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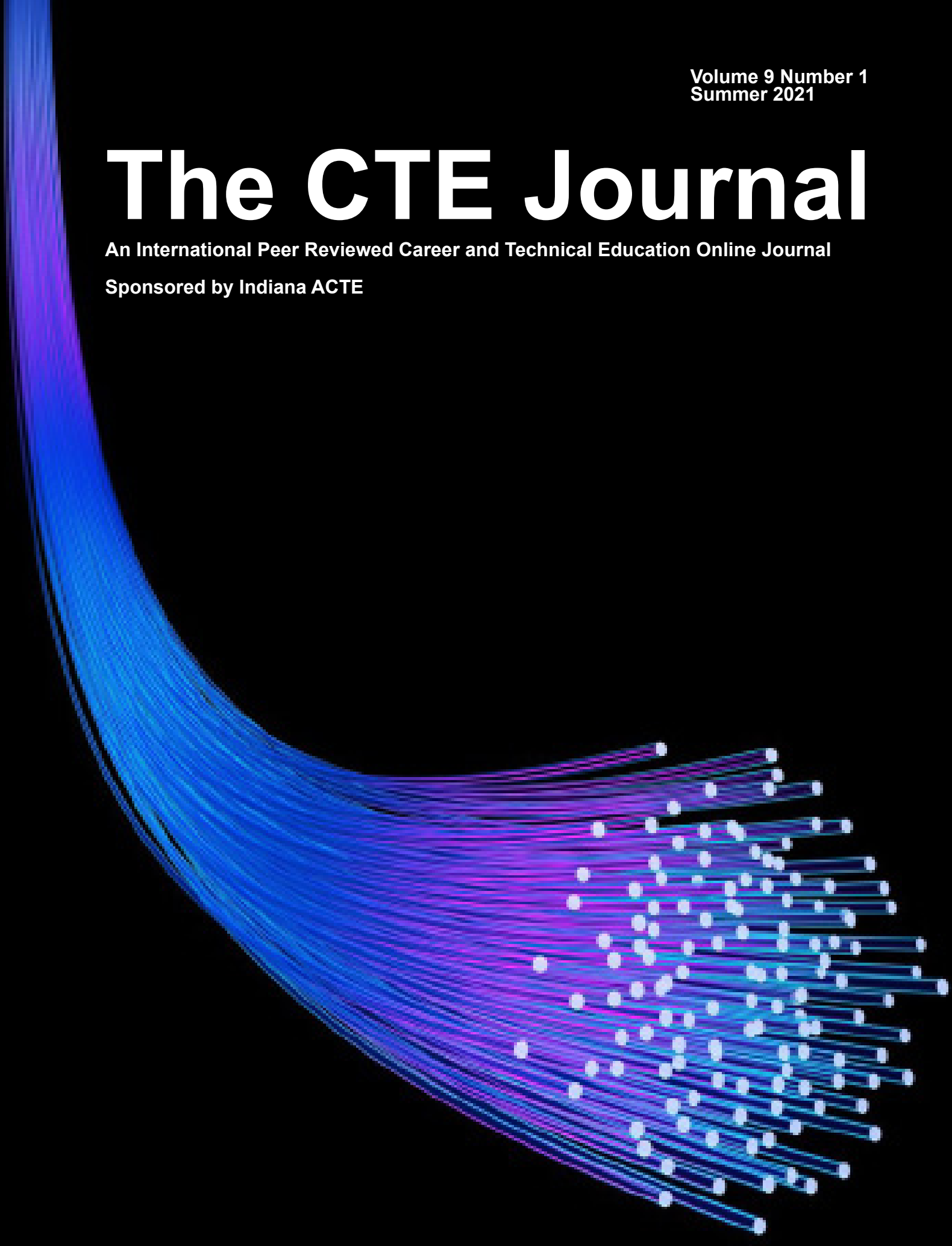

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Table of Contents

Volume 9, Number 1, Summer 2021

An Exploratory Study to Develop a CTE Leadership Self-Efficacy Scale

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Introduction

High-quality CTE has become a "catchphrase" in recent years used by policymakers, practitioners, and education and workforce stakeholders (ACTE, 2020). The Association for Career and Technical Education (ACTE) designed a framework to define high-quality career and technical education (CTE) programs, as well as resources and a program self-assessment. Achieving a high-quality program as defined in the framework requires CTE leaders with an

understanding of the framework as well as the skills to move programs toward the high-quality benchmarks. This study began as a discussion among the researchers on the leadership of high-quality CTE programs and understanding how leaders of such programs perceive their own skills and abilities. The discussion proceeded to the concepts of leadership skills and self-efficacy, and the need for a tool to help CTE leaders assess their skills and abilities relative to the ACTE high-quality CTE program of study framework. This study comprises the development and validation of an assessment tool to assist CTE leaders in doing just that.

