newspaper/ Journal/Yearbook
- [ ] Student Council
- [ ] Student Competitions that are not co-curricular
- [ ] Supervise School Grounds (bus or lunch duty)
- [ ] Technology Student Association (TSA)
- [ ] Other: ______________________

23. 8. How did your duty area responsibilities affect your technology education classroom experience? *

Mark only one oval.

- Distracts from my teaching
- Has no effect
- Improves me as a teacher
- Supports my classroom

Your instruction

The following questions pertain to how you deliver your instructional content.

24. 1. *Since beginning your career*, which significant changes have you made for your students to improve their technology education classroom experience? *

Choose YOUR top 2 significant changes

Check all that apply.

- No significant changes occurred
- This is my first year teaching
- Certifications were offered with end of course assessments
- Developed a mentorship program
- Dual enrollment course(s) were offered
- Implemented a student competitive experience
- Integrated instruction with other educators
- Integrated STEM or STEAM
- Made major revisions to course instruction by changing assessments
- Made major revisions to course instruction by changing projects
- Made major revisions to course instruction by changing teacher delivery method
- New course(s) were offered
- Other: ______________________

25. 2. Since you began your teaching career, which factor was the MOST influential cause of change in your teaching methods? *

Mark only one oval.

- No changes occurred
- This is my first year
- Attended a conference
- College course
- Input from a colleague
- Professional development offered by local school district
- Professional development offered by Virginia Department of Education
- Professional development offered by VTEEA
- Research and development on my own

26. 3. Indicate your level of comfort with TEACHING the following core concepts of technology. *

Mark only one oval per row.

	Not course competency	Not taught	Not comfortable	Need to learn more	Very comfortable
Applying, maintaining, and assessing technological products and systems	◯	◯	◯	◯	◯
Core concepts of technology and engineering	◯	◯	◯	◯	◯
Design in technology and engineering education	◯	◯	◯	◯	◯
History of technology	◯	◯	◯	◯	◯
Impacts of technology	◯	◯	◯	◯	◯
Influence of society on technological development	◯	◯	◯	◯	◯
Integration of knowledge, technologies, and practices	◯	◯	◯	◯	◯
Nature and characteristics of technology and engineering	◯	◯	◯	◯	◯

27. 4. What instructional areas do you teach?

Check all that apply.

	Not taught	Teach for 2 weeks or more	Need to learn more
3D Printing	☐	☐	☐
Agricultural technologies	☐	☐	☐
Artificial Intelligence	☐	☐	☐
Biotechnology	☐	☐	☐
Construction	☐	☐	☐
Drafting	☐	☐	☐
Electronics	☐	☐	☐
Energy and power	☐	☐	☐
Engineering	☐	☐	☐
Graphic arts	☐	☐	☐
Laser engraving	☐	☐	☐
Leather work	☐	☐	☐
Manufacturing	☐	☐	☐
Materials and Processes	☐	☐	☐
Mathematics concepts	☐	☐	☐
Medical and health-related technologies	☐	☐	☐
Metal working	☐	☐	☐
Nanotechnology	☐	☐	☐
Plastics	☐	☐	☐
Photography	☐	☐	☐
Power mechanics	☐	☐	☐
Problem Solving	☐	☐	☐

Robotics	☐	☐	☐
Scientific concepts	☐	☐	☐
Tooling and machines	☐	☐	☐
Transportation and logistics	☐	☐	☐
Wood working	☐	☐	☐

About your challenges

The following questions pertain to areas which you may desire more knowledge.

28. 1. What is your level of difficulty with the following epistemology issues? *

Choose your top issue

Mark only one oval per row.

	No struggle	Some struggle	Lots of struggle	Not applicable to my classes
Acquiring adequate training in technology education content	⬭	⬭	⬭	⬭
Compliance with School/ District/ State policies	⬭	⬭	⬭	⬭
Creating a positive and safe classroom culture	⬭	⬭	⬭	⬭
Integration of state CTE competencies	⬭	⬭	⬭	⬭
Ordering supplies and equipment	⬭	⬭	⬭	⬭
Providing career information for students	⬭	⬭	⬭	⬭
Repairing and maintaining equipment	⬭	⬭	⬭	⬭
Securing appropriate instructional resources such as textbooks	⬭	⬭	⬭	⬭
Teaching workplace readiness skills	⬭	⬭	⬭	⬭
Understanding how to teach concepts of STEL	⬭	⬭	⬭	⬭

29. 2. What is your level of difficulty with the following assessment issues? *

Choose your top issue

Mark only one oval per row.

	No struggle	Some stuggle	Lots of struggle	Not applicable for my classes
Developing relevant assessments	⬭	⬭	⬭	⬭
Disciplining students	⬭	⬭	⬭	⬭
Finding and preparing students for appropriate certifications	⬭	⬭	⬭	⬭
Funding competitive student activities	⬭	⬭	⬭	⬭
Maintaining competency records	⬭	⬭	⬭	⬭
Marketing your program	⬭	⬭	⬭	⬭
Providing relevant industrial experiences	⬭	⬭	⬭	⬭
Safety contracts and documentation	⬭	⬭	⬭	⬭
Serving my professional community	⬭	⬭	⬭	⬭
Working with your CTE advisory committee	⬭	⬭	⬭	⬭

30. 3. What is your level of difficulty with the following pedagogy concepts? *

Mark only one oval per row.

	No struggle	Some struggle	Lots of struggle	Not applicable for my classes
Acquiring and teaching with new instructional technology	◯	◯	◯	◯
Balancing family and extracurricular activities	◯	◯	◯	◯
Collaborating with peers	◯	◯	◯	◯
Creating equitable lessons and activities	◯	◯	◯	◯
Finding adequate preparation time for activities	◯	◯	◯	◯
Funding professional teacher conferences	◯	◯	◯	◯
Integration of co-curricular student competition activities	◯	◯	◯	◯
Providing learning experiences for students with special needs	◯	◯	◯	◯
Providing students with leadership opportunities	◯	◯	◯	◯
Teaching students how to work in teams	◯	◯	◯	◯

teams
to work in
teams

31. 4. How do you provide students with the MAJORITY of supplies needed in your class? *

Mark only one oval.

