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Technology Education: Pertinent academic discipline to the 21st century learner

Session 1: Content, Method, and New Directions

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Abstract

In 2018, there questions about relevancy of a Technology Education degree. Technology Education may be deemed archaic as it is stigmatized by its predecessors, Vocational and Industrial Education. In modern Technology Education, there is education and training of the technological categories (e.g. Manufacturing Technology, Information Technology, Construction Technology, etc.) and sub-categories (e.g. Automotive Technology, Computer Application Technology, Design Technology, etc.) to help students better understand limitless technological capabilities. In understanding this discipline, this paper provides information of progressive undergraduate and graduate Technology Education degree programs regarding curriculum and career preparation. This paper also described a potentially new career pathway, in which, Technology Education may continue to maintain its significance while preparing 21st Century learners the current and forecasted workforce.

Keywords: Technology, Technology Education, 21st Century Learners, Workforce

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Introduction

Technology permits unlimited world-wide interactions, and is essential to the overall society. Technology not only focuses on the present, but its ingenious innovators project future educational, workforce, and societal demands and interests. For future projections, Beall (2018) asserted that several types of Technology will be public domain by 2020. Beall's forecast included the growing adoption of virtual assistant devices for harmonious home system applications and more sophisticated automation systems eliminating the need for cashiers while shopping. Beall further contended that technological advancement led to the development of cryptocurrencies (electronic cash) with Bitcoin being an anticipated mainstream method of payment by 2020. Because ever-changing Technology enables human innovations to meet societal demands, it is important to have an academic discipline that develops professionals to address the appropriate management of materials and methods.

The academic discipline of Technology Education does afford such knowledge acquisition of Technology and Engineering concepts by promoting activity-based and project-driven learning. In Technology Education, there are categories (e.g. Manufacturing Technology, Information Technology, Construction Technology, etc.) and sub-categories (Automotive Technology, Computer Applications Technology, Design Technology, etc.) enabling students to better understand limitless technological applications (FAMU, 2018). Students participating in such an academic discipline are prepared for vastly growing Technology-based careers as they learn how to properly apply innovative strategies to solve problems.

According to the Bureau of Labor Statistic's Occupational Outlook Handbook (2018), careers in Technology-based careers such as Computer and Information Technology were projected to grow by 13% from 2016 to 2026, which is faster than average for all careers. These careers are projected to add approximately 557,100 new jobs with a need for workers skilled in cloud-computing, big data collection and storage, and information security. U. S. News and World Report (2018) reported that nine (9) out of the twenty-five (25) best STEM (i.e. Science, Technology, Engineering, and Mathematics) Technology-based careers ranged from Software Developer to Computer Network Architect. The unemployment rate ranged from 1.1% (Computer Network Architect) to 5.2% (Web Developer). However, the career outlook is not as promising for Career & Technical Education teachers.

In regards to Career and Technical Education teacher careers, the Bureau of Labor Statistics (2018) report did not reflect a progressive inclination. The Occupation Outlook Handbook asserted that the career outlook for Career and Technical Education Teacher, from 2016-2026, will only grow by 4% (slower than average). However, the career outlook for Instructional Coordinators (i.e. those who oversee school curriculums and teaching standards from elementary, secondary and post-secondary levels for state local and governments and may require knowledge of current Technology applications) has encouraging growth, from 2016 to 2026 of 11% (faster than average). Being mindful of career projections, it is important that Technology Education programs continue to modify curriculums, course objectives and

interactive class activities in order help students to acquire and maintain desirable competencies that enables them to greatly contribute to this technological centered workforce.

Literature Review

History of Technology Education

Scott & Sarkees-Wircenski (2008) contended that Technology Education evolved from Industrial Arts and viewed as a service area of Career and Technical Education. Scott & Sarkees-Wircenski (as cited in Buck, Alant, et. al, 2014) further asserted that Technology Education extended it purposes from primarily vocational training to general and academic education designed from K-12 and post-secondary education with the focus on the study of Technology as a means of developing technological literacy. The International Technology Education Association (now the International Technology and Engineering Education Association) in 2000 stated that Technology Education is a study covering human capabilities to revolutionize the physical world in order to fulfill necessities by maneuvering materials and devices with procedures. However, the overall status of Technology Education in present day society must be accessed to determine its direction and impact across the Nation.

