106th Mississippi Valley Technology Teacher Education Conference
57th Southeastern Technology Education Conference

Nashville, Tennessee

How Can Career Switchers and Teachers without Formal Training be Quickly Prepared to Teach Engineering and Technology Education?

Session IV: Teacher Preparation

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November 14-15, 2019

Abstract

Old Dominion University (ODU) provides a six-hour, hands on workshop to train technology education teachers in design-based learning, production laboratory safety, and laboratory management. The teachers are provided with information about technology education content and pedagogy as well as safety contracts, legal liability, and machine use and maintenance. Teachers in this workshop learn (or update) important laboratory safety procedures and tool skills through instruction, demonstrations, and an active learning project.

The workshop is co-hosted by the ODU Technology Education Program and the Virginia Technology and Engineering Education Association (VTEEA). Three workshops have been held and program interest is increasing. The first workshop had 10 attendees while the second had 20 with a waiting list of 15 teachers. The third workshop was hosted by Arlington public schools and had nine teachers. A new program comprising of six, two-hour sessions is being conducted with Virginia Beach City Public Schools. Professional Development points are provided through the Virginia Department of Education. The teachers are provided materials and instruction on professionalism, ethics, and professional organization involvement.

Keywords: Virginia technology teacher education, career switcher, design-based learning, laboratory safety, career and technical education, STEM education

How Can Career Switchers and Teachers without Formal Training be Quickly Prepared to Teach Engineering and Technology Education?

There are tremendous shifts occurring in the preparation of technology and engineering teachers. Although Volk stated in 1997, "the demise of the technology teacher preparation programs will occur around the year 2005" (p. 26) the profession continues to exist, but teacher preparation programs have diminished. An analysis of the 2002-2003 *Industrial Teacher Education Directory* compared teacher preparation programs with over 20 students to the 2012-2013 *Technology & Engineering Teacher Education Directory* yielded a loss of 40% during the ten-year span (Litowitz, 2014). These visions of demise and the declining trendlines are cause for concern and forcing adaptations in the way technology and engineering teachers are recruited, certified, and trained.

When discussing the teacher shortage, it is imperative to understand how teachers become certified to teach technology and engineering education. Each state is responsible for the teacher certification process independent of national norms or requirements. The process of certification varies from state to state with most states offering several pathways for certification and training. The focus of this paper will be on technology education teacher certification in Virginia and a workshop to aid career and teaching discipline switchers. Virginia has two methods of certification: approved collegiate programs leading to licensure and alternative routes to licensure.

Approved programs are institutions of higher education that offer state-approved teacher preparation programs. Currently, out of the 37 institutions of higher education that offer state-approved teacher preparation programs, Virginia's sole source for an undergraduate technology education degree is at Old Dominion University (ODU) in Norfolk. By law, all state universities in Virginia have two-year community college articulation agreements that provide pathways for students of varying programs to transfer into four-year degree programs (SCHEV, 2010). In order to become trained as a technology education teacher through the approved program process, a student in Virginia would need to attend ODU for four years or attend a community college and transfer to ODU for two years. A plan is currently in the works to provide a distance learning option to service the entire state and to more clearly identify community college programs such as engineering technology that provide a smoother transition to ODU's technology education program.

In the 1990's, Virginia had multiple universities with approved technology teacher preparation programs but most closed due to low enrollment and retiring faculty. This has been a national trend in technology education (Moye, 2009; Litowitz, 2014) and emulates broader teacher preparation trends. According to the Title II Higher Education Act 2018 Reports, the traditional pathway for all teacher preparation has gone from 3,602 in 2014-2015 to 2,976 in 2016-2017 which indicates a 17% decline over three years (National Teacher Preparation Data, 2018). These teacher preparation trends have led Virginia to establish alternative routes to teacher licensure and school divisions are increasing the number of alternatively licensed teachers.

Alternative routes to licensure are set forth by the Virginia Administrative Code, Chapter 23: Licensure Regulations for School Personnel (Commonwealth of Virginia, 2019). 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 in which they are transferring. Virginia also has reciprocity with most states that allows an out-of-state teaching license to be accepted in Virginia. In 2016, the number of alternative licenses completed was 396 which was 12% of all teacher programs completed (National Teacher Preparation Data, 2018). This is an increase from 2014-2015 when alternative licenses represented 10% of all completed teacher preparation programs.