- A lab fee is charged for all students
- A lab fee is charged based on student's family income
- Fundraising by the student organization
- PTA provides funding
- Students pay for what they use
- Supplies are furnished by an outside business sponsor
- Supplies are furnished by the CTE department
- Supplies are furnished by the school
- Supplies are furnished by the school district general fund
- The school provides some supplies free but the student pays for any projects they take home

32. 5. What is the most pressing educational issue for you as a technology education teacher? *

33. 6. What content specific professional development activity do you need to become a better teacher? *

APPENDIX B: VDOE REQUEST TO COMPLETE SURVEY

To: Lynn Basham <lynnbasham76@gmail.com>, Lynn Basham <lynn.basham@doe.virginia.gov>

Lynn:
Could you please send the email below through the Virginia Tech Ed Listserv? Feel free to change as needed. I have only collected 42 data points and I need 298.
Thank you soooo much!
-Kathleen

---------- Forwarded message ---------
From: **Ferguson, Kathleen** <mkfergus@odu.edu>
Date: Thu, Jun 8, 2023 at 1:28 PM
Subject: Help me, Help YOU!
To: FERGUSON, KATHLEEN <mferg010@odu.edu>

Questions with solid fill

What: Participate in a research study by completing the survey at https://forms.gle/LyUy8tFmaLqmdQZR7

Why: To create data that will identify the needs and desires of technology teachers in Virginia

How: Approximately 15 minutes to complete the survey

Who: Technology and engineering education teachers in Virginia

Why: After you complete the survey, you can connect to a link to receive a free technology education lesson!

What: Complete the 30 multiple choice questions and 2 open-ended questions survey

When: NOW or by the end of the week

Why: Once this research is complete, the results will be presented at my dissertation defense after which my doctorate will be conferred which is open to the public.

Questions: Contact me at 804-641-7605 or by email.

Thank you very much for considering participation in this study.

My best,

Kathleen

M. Kathleen Ferguson
Adjunct Professor | STEM Education and Professional Studies
Old Dominion University
4101-A EDUCATION BLDG
NORFOLK, VA 23529
Phone: 804-641-7605
Email: mkfergus@odu.edu
https://www.odu.edu/academics/programs/undergraduate/technology-education

2 attachments

APPENDIX C: VTEEA REQUEST TO COMPLETE SURVEY

OLD DOMINION UNIVERSITY

ODU: Kathleen Ferguson <mferg010@odu.edu>

survey dissemination
1 message

ODU: Kathleen Ferguson <mferg010@odu.edu> Wed, Jun 28, 2023 at 11:02 AM
To: Ray Wu-Romer <wuromem@fccps.org>

Good morning, Ray:
Could you please send my survey to the technology teachers in constant contact? I requested Lynn to send it 2 weeks ago but she has not been able to do it. Expedience would be greatly appreciated. Also, I have a second request that I will send to you in 2 weeks. (I realize this time of year sucks for emails but I'm chugging along anyway.) See below for the email.

----
subject: Free Technology Education Lesson

Hello Technology Education Teacher:

PLEASE HELP! I am a technology education researcher who is conducting a survey on Virginia technology education programs, teachers, laboratories, and instruction in secondary schools. The purpose of this research is to identify the needs and desires of technology teachers in Virginia. I would like to invite you to participate in this research study by completing the survey through the link provided (https://tinyurl.com/TechEdResearch). The survey will take approximately 15 minutes to complete (30 multiple choice questions and 2 open-ended questions). *After you complete the survey, you can connect to a form to receive a free technology education lesson!*

Survey of Technology Teachers in Virginia
forms.gle

The introductory page of the survey provides important information about the research study, its purpose, benefits, risks, compensation, and confidentiality. Your participation in this study is voluntary, and you may choose to withdraw at any time without penalty. I would like to emphasize that your responses will be anonymous and confidential. The information you provide will only be used for research purposes, and no identifying information will be included in the study results.

Your participation in this survey is vital to the success of this research study, and it will greatly contribute to the improvement of technology education programs and instruction in Virginia. I would greatly appreciate it if you could complete the survey by Friday, July 14, as it would allow us to move forward with our research. Once this research is complete, the results will be presented at my dissertation defense after which my doctorate will be conferred.

In order to limit responses to the form without collecting personal information, the form requires a google account sign in. If you do not have a google account, please email me for a pdf version of the form for completion. For questions or concerns about this research study, please feel free to contact me at M Kathleen Ferguson, 804-641-7605, or by email at mferg010@odu.edu.

Thank you very much for considering participation in this study. I look forward to your response.

Best regards,

Kathleen

M. Kathleen Ferguson
PhD Candidate | Adjunct Professor | STEM Education and Professional Studies
Old Dominion University
4101-A EDUCATION BLDG
NORFOLK, VA 23529
Phone: 804-641-7605
Email: mkfergus@odu.edu
https://www.odu.edu/academics/programs/undergraduate/technology-education
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M. Kathleen Ferguson
Graduate Teaching Instructor
Occupational and Technical Studies
Old Dominion University
New Education Building, room 4100
Norfolk, VA 23529

APPENDIX D: QR CODE REQUEST FOR VTEEA CONFERENCE

APPENDIX E: CTE DIRECTOR REQUEST TO COMPLETE SURVEY

Ferguson, Kathleen K.