In a study conducted by Akmel, Oaks, & Barker (2002), the authors discussed the progress of Technology Education over the past 100 years. The authors elaborated on how Technology Education prepares students for technological literacy. As this third of a series of studies evaluated the status of Technology Education in the United States and Canada, The authors further contended that Technology Education needs to be more fully recognized and validated in each state for the key role it plays in the education of all children and youth in an increasingly technological society. In the U. S.'s standards-based movement, too often the role of Technology Education is not fully esteemed as one of the primary competencies students must have to succeed in society. Second, for the profession to grow, more quality teachers will need to be recruited and trained, and those teachers need to embody the diverse populations they will oblige. Third, the continued trend of closing teacher preparation and K-12 Technology Education programs must be overturned. The profession cannot persist with depleted numbers of teachers being prepared and the successive closure of increasing numbers of Technology classrooms and programs. Fourth, significantly higher levels of funding must be available and recognition by all states that Technology Education is a funding priority must be advanced. Fifth, further analysis of Technology Education as a recognized equivalent field of study needs to endure and accelerate. Nevertheless, richness of Technology Education affords the further study of specified concentrations to help the program sustain.

Scott and Sarkees-Wircenski (2008) further asserted that Technology Education students have numerous concentration areas such as Energy, Manufacturing and Material Processing, Information Processing, and Medical Technology. They study new technologies like genetic Engineering and emerging technologies such as fusion power, which may provide solutions to some of the world's energy supply problems. Students learn that Technology can provide tools to solve problems but it can also generate new problems like toxic waste, which is a by-product of chemicals used in manufacturing processes. To summarize, Technology Education was designed to help students better understand the meaning of Technology, the creation of Technology, and

its societal impact. With this philosophy, Technology Education programs should be designed from key component serving as the programs' foundations. According to ITEEA (2011), Technology Education is problem-based learning utilizing Technology, mathematics, and science principles. ITEEA further provided a list of what Technology Education concepts involve:

- Designing, developing, and utilizing technological systems;
- Open-ended, problem-based design activities;
- Cognitive, manipulative, and effective learning strategies;
- Applying technological knowledge and processes to real world experiences using up-to-date resources; and,
- Working individually as well as in a team to solve problems.

However, Scott and Sarkees-Wircenski (2008) affirmed that colleges and universities are working with state departments of education and local school administrators to provide pre-service and in-service training essential in preparing or upgrading teachers. Teachers will enhance proficiencies needed to create a curriculum based on the ITEEA Standards for Technology Literacy improving Technology literacy for all students. With these standards, the concern for the current state of Technology Education is at the vanguard of further education consideration for academic programs; thus, aiding in the transition of Technology Education with an inclusion of Engineering concepts.

Engineering concepts and the implementation of such concepts were a consideration to better market Technology Education, and secure the position of Technology Education in modern society. According to Hill (2006), perceptions concerning the role Engineering should play within the discipline of Technology Education noticeably fluctuate. Hill further indicated that such positions range from encouraging that Technology Education take on the role of Pre-Engineering for high school students to arguments in service of retaining an extensive focus for Technology Education that regards Engineering design as simply one of many forms of inspired movement. The perception is that Technology Education should hold a general education role, providing hands-on learning activities for all students and encompassing approaches to design and problem-solving that extend beyond Engineering to embrace aesthetics and artistic innovation. Engineering design; nevertheless, can provide a focus for the discipline of Technology Education that is applicable for students in all grade levels and career paths.

Moreover, Strimel & Grubb (2016) discussed the multiple implementation opportunities for Engineering and three primary conduits. First, Technology and Engineering Education can stay the course, continuing what has been done in the past and concentrating on universal technological literacy. Second, considering the close relationship from implementing Engineering design, the Technology and Engineering Education profession can further collaborate with science education, having distinguishing factors between both fields. The last, and considered the most important, option is to work with the Engineering and Engineering Education community to establish Engineering Education as the chief channel for Engineering content and practices. However, the current state of Technology Education must render detailed deliberate for further program development and enhancement.

Current State of Technology Education

The Technology Education role and esteem in modern education and society is at the pentacle of concern. Steinke & Putman (2009) contended that the current field of Technology Education is described through a justification and edifice of universal of Technology. The authors referenced the, then, International Technology Education Association (ITEA) by stating that, Technology consists of a worldwide process, knowledge and context base; because of its participation in the generation of knowledge and processes to develop systems that resolve problems and encompass human capabilities. The processes of such actions that people start to develop, invent, design, transform, produce, control, maintain, and use products or systems. The processes are divided into four subsets which include 1) designing and developing technological systems, 2) determining and controlling the behavior of technological systems, 3) utilizing technological systems, and 4) assessing the impact and consequences of technological systems (ITEA as cited in Steinke and Putman, 2009).

In recent years, research has been conducted to emphasize the need for Technology utilization in education as it improves student outcomes. A survey of teachers across the United States by an independent market research company found out that 86% of teacher-respondents agreed that Technology must be used in the classroom. Ninety-six percent indicated that Technology encourages engagement of students, and 89% agreed that it enhanced student outcomes (Fractus Learning, 2013). According to the University of Cincinnati (2018), Technology exists in numerous education systems. Herold (2016) indicated that (as of July 2018) American public schools afford one desktop computer for every five students and spend over $3 billion annually on digital information. In school year 2015-2016, the government conducted more state-standardized testing for elementary and middle levels through digital platforms instead of the traditional pen and paper method.