While alternative licensure provides pathways for educators to become certified in technology education, certain skills are not learned during the process. Put another way, alternative licensure programs *certify* individuals to become teachers, but it does not guarantee that they are *qualified*. Discipline specific history, epistemology, and laboratory safety and maintenance require extensive training in technology education. Courses in alternative licensure focus on broader education and classroom management techniques. For example, courses for ODU's Career Switcher program include School Law, Communicating with Stakeholders, and Behavior Management (Old Dominion University, 2019). The courses do not focus on topics specific to technology education. Large school districts in Virginia such as the City of Virginia Beach and Fairfax County have begun their own safety and equipment training programs for technology education teachers who are career or teaching discipline switchers.

It was clear that this lack of disciplinary grounding was an issue after extensive discussions with school division teachers and administrators, as well as participants at the annual Virginia Technology and Engineering Education Association (VTEEA) conference. Many teachers admitted that they were not using tools to engage students in design-based learning because they did not know how. Seeing this need, the ODU technology education program partnered with the VTEEA and Virginia DOE Technology Education Specialist to develop a six-hour workshop to aid teachers who are certified in technology education but do not have the formal grounding provided through an approved technology teacher preparation program. The workshop was run in November 2018 and February 2019 at Old Dominion University. A summer workshop was held at Arlington Technical Center in June 2019 and a December 2019 session is scheduled at Old Dominion University.

Registration Process

A call for participants was distributed through the VTEEA Constant Contact list as well as in the monthly announcements from the Technology Education Specialist at the Virginia Department of Education (VDOE). Interested participants were asked to email workshop organizers and then each person was provided a google form link. The google form requests demographic information such as teaching experience and degree. The form also gives information about logistics (i.e. lunch, parking) and informs the participant that further information will be provided one week prior to the event.

One week prior to the event, an email is sent to each participant that describes 1) safety protocol including required clothing, footwear and hair, 2) parking information, 3) directions into the building, and 4) the nature of the workshop (active learning). The instructors' cell phone numbers were included if further information was needed once on site. A reminder of the start and end times were included. The length of the workshop was set by the Virginia DOE for participants to qualify for professional development points. Professional development points are required for recertification in Virginia.

Workshop Content

The workshop was designed to introduce teachers to the history, epistemology, curriculum, and production laboratory safety through discussion, active participation, and interactions with peers. The workshop involved classroom and production lab components. The production lab equipment included tools and equipment for woods, metals, ceramics, and composites but only basic hand tools (e.g. measuring tools, saws, hammers, etc.) needed for the workshop were introduced. Future workshops will expand hand tool instruction and teaching support materials. Additionally, the Technology Education Specialist at the Virginia DOE had identified specific power tools (i.e. table saw, band saw, combination sander, router table, drill press, compound miter saw, and wood lathe) to be covered in the workshop. The complete schedule is listed in Figure 1.

9:00am	Introductions, experience, and logistics
9:30am	A brief history and philosophy of technology and engineering education
10:00am	Virginia's technology education curriculum (http://cteresource.org/about/) and professional organizations (TSA, VTEEA, and ITEEA)
10:30am	Safety website overview (https://sites.google.com/odu.edu/odutechedsafety/home)
11:00am	Power tool demonstration instructions with observation rubrics
11:30am	Information on general lab organization, cleanliness, and maintenance
12:00pm	Lunch
12:30pm	Machine use activity*
2:30pm	PD points, words of wisdom, and conclusion

Please note: The active project in this course focuses on safety, not design-based learning. The sole purpose of these activities is to teach tool and machine safety. Technology education lessons provide deep learning when they are open ended and focus on the problem or design process instead of the tools and machines.