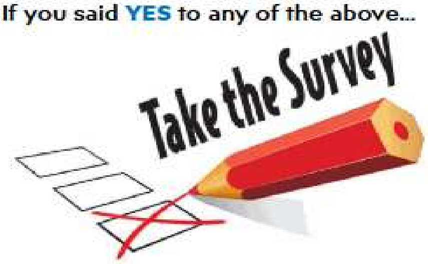
From:	Ferguson, Kathleen
Sent:	Friday, November 17, 2023 4:40 PM
Subject:	Please help an ODU CTE student send out a survey

Dear CTE Director:
Please send the message below the line to your technology and engineering teachers. I am currently pursuing my PhD at Old Dominion University. This survey is a component of my dissertation. Completion of this survey will allow me to report on the needs of technology teachers in Virginia to provide more relevant resources and professional development. Your help in getting this survey to technology and engineering education teachers would help me immensely and be greatly appreciated.

Dear Technology and Engineering Education Teachers:

- ✓ Have you ever sat through a professional development that was *irrelevant* to you?
- ✓ Is the process of getting your teacher license confusing?
- ✓ Do you want more relevant resources from universities, the Department of Education, and your professional organization?
- ✓ Do you have issues in teaching technology that YOU want addressed?!?

If you said **YES** to any of the above...



Or click this link: https://forms.gle/LyUyStPmaLqmdQZR7

The survey has 30 multiple choice questions with 2 open ended questions. My research is collecting data to determine the needs of technology teachers in Virginia. I will be presenting this research to get my PhD, to teacher organizations, and to the state department of education. Please help me determine what YOU need to become successful in your classroom so I can tell the people who create the workshops, licenses, and curriculum for you.

If you have questions, contact me at 804-641-7605 or by email.

Thank you for making my research a success.
You are AWESOME!!
-Kathleen

M. Kathleen Ferguson
PhD Candidate | STEM Education and Professional Studies
Old Dominion University
4101-A EDUCATION BLDG
NORFOLK, VA 23529
Phone: 804-641-7605

https://www.odu.edu/academics/programs/undergraduate/technology-education

1

APPENDIX F: MODIFICATIONS OF SCHMITT AND PELLEY SURVEY

Modification of the Schmitt and Pelley Survey (S&PS)

	S&PS Questionnaire #	Current Survey	Modification
	Front matter	1.1	Consent and identification as technology education teacher in VA
Demographics			
School name	[1]P1, P2, P3, P4	2.1	Name of school provides access to online data for document review
County or City of your school	Added	2.2	To clarify schools with duplicate names
# of IA labs	P5	2.3	Changed to teachers instead of programs due to focus on teachers instead of labs
How many students	[2]T17	2.5	Separated into smaller questions
Length of teaching contract	Added	2.6	Contract lengths vary since this may affect amount of time available for specialized PD
RQ 1: Educational background			
Highest degree earned	T3	3.1	No change
Degree major	Added	3.2	Open-ended question
Concentration in education degree	Added	3.3	Open-ended question
Semester hours earned for degree	T4	3.4	No change
Formal training prior to teaching	Added	3.5	Educators can have non-education degrees
Years of experience in teaching	T7	3.6	No change
Total years of industrial experience	T19	3.7	No change
Teaching certificate	T2	3.8	Updated using 8VAC20-23-50
RQ 2: Goals			
Course code, % theory, % lab work, length of class, how many male/ female students	T17	2.4, 4.2	% theory, % lab work, length of class, how many male/ female students removed Grade level, #students taught, course codes
Purpose of program in your school	P6, T1	4.1	No changes
Curriculum guide	T11	4.3	No changes
Instructional focus	T18	4.4	Added STEL core disciplinary standards and practices, added career pathways, certifications,

[1] The questions from the Schmitt & Pelley principal's survey have a P designation.
2 The questions from the Schmitt & Pelley teacher's questionnaire have a T designation.

			computational thinking, engineering, finance, problem solving, safety, tools and machines, TSA, and workforce readiness skills
Non-Industrial Arts classes taught	T9	4.5	
RQ 3: Issues			
How teaching non-TE classes affect classes?	Added	4.6	
Responsibilities	T8	4.7	Added administrative aide, bus driver, bus duty, and department chair, changed school club into afterschool club, changed IA club to TSA (co-curricular), changed IA contests to Technology Education Competitions (not co-curricular)
How do responsibilities affect classes?	Added	4.8	
Significant changes in classes	T15	5.1	No changes
Factor caused change		5.2	
Level of comfort teaching concepts		5.3	
Level of comfort in instructional areas		5.4	
Major struggle with content	Added	6.1	
Major struggle with how to teach	Added	6.2	
Major struggle with how to assess	Added	6.3	
Source of Supplies	T14	6.4	No changes
Teaching problems	T16	6.5	Made open ended
Professional development needed	Added	6.6	Made open ended
Deleted Questions			
Requirement of IA for elementary student graduation	P7	deleted	Not relevant to research questions
IA Compulsory	P8	deleted	Not relevant to research questions
IA substituted for science	P9	deleted	Not relevant to research questions
Money spent on IA	P10	deleted	Not relevant to research questions
Work experience program	P11	deleted	Not relevant to research questions
Names of IA teachers	P12	deleted	Not needed for confidentiality reasons
Gross salary	T5	deleted	Not relevant to research questions
Income from teaching vs. non-teaching jobs	T6	deleted	Not relevant to research questions

Ability of students	T10	deleted	Not relevant to research questions
Teaching methods at beginning of class	T12	deleted	Not relevant to research questions
Teaching methods for new students	T13	deleted	Not relevant to research questions

APPENDIX G: IRB APPROVAL LETTER

OLD DOMINION UNIVERSITY

OFFICE OF THE VICE PRESIDENT FOR RESEARCH

Physical Address
4111 Monarch Way, Suite 203
Norfolk, Virginia 23508
Mailing Address
Office of Research
1 Old Dominion University
Norfolk, Virginia 23529
Phone(757) 683-3460
Fax(757) 683-5902

DATE:	June 12, 2023
TO:	Philip Reed
FROM:	Old Dominion University Education Human Subjects Review Committee
PROJECT TITLE:	[2061054-1] A Review of Technology Education Teacher Needs in Virginia
REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	
REVIEW CATEGORY:	Exemption category #2

Thank you for your submission of New Project materials for this project. The Old Dominion University Education Human Subjects Review Committee has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact John Baaki at (757) 683-5491 or jbaaki@odu.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Old Dominion University Education Human Subjects Review Committee's records.