As the digital age continues to change, it offers a renewed potential of infinite possibilities of access to information. Students can learn online even if they are not inside the classroom. Advancement in Technology necessitates new approaches of uniting present and future technological improvements and incorporating these innovations into the public education system (National Conference of State Legislatures, 2018). Wardlow (2015) stated that Technology space in education is massive, and it rapidly progresses. Rossi (2015) further asserted that Computer Technology helped promote standards in different schools to defy various challenges in the United Kingdom. The UK adopted the “Flipped Classroom” concept after it become popular in the United States. The idea is to reverse conventional and conservative teaching methods through the delivery of instructions online and outside of traditional classrooms (Wakefield, 2015). Regarding the current status and the projection of Technology Education in higher education, academic (i.e. on the undergraduate and graduate) programs continue to focus on developing proficient professionals to enter an ever-change educational and workforce demands.

Examples of Academic Degree Program in Technology Education

Undergraduate Programs

There are Bachelor of Science Degree in Technology Education programs with curriculum designed to cultivate premier Technology teachers on the K-12 and higher education levels. Not only do these programs develop vastly qualified teachers, such diverse programs

develop exceptional leaders for Technology-driven business and industry. A good example of such a program is the Bachelor of Science in Technology Education at the University of Wisconsin (UW)-STOUT. This program in Technology Education provides teaching certification in Technology education. With the continued growth of STEM careers, graduates with this degree are in high demand as teachers and leaders (UW-STOUT, 2018). UW-STOUT's Technology Education program provides interactive classroom and actual classroom experience with courses emphasizing philosophy, principles, method of instruction, course construction, and class/lab management. Moreover, UW-STOUT's technical courses provide students with engaging and contemporary training; thus, enabling them to meet the current and further workforce demands.

Some of UW-STOUT's technical courses include: STME 160: Introduction to Technology and Science Education, STME 390: Lab and Classroom Management in Science and Technology, AEC 172: Construction of Technology, ETECH 110: Materials and Manufacturing Processes, and etc. This B. S. degree program has the minimum requirements of 120 total course credits and a 2.75 cumulative GPA. Similar four year degree programs offering a K-12 teaching certification and in-depth knowledge of technological systems are California University of Pennsylvania and Valley City State University (VCSU), just to name a few of these outstanding programs. In addition to these programs affording a unique opportunity for undergraduate students interested in Technology and Engineering related profession in high demand, such program prepare students for advanced studies. Advance degrees allows the Technology graduates a chance for promotions and salary increases.

An advance degree (i.e. Master's degree) in Technology Education directs its graduates in becoming K-12 and post-secondary curriculum developer, course designers with technology platforms, educational administrators and mid to upper management in education and industry. Jackson State University (JSU) Master of Science in Education's Technology Education (2018) degree equips its graduates to demonstrate leadership and governance in addressing Technology issues, develop and incorporate technology-based instructional programs, understand ethical and legal issues surrounding Technology, and analyze substantial technological developments. This program has three degree options: 30 course credit hours (thesis), 33 course credit hours (project), and 36 course credits (with designated Technology Education electives). JSU's Technology Education core courses include TE 501: Current Literate & Research in Tech Ed, TE 504: Lab Planning and Management, TE 505: History & Philosophy of Tech Ed., TE 512: Administration & Funding, and TE 513: Instructional Aids. In reviewing a similar program, VCSU also provides a comprehensive foundation in education, research, and technology.

As JSU and VCSU's M.S. Technology Education program bare some comparison, the contrast identifies options that are distinctive for VCSU's program. VCSU (2018) offers the program options with a minimum of 36 hours: 1) Secondary STEM Education, 2) Elementary STEM Education; and 3) Career and Technical Education. VCSU incorporates standards-based programs in Technology Teacher Education, and it has designed the concentration for teachers at either primary or secondary levels wishing to pursue a Master's Degree. The curriculum was designed to emphasize the preparation of the next generation of Technology Education teachers remedying a technology teacher shortage. Some examples of VCSU's Technology Education Master's degree courses are: EDUC 601: Research in Education, TECH 675: Research &

Assessment in Technology Education, STEMED 660: Design for Engineering, STEMED 660: Design for Engineering, STEMED 665: Invention & Innovation, TECH 688: Safety & Management in Technology Lab, and other core/required and elective courses. As the aforementioned and other similar and related program were instituted to remedy teacher shortages and to foster technological competencies in both education and industry, the discipline of Technology Education must continue to diversify and prepare its graduates forecasted career inclinations. The relatively new and non-traditional discipline of Emergency Management that can make a transition as concentration or specialize sub-area of Technology Education.