Figure 1: Technology and Engineering Education Workshop Agenda

The morning provided for introductions and an overview. Most participants had backgrounds as engineers, designers, scientists, or were teachers from various other disciplines so time was spent discussing a brief history of the field. Workshop leaders felt it was important for participants to understand the epistemological development of the field from manual training to industrial arts to technology education, and finally technology and engineering education. After learning the field's pragmatic teaching approach, participants were introduced to *Standards for Technological Literacy* (ITEEA, 2007) and how technology education fits within general education, career and technical education (CTE), and science, technology, engineering, and mathematics (STEM) education (Reed, 2017, 2018).

In Virginia technology education fits under CTE so it is cross walked to, but not based on, Virginia's Standards of Learning (SOL). The Virginia General Assembly funds the Career and Technical Education Resource Center (see: http://cteresource.org/about/) which lists the programs, courses, competencies, and other resources for technology education and the other six CTE disciplines. Participants were briefly introduced to the CTE Resource Center as the primary tool for developing lessons and tracking student progress. Additional resources are on the Virginia Department of Education, Technology Education web page: http://www.doe.virginia.gov/instruction/career_technical/technology/index.shtml

The morning session included an overview of the Old Dominion University Technology Education Lab Safety Website (Ferguson, 2019). Figure 2 shows the main page and menu of this website which includes the workshop agenda, demonstrations, regulations, machine nomenclature, online safety tests, traditional safety tests, and additional materials. The site was developed to link to materials from reputable sources rather than re-creating materials. Plans to expand the site include more information on hand tools as well as laboratory organization and management. The site can be accessed here and we would appreciate your comments: https://sites.google.com/odu.edu/odutechedsafety/home.

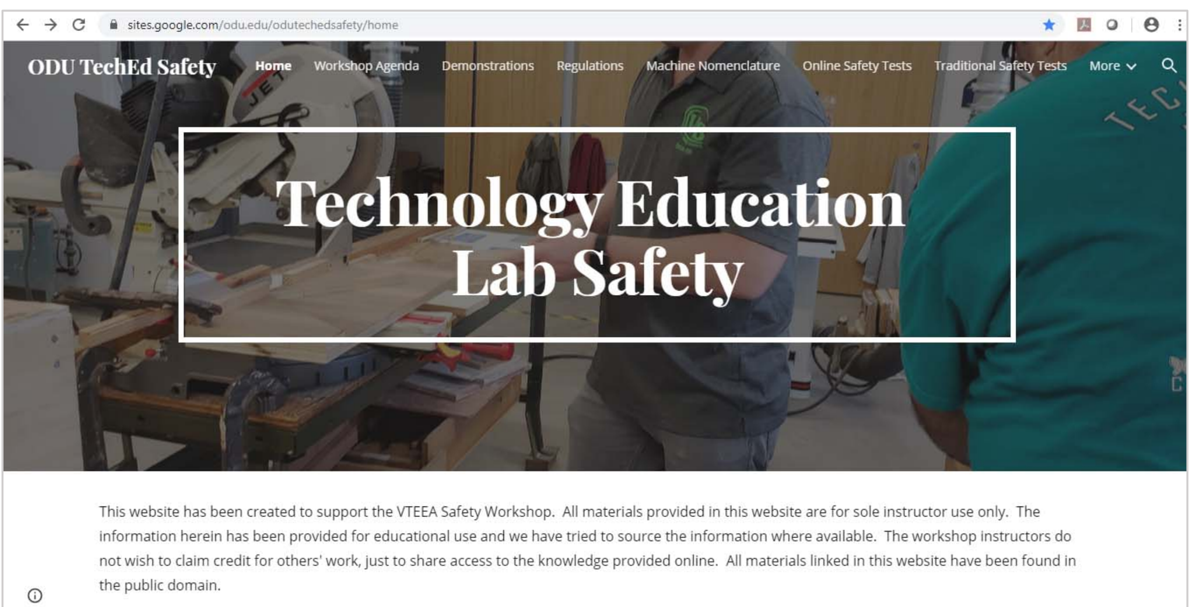

Figure 2: The Old Dominion University Technology Education Laboratory Safety Website (Ferguson, 2019)