APPENDIX H: CONSENT FORM

INFORMED CONSENT DOCUMENT
OLD DOMINION UNIVERSITY

PROJECT TITLE: **A REVIEW OF TECHNOLOGY EDUCATION TEACHER NEEDS IN VIRGINIA**

INTRODUCTION
The purposes of this form are to give you information that may affect your decision whether to say YES or NO to participation in this research, and to record the consent of those who say YES. **Purpose of Research**: To gather information about Virginia technology education programs, teachers, laboratories, and instruction in secondary schools in order to inform the public about teacher's needs and desires.

RESEARCHERS
Hello! My name is M. Kathleen Ferguson and I am working on my dissertation in Occupation and Technical Studies with an emphasis in Technology Education at Old Dominion University. The principal investigator of this research is Dr. Philip A. Reed (preed@odu.edu).

DESCRIPTION OF RESEARCH STUDY
Several studies have been conducted looking into the needs of classroom teachers. None of them have explained the trends and needs for technology and engineering education teachers across the Commonwealth of Virginia. Technology education helps students develop their technological literacy. Due to the changing nature of technology, it is important to review the needs of technology teachers and create professional development opportunities to meet these needs. The survey is being sent to public school secondary technology teachers in the Commonwealth of Virginia to obtain data to help stakeholders determine funding, workshops and possible opportunities for curriculum development.

If you decide to participate, then you will join a study involving the research of professional development needs technology and engineering teachers. If you say YES, then your participation will last for the 15 minutes used to answer this online survey. Approximately, 275 out of 1,000 technology teachers will be participating in this study.

EXCLUSIONARY CRITERIA
You should be teaching technology education in a Virginia school. To the best of your knowledge, you should not be teaching a subject other than secondary technology and engineering students that would keep you from participating in this study.

RISKS AND BENEFITS
RISKS If you decide to participate in this study, then you may have a risk of computer fatigue. The researcher tried to reduce these risks by making the survey concise and succinct. And, as with any research, there is some possibility that you may subject to risks that have not yet been identified.

BENEFITS: The main benefit to you for participating in this study is the development of new professional development opportunities. Others may benefit by developing knowledge about *Standards for Technological and Engineering Literacy* (ITEEA, 2020).

COSTS AND PAYMENTS
The researchers want your decision about participating in this study to be voluntary. Yet they recognize that your participation may pose some inconvenience. The researchers are unable to give

you any payment for participating in this study. The researchers will provide a link to a complimentary lesson plan specific to technology education.

NEW INFORMATION

If the researchers find new information during this study that would reasonably change your decision about participating, then they will give it to you.

CONFIDENTIALITY

The researchers will take reasonable steps to keep private information confidential such as your school's name and opinions. The researchers will remove identifiers from all identifiable private information collected. The data collected from the surveys will be downloaded from the google form after collection and placed on a separate USB device. The subject's information will not be used or distributed for future research studies even if the identifiers are removed. The results of this study may be used in reports, presentations, and publications; but the researchers will not identify you. Of course, your records may be subpoenaed by court order or inspected by government bodies with oversight authority.

WITHDRAWAL PRIVILEGE

It is OK for you to say NO. Even if you say YES now, you are free to say NO later, and walk away or withdraw from the study -- at any time. Your decision will not affect your relationship with Old Dominion University, or otherwise cause a loss of benefits to which you might otherwise be entitled.

COMPENSATION FOR ILLNESS AND INJURY

If you say YES, then your consent in this document does not waive any of your legal rights. However, in the event of harm arising from this study, neither Old Dominion University nor the researchers are able to give you any money, insurance coverage, free medical care, or any other compensation for injury. In the event that you suffer injury as a result of participation in any research project, you may contact Dr. Philip Reed at 757-683-4576, Dr. John Baaki, DCEPS IRB Chair, jbaaki@odu.edu, 757-683-5491, or the Old Dominion University Office of Research at 757-683-3460 who will be glad to review the matter with you.

VOLUNTARY CONSENT

By signing this form, you are saying several things. You are saying that you have read this form or have had it read to you, that you are satisfied that you understand this form, the research study, and its risks and benefits. The researchers should have answered any questions you may have had about the research. If you have any questions later on, then the researchers should be able to answer them:
Dr. Philip A. Reed, 757-683-4576
M. Kathleen Ferguson, 804-641-7605.

If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. John Baaki, DCEPS IRB Chair, jbaaki@odu.edu, 757-683-5491, or the Old Dominion University Office of Research, at 757-683-3460.

And importantly, by signing below, you are telling the researcher YES, that you agree to participate in this study. The researcher should give you a copy of this form for your records.

Subject's Printed Name & Signature	**Date**
Parent / Legally Authorized Representative's Printed Name & Signature (If applicable)	**Date**

INVESTIGATOR'S STATEMENT

I certify that I have explained to this subject the nature and purpose of this research, including benefits, risks, costs, and any experimental procedures. I have described the rights and protections afforded to human subjects and have done nothing to pressure, coerce, or falsely entice this subject into participating. I am aware of my obligations under state and federal laws and promise compliance. I have answered the subject's questions and have encouraged him/her to ask additional questions at any time during the course of this study. I have witnessed the above signature(s) on this consent form.