Proposed New Concentration in Technology Education: Emergency Management

Natural and man-made disasters are rapidly intensifying in today's society. From hazardous weather events to premeditated and random acts of violence, it is essential to have highly proficient and problem-solving professionals who can effectively and efficiently such horrific situations. Emergency Management is the paramount concern for both the general public and the academic community. According to Buck et al. (2012), the concern is due to potential loss of life, property, and a disruption of normal daily routines. Emergency Management is that auspice, in which, emergencies/disaster can be properly resolved.

According to the Federal Emergency Management Agency (as cited in Buck, 2012), Emergency Management is "the managerial function charged with creating the framework within which communities reduce vulnerability to hazards and cope with disasters" (p. 244). FEMA further stated that Emergency Management advocates safer and less vulnerable communities with the ability to manage hazards and disasters. The mission of Emergency Management is to protect communities by coordinating and integrating all activities necessary to build, sustain, and improve the capability to mitigate against, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters. Such disasters may include natural (e.g., hurricanes, tornadoes, typhoons, tsunamis, earthquakes, and etc.), and man-made (e.g., terrorism, bio-terrorism, pandemics, school violence, and etc.). Regardless of natural or man-made disaster, there is an immediate call to action in producing competent professionals who can properly apply technology to the four functions of Emergency Management.

Buck listed and described the FEMA's four functions in Emergency Management that includes: mitigation, preparedness, response, and recovery.

***Mitigation*:** Attempts to prevent hazards from developing into disasters altogether or to reduce the effects of disasters. Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. This is achieved through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk.

***Preparedness*:** Impact of disaster events on people. Preparedness is a continuous cycle of planning, managing, organizing, training, equipping, exercising, creating, evaluating, monitoring and improving activities to ensure effective coordination and the enhancement of capabilities of concerned organizations to prevent, protect against, respond to, recover from, create resources and mitigate the effects of natural disasters, acts of terrorism, and other man-made disasters.

***Response*:** The response phase includes the mobilization of the necessary emergency

> services and first responders in the disaster area. This is likely to include a first wave of core emergency services, such as firefighters, police and ambulance crews.
>
> ***Recovery*:** Restore the affected area to its previous state. It differs from the response phase in its focus; recovery efforts are concerned with issues and decisions that must be made after immediate needs are addressed. Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment, and the repair of other essential infrastructure (p. 244-245).

As Emergency Management in a multidisciplinary area, its integration with technology will further advance efforts in creating a sounder infrastructure of executing these functions for society well-being.

Emergency Management programs with a technology emphasis will aid in continuous improvement through proper planning, forecasting, detecting/securing, and information sharing. Information Technology serves as a suitable examples of technology integration in Emergency Management. Buck et al. (2012) stated that Information Technology (IT) is a vital tool in Emergency Management that supports planning and time reduction. The internet and social media serve as more specific examples of IT that performs many capabilities that impact Emergency Management's proficiency. The internet and social media heightens awareness through web pages that inform and prepare citizens. The internet and social media are modern platforms providing opportunity for community discussion groups, making disaster plans available online, providing educational disaster management material to specific entities and the general public. Since Technology Education develops the understanding of technological competence, creative and flexible problem solving, critical thinking, and understanding the need to adapt to technological advances; the unification of this discipline with Emergency Management will be impactful as the mandates more Emergency Management professionals is at the vanguard of national attention.

Rendering results from the Bureau of Labor Statistics (2017), Emergency Management careers are projected to have annual increase by 8% between the years of 2016-2026 (faster than average). Emergency Management Directors are needed to prepare plans and procedures for disaster response. These leaders provide guidance of emergency mitigation, preparedness and recovery efforts. They may be employed by state or local governments, private corporations, hospitals, or nonprofit organizations. Some Emergency Management Directors may serve as administrators for volunteer organizations. In developing competent Emergency Management professionals, Technology Education can be an advantageous avenue for these professionals to increase technology literacy and properly integrate technology; thus, endorsing management of the resources and responsibilities concerning all humanitarian facets against disaster and catastrophe.

Summary

As man-kind continues to greatly depend on technology, there remains a need to encourage persistent advancement of post-secondary academic programs promoting the understanding of essential technological perceptions, proficiency, progression and problem-solving to acclimatize into the workplace. With technology being a pivotal point in our society

and economy, the job market continues to grow with the constantly shifting technology trends. In emphasizing the current state of Technology Education and the relevancy of discipline, this research explored examples of progressive undergraduate and graduate Technology Education degrees, the career preparation for program students, and an overview of relevancy for the 21st Century student. In regards to the 21st Century student and workforce, new pathways such as Emergency Management will help Technology Education maintain significance and promote constant progression.

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