Career and technical education student organizations (CTSO's) are co-curricular in Virginia so workshop organizers impressed upon participants that Technology Student Association (TSA) activities should be incorporated throughout technology education programs, not as an after-school activity. A model for using the TSA leadership structure to manage a laboratory was introduced (see the ODU Safety Website under the *More* tab, *Lab Management* link). Participants were also shown the Virginia TSA and national TSA websites. Additionally, participants were charged with active participation in their primary professional associations: the VTEEA (https://www.vteea.org/) and the International Technology and Engineering Educators Association (ITEEA; https://www.iteea.org/). Virginia is an Engineering by Design™ (EbD™) consortium member so the process of accessing EbD™ materials through ITEEA and Virginia's CTE Resource Center Director was explained.

The final activity in the morning was to demonstrate safe use of the tools that where identified by the Technology Education Specialist at the Virginia DOE (i.e. table saw, band saw, combination sander, router table, drill press, compound miter saw, and wood lathe). Participants were provided checklists for each machine so they could follow the demonstrations. These safety checklists are on the ODU Safety Website under the *More* tab, *Resources* link. Scrap material was provided to encourage participants to perform the demonstrated operations. In several of the workshops, experienced teachers were paired with novice teachers to facilitate learning.

The working lunch allowed participants to share their experiences that led them to teaching. Many participants indicated that they were drawn to teaching for the altruistic nature of the profession and the teachers that had switched disciplines overwhelmingly claimed it was the authentic, engaging teaching methods in technology education that made them eager to switch. Additionally, many teachers that switched disciplines did not like being tied to the Virginia SOL's and felt that technology education provided more academic freedom. The authors are working on institutional review board (IRB) approval to follow up on this anecdotal evidence through surveys and other research methods.

The afternoon was spent using the machines to build a wooden toolbox. Workshop organizers deliberately selected a project with the intent of fostering safe machine use and confidence with participants (see http://www.woodworkingcorner.com/toolcaddy.php). The processes used to build the toolbox included layout, drilling, crosscutting, ripping, routing, assembling, and nailing. The opportunity was taken to reiterate the philosophy of design-based learning in technology and engineering education (see note in Figure 1) so some minor changes were added to the project. The participants had to use 1/8" lauan plywood for the bottom and secure it inside a blind dado. These changes caused participants to alter the layout and machining to create the tool caddy. There were also discussions on creating jigs and fixtures as well as determining the best tools and processes for each operation.

The workshop concluded with a review of the goals and activities. Participants were provided information on obtaining professional development (PD) verification from the Technology Education Specialist at the Virginia DOE. Finally, participants were once again charged with professional engagement in TSA, VTEEA, and ITEEA to continue learning about technology and engineering education's focus on design-based learning.

Conclusions

The profession of technology education continues to have a semantics issue with the rise of STEM education, PK-12 engineering, makerspaces, and other programs that continue to define and use technology in diverse ways. Perhaps this ambiguity has contributed to the decline of technology teacher preparation programs and fostered the increase in career and teaching discipline switchers in technology education. The workshops highlighted here are an attempt to orient career and teaching discipline switchers to the specific history, epistemology, and laboratory safety, use, and maintenance in technology education. There are severe limitations in attempting to cover so much in a six-hour workshop. Technology and engineering teachers require extensive training in order to implement design-based learning. These workshops are not ideal and, at best, are a compromise to the teacher certification climate that exists in Virginia.

Similar trends may exist in other states which may prompt similar workshops. Materials needed for the workshop are minimal and the project selected should insure success and confidence for even the most novice participant. The workshop should not exceed 20 participants with two instructors and accommodations should be made for instructional technology and Wi-Fi access so resources can be accessed and discussed. The *doing* part of the workshop will only be successful if the history, pedagogical, and professional connections to the discipline are clear. Funding for our workshops was acquired from several locations (i.e. university, DOE). Whenever possible, such an effort for career and teaching discipline switchers should include teacher educators, the state department of education, the state professional associations (e.g. TSA, VTEEA), ITEEA, and some experienced technology teachers. Building these collaborations may not provide a return to historical models of teacher education or professional development but they can certainly strengthen the technology and engineering education community and lead to opportunities for new directions.

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