Investigator's Printed Name & Signature	**Date**

APPENDIX I: FREE LESSON PLAN FORM

Technology Education Lesson

Thank you for completing the survey of technology teachers in Virginia. Your time to complete the survey will not only help improve training and support for technology education teachers, this work will also help me on my journey to finish my doctorate. In appreciate for your help, I would like to research and share a technology lesson for you. These lessons will be open source and may or may not be created by me. I may or may not have not taught these lessons. This offer is meant to bring new ideas to your curriculum and provide you with free research so that you can have more time to complete future surveys. Please complete this form for your free technology education lesson.
*indicates required question

Email* ______________________

Your name* ______________________

Grade level *

Mark only one oval.

0 6
0 7
0 8
0 9
0 10
0 11
0 12
0 other...

Length of lesson *

Mark only one oval.

0 15 minutes   0 30 minutes   0 45 minutes   0 60 minutes

For this course... *

____

Instructional Area*

Mark only one oval.

0 3D Printing
0 Agricultural technology
0 Artificial Intelligence
0 Biotechnology
0 Career pathways
0 Computational thinking
0 Construction
0 Drafting
0 Electronics
0 Emerging technology
0 Energy and power
0 Engineering
0 Graphic arts
0 Laser engraving
0 Leather working
0 Manufacturing
0 Nanotechnology
0 Plastics
0 Photography
0 Power mechanics
0 Problem solving
0 Robotics
0 Safety
0 Scientific concepts
0 Systems thinking
0 Tooling and Machining
0 Transportation LJTSA
0 Woodworking
0 Workplace readiness skills

My students have access to *

Check all that apply.

D CAD or some equivalent
D computers
D drafting equipment
D electronics
D hand tools
D power tools
D printers
D robotics

Purpose of lesson *

Mark only one oval.

0 Independent work
0 Individual work
0 Introduction of concepts
0 Groupwork
0 Use with a substitute

Other concerns*

APPENDIX J: TECHNOLOGY EDUCATION COURSE CODES

SCED Code	Course Code/VA Assignment Code	Course Description
21149	8438	Advanced Drawing & Design
21019	8428	Aerospace Engineering (PLTW)
21055	8487	Aerospace Technology I
21055	8488	Aerospace Technology II
21015	AC8479	App Creators (PLTW)
21103	8437/ 8492	Architectural Drawing/Design
21015	AR8476	Automation and Robotics (PLTW)
21049	8467	Biomedical Engineering
21999	8468	Biotechnology Foundations in Technology Education
21021	8430	Civil Engineering and Architecture (PLTW)
11002	8415/ 8418	Communication Systems
21022	8442	Computer Integrated Manufacturing (PLTW)
21015	CS8479	Computer Science for Innovators and Makers (PLTW)
17002	8431/ 8432	Construction Technology
13002	8499	Cybersecurity in Manufacturing
13002	8496	Cybersecurity in Manufacturing, Advanced
21015	DM8476	Design and Modeling (PLTW)
21023	8440	Digital Electronics (PLTW)
11153	8459	Digital Visualization
17106	8416/ 8417	Electronics Systems I
17106	8412	Electronics Systems II
17106	8413	Electronics Systems III
20101	8448/ 8495	Energy and Power
21015	EE8479	Energy and the Environment (PLTW)
20901	ED8411	Energy Demand: Sustainability and Efficiency
20903	LC8411	Energy Source Life Cycle
20901	ES8411	Energy Supply: Sustainability and Efficiency
20902	TD8411	Energy Transmission and Distribution, Advanced
20903	EES8411	Engineered Energy Systems
21016	8451	Engineering Analysis and Applications II
10019	8449	Engineering Computer Science
21005	8452	Engineering Concepts and Processes III
21007	8443	Engineering Design and Development (PLTW)
21106	8436/ 8493	Engineering Drawing and Design

21006 or 21026	8906	Engineering Essentials (PLTW)
21005	8450	Engineering Explorations I
21047	8453	Engineering Practicum IV
21002	8491	Engineering Studies
21024	8911	Environmental Sustainability (PLTW)
05056	8489	Entertainment Design and Technology
21015	FS8479	Flight and Space (PLTW)
15055	8409	Forensic Technology
20904	FP8411	Fundamentals of Power Generation
10205	8400	Game Design and Development
10205	8401	Game Design and Development, Advanced
21058	8423	Geospatial Technology I
21058	8424	Geospatial Technology II
20151	8419	Global Logistics and Enterprise Systems I
20151	8422	Global Logistics and Enterprise Systems II
11155	8458/ 8494	Graphic Communications Systems
21015	GA8479	Green Architecture (PLTW)
11054	8474/ 8455	Imaging Technology
03206	IB4585	IB Design Technology I
03206	IB4586	IB Design Technology II
20902	IT8411	Introduction to Energy Transmission and Distribution
21017	8439	Introduction to Engineering Design (PLTW)
21051	8480/ 8481/ 8482/ 8483/ 8484	Introduction to Technology and Engineering
21099	8454/ 8456/ 8464/8461/ 8485	Inventions and Innovations
21015	ME8479	Magic of Electrons (PLTW)
13002	8425/ 8426	Manufacturing Systems I
13002	8427	Advanced Manufacturing Systems II
13052	8433/ 8478	Materials and Processes Technology
21015	MD8479	Medical Detectives (PLTW)
21015	8460	Modeling & Simulation Technology
20102	8444/ 8445	Power & Transportation
20904	PG8411	Power Generation Design and Function
21018	8441	Principles of Engineering (PLTW)
03153	9811	Principles of Technology I
03153	9812	Principles of Technology II
13101	8446/ 8447	Production Systems
17105	8408	Renewable Energy
21015	ST8479	Science of Technology (PLTW)

10015	8470	Software Engineering (PLTW)
10015	8473	Software Engineering Essentials (PLTW)
21053	8414	Sustainability and Renewable Technologies
21901	8410	Technology Awareness
21101	8434/ 8435	Technical Drawing/Design
21001	8477/ 8457/ 8486/ 8463/ 8462	Technological Systems
21054	8406/ 8407	Technology Assessment
13099	8471	Technology Education--Development
13099	8469	Technology Education--Preparation
21003	8402/ 8403	Technology Foundations
21009	8420/ 8421	Technology of Robotic Design
21052	8404/ 8405	Technology Transfer
20905	8910	Unmanned Aircraft Systems
20905	8912	Unmanned Aircraft Systems, Advanced
11055	8497	Video and Media Technology

Notes:

SCED codes in bold are used for more than 1 course.

Course names in red are not listed on the VDOE Technology Education page.

APPENDIX K: COURSE LISTING DISCREPANCIES

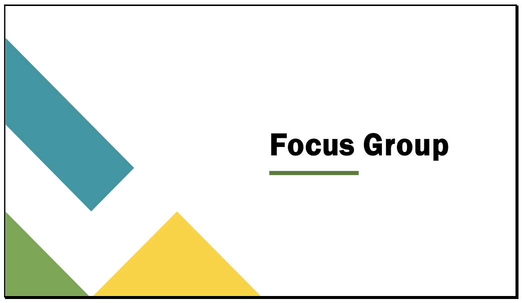
Courses NOT listed in the Technology Education Career Clusters as indicated at https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/career-and-technical-education-cte/cte-program-areas

Course Number	Course Name Identified in 2022-2023 Course Listing for Technology Education*	CTE Resource Center Listed Career Cluster
8428	Aerospace Engineering (PLTW)	Transportation, Distribution & Logistics
8487	Aerospace Technology I	Transportation, Distribution & Logistics
8488	Aerospace Technology II	Transportation, Distribution & Logistics
8437/8492	Architectural Drawing and Design	Architecture & Construction
8430	Civil Engineering and Architecture (PLTW)	Architecture & Construction
8415/8418	Communication Systems	Arts, Audio/Video Technology and Communications
8442	Computer Integrated Manufacturing (PLTW)	Manufacturing
8431/8432	Construction Technology	Architecture & Construction
8499	Cybersecurity in Manufacturing	Manufacturing
8496	Cybersecurity in Manufacturing, Advanced	Manufacturing
8459	Digital Visualization	Arts, Audio/Video Technology and Communications
8489	Entertainment Design and Technology	Arts, Audio/Video Technology and Communications
8400	Game Design and Development	Arts, Audio/Video Technology and Communications
8401	Game Design and Development, Advanced	Arts, Audio/Video Technology and Communications
8423	Geospatial Technology I	Information Technology
8424	Geospatial Technology II	Transportation, Distribution & Logistics
8419	Global Logistics and Enterprise Systems I	Transportation, Distribution & Logistics
8422	Global Logistics and Enterprise Systems II	Transportation, Distribution & Logistics
8458/8494	Graphic Communications Systems	Arts, Audio/Video Technology and Communications
8474/8455	Imaging Technology	Arts, Audio/Video Technology and Communications
8425/8426	Manufacturing Systems I	Manufacturing
8427	Manufacturing Systems II, Advanced	Manufacturing
8433/8478	Materials and Processes Technology	Manufacturing
8444/8445	Power and Transportation	Transportation, Distribution & Logistics
8446/8447	Production Systems	Manufacturing
(NEW)	Unmanned Aircraft Systems (New)	Transportation, Distribution & Logistics
8497	Video and Media Technology	Arts, Audio/Video Technology and Communications

*Retrieved from https://www.doe.virginia.gov/home/showpublisheddocument/10028/638029143257830000

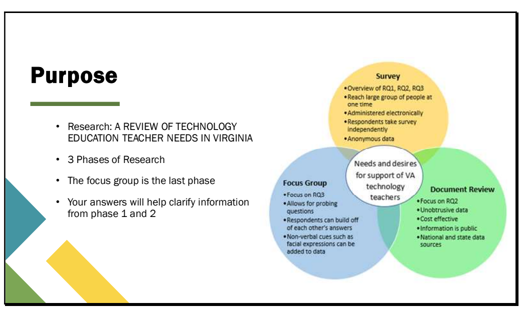
APPENDIX L: FOCUS GROUP SLIDE SHOW

Slide 1



Slide 2

Slide 3



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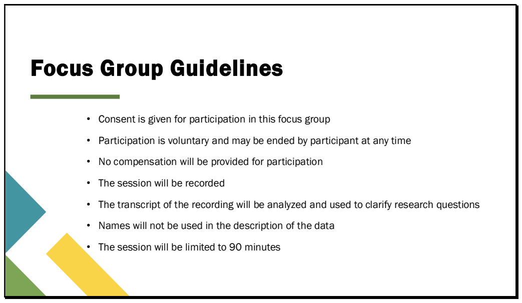

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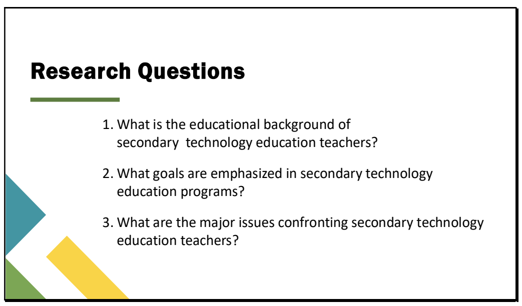

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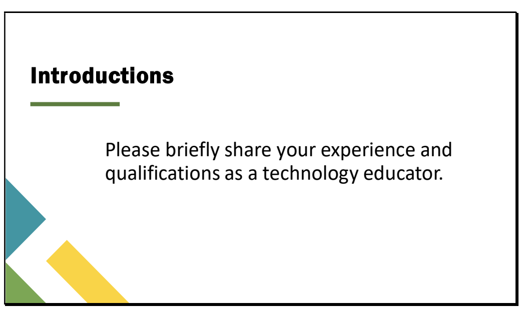

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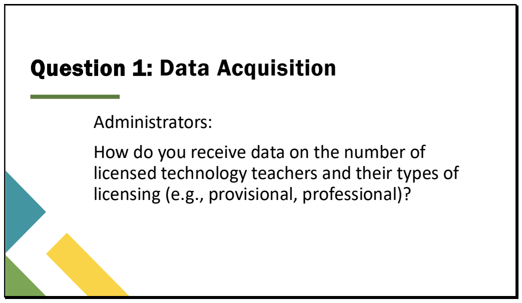

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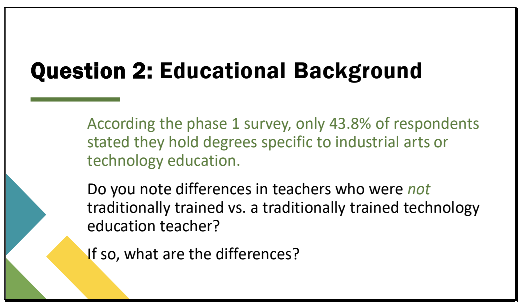

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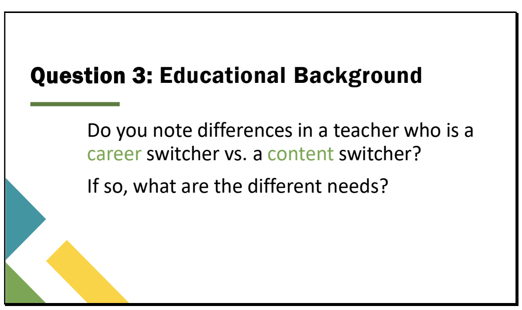

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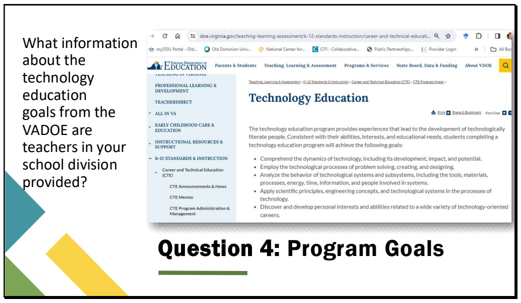

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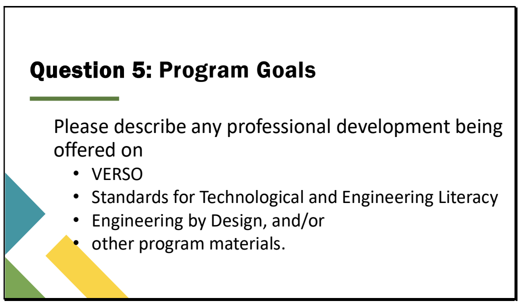

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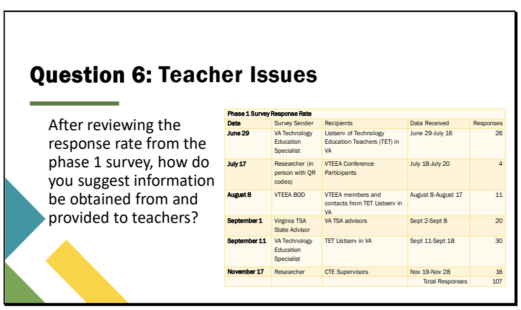
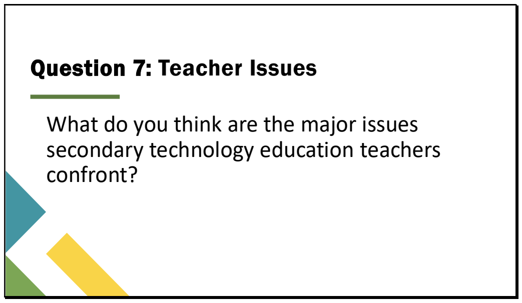


Phase 1 Survey Response Rate

Date	Survey Sender	Recipients	Data Received	Responses
June 29	VA Technology Education Specialist	Listserv of Technology Education Teachers (TET) in VA	June 29-July 16	26
July 17	Researcher (in person with QR codes)	VTEEA Conference Participants	July 18-July 20	4
August 8	VTEEA BOD	VTEEA members and contacts from TET Listserv in VA	August 8-August 17	11
September 1	Virginia TSA State Advisor	VA TSA advisors	Sept 2-Sept 8	20
September 11	VA Technology Education Specialist	TET Listserv in VA	Sept 11-Sept 18	30
November 17	Researcher	CTE Supervisors	Nov 19-Nov 28	16
			Total Responses	107

Slide 13



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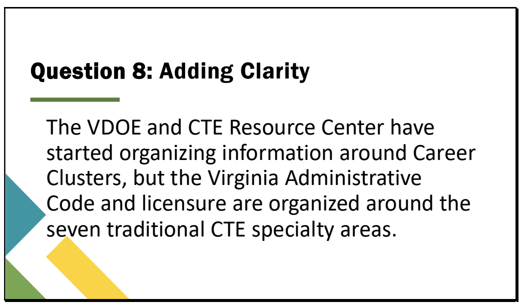

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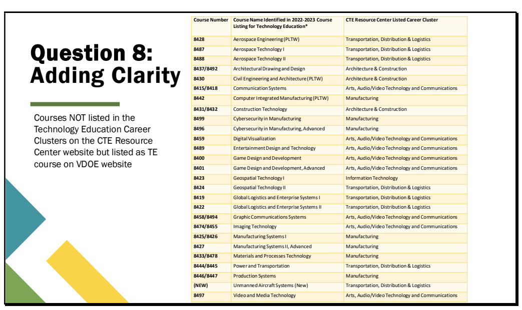

Course Number	Course Name Identified in 2022-2023 Course Listing for Technology Education*	CTE Resource Center Listed Career Cluster
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8489	Entertainment Design and Technology	Arts, Audio/Video Technology and Communications
8400	Game Design and Development	Arts, Audio/Video Technology and Communications
8401	Game Design and Development, Advanced	Arts, Audio/Video Technology and Communications
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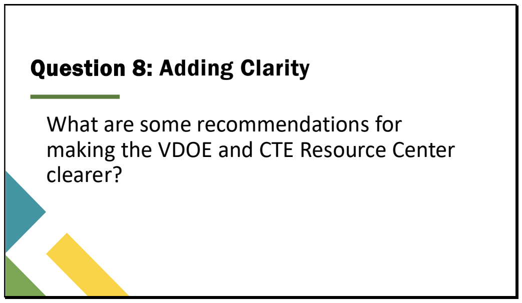
8424	Geospatial Technology II	Transportation, Distribution & Logistics
8419	Global Logistics and Enterprise Systems I	Transportation, Distribution & Logistics
8422	Global Logistics and Enterprise Systems II	Transportation, Distribution & Logistics
8458/8494	Graphic Communications Systems	Arts, Audio/Video Technology and Communications
8474/8455	Imaging Technology	Arts, Audio/Video Technology and Communications
8425/8426	Manufacturing Systems I	Manufacturing
8427	Manufacturing Systems II, Advanced	Manufacturing
8433/8478	Materials and Processes Technology	Manufacturing
8444/8445	Power and Transportation	Transportation, Distribution & Logistics
8446/8447	Production Systems	Manufacturing
(NEW)	Unmanned Aircraft Systems (New)	Transportation, Distribution & Logistics
8497	Video and Media Technology	Arts, Audio/Video Technology and Communications

Slide 16



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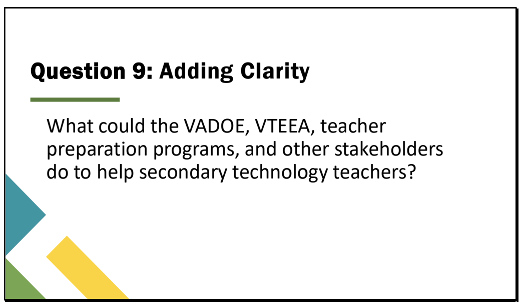

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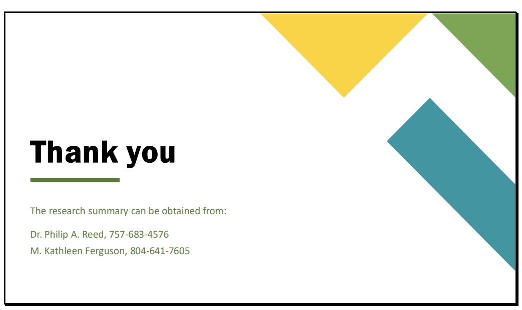

VITA

EDUCATION

Old Dominion University
PhD in Education 2024
Area of Concentration: Technology Education

Clemson University
Master's in Industrial Technology Education 1992
Area of Concentration: Industrial Education
Thesis: "The definitive guide to hosting a regional Technology Education Collegiate Association (TECA) Conference"

Virginia Polytechnic Institute
BS in Education 1991
Area of Concentration: Technology Education

TEACHING EXPERIENCE

Instructor – OLD DOMINION UNIVERSITY 2017 - present
STEM 110, STEM 251, STEM 370, SEPS 400
Introduction to Technology (110), Computer Literacy: Communication and Information (251), Technology and Society (370), Instructional Systems Development (400)

Shop Supervisor – OLD DOMINION UNIVERSITY 2023 - present
Theater Arts

Instructor and Department Chair -- CARVER COLLEGE AND CAREER ACADEMY 2015 – 2017
Principles of Technology 1 &2, Construction Technology

Instructor and Department Chair-- TUCKAHOE MIDDLE SCHOOL 2010 - 2015
Journalism, Inventions and Innovations, Intro to Engineering

Instructor – MOUNT VERNON MIDDLE SCHOOL 2008 - 2010
Technological Systems, Intro to Technology, Inventions and Innovations

Instructor – NEW BRIDGE MIDDLE SCHOOL 2007 - 2008
Intro to Technology, Intro to Greenhouse, Children's Engineering

Instructor – THOMPSON MIDDLE SCHOOL 2004 - 2007
Gateway to Technology (Project Lead the Way)

PUBLICATIONS

Reed, P. A. and Ferguson, M. K. (2021). Safety training for career and content switchers. *Technology and Engineering Teacher (80)* 7, 16-19.

Ferguson, K. (2019). The leader's guide to emotional agility: How to use soft skills to get hard results. *Journal of Technology Education (31)* 1, 63-65.

Ferguson, K. and Reed, P. A. (2018). Old Dominion University TEECA Students and Faculty Participate at the TEECA Eastern Regional Conference. *Technologize,* Winter Newsletter of the Virginia Technology and Engineering Education Association.

REFEREED CONFERENCE PROCEEDINGS

Ferguson, K. (Presenter and Co-Author) and Reed, P. A. (Presenter and Co-Author). (2023). *A Review of Technology Education Needs in Virginia.* Paper presented at the 1st 1909 Conference. Nashville, TN.

Ferguson, K. (Presenter and Co-Author) and Reed, P. A. (Presenter and Co-Author). (2019). *How can career switchers and teachers without formal training be quickly prepared to teach engineering and technology education?* Paper presented at the 106th Mississippi Valley Technology Teacher Education Conference. Nashville, TN.

Ferguson, K. (2013). *How to integrate hands-on technology into class activities.* Paper presented at the Metropolitan Educational Research Consortium (MERC) Conference. Richmond, VA.