Drawing on the Skills Approach to Leadership and Self-Efficacy

The skills approach to leadership was first studied by Katz (1955) as a shift from the idea of leadership traits or attributes of "ideal executives." Katz proposed a three-skill approach: technical skill, human skill, and conceptual skill. Technical skill includes specialized knowledge in process, procedures, or techniques, the analytical ability within the particular field, and an understanding of the tools and techniques of the discipline (Katz). Later described by Northouse (2019), technical skills also include hands-on ability with a product or process. Human skill, as defined by Katz, includes the ability of the leader to work effectively with groups and to build cooperative teams. These skills allow a leader to see multiple perspectives, communicate well with others, and take others' perspectives into account when acting in the interest of the group (Katz). The third skill, conceptual skill, are those skills that allow the leader to recognize the various functions of the organization, how change impacts the organization, and the significance of decisions on the future of the organization. In other words, conceptual skill is the mental work of shaping the meaning of policies or issues (Katz). Katz believed that a leader needed all three skills, but the relative importance of each changes over the course of an individual's career, depending on the level of management.

Starting in the 1990s a group of researchers studying effective leadership performance in the Army expanded the skills approach (see Mumford et al. studies in references). However, for the purposes of this study, the researchers determined that the simplicity of the original Katz (1955) model had the best alignment to the ACTE high-quality CTE program of study framework.

Self-efficacy is defined as an individual's belief in the ability to successfully handle specific situations or duties required (Bandura, 1986). Bandura (1977) outlined four sources of self-efficacy information, including performance accomplishments or personal mastery experiences, vicarious experiences, verbal persuasion, and emotional arousal. Leaders with high self-efficacy then believe in their ability to lead (Neck and Houghton, 2006), and within educational environments, to lead others toward the achievement of goals (McCormick, 2001). In developing self-efficacy measures, Bandura (2001) recommends that measurements should examine both the level and strength of self-efficacy and be context specific.

High-Quality CTE Program of Study Framework and Relevant Scales

The ACTE quality program of study framework provides a very specific context in which to assess an individual's belief in their ability to lead high-quality CTE programs. Starting in July 2015, ACTE began reviewing research findings to guide the framework and to document trends in successful CTE programs. Following the initial development of the framework, three drafts were released over three years to gain feedback across a broad constituency group in secondary and post-secondary education. A correlation was conducted with program-level Perkins performance data. In October 2018, the final "ACTE Quality CTE Program of Study Framework" was released. This framework has defined high-quality for CTE programs nationally since that time (Imperatore & Hyslop, 2018).

The framework consists of twelve elements with 92 criteria (Imperatore & Hyslop, 2018). To summarize, the twelve elements include:

1. Standards-aligned and Integrated Curriculum: addresses development, implementation, and revision of program of study curriculum
2. Sequencing and Articulation: addresses articulation, coordination, and collaboration to support programs of study, career pathways, and accelerated learning
3. Student Assessment: addresses the types and quality of assessments
4. Prepared and Effective Program Staff: addresses the qualifications and professional development of educators and other personnel
5. Engaging Instruction: addresses instructional strategies within the learning environment
6. Access and Equity: addresses promotion, student recruitment, and strategies to support various student populations
7. Facilities, Equipment, Technology, and Materials: addresses physical/material components, such as laboratories, classrooms, industry-specific equipment, tools, etc.
8. Business and Community Partnerships: addresses partnership structure and activities to support the program and ensure alignment with workforce needs
9. Student Career Development: addresses strategies to help students engage in education and career planning and decision-making
10. Career and Technical Student Organizations (CTSOs): addresses CTSO opportunities as an integral part of the instructional program for skill and leadership development
11. Work-based Learning: addresses a variety of work-based learning for sustained, meaningful engagement with tasks of a given career field
12. Data and Program Improvement: addresses collection, reporting, and use of data for continuous program improvement (Imperatore & Hyslop, 2018).

In addition to the Framework, ACTE developed a self-assessment instrument for educators to rate their CTE program on the twelve elements (ACTE, 2018). No instrument currently exists, however, for the knowledge and skills needed for those who lead such programs.

Yost et al. (2019) piloted a study to develop a self-efficacy tool for CTE administrators. The tool utilized previous scales developed for leadership self-efficacy (Bobbio & Manganelli, 2009) and Principals' self-efficacy (Tschannen-Moran & Gareis, 2004). The original scale (51-items) was piloted in four states with 85 usable survey results. These results yielded a Cronbach's alpha reliability coefficient of .960. The final scale was reduced to 35 items, with a Cronbach's alpha of .946 (Yost et al., 2019). The focus on administrative roles in CTE programs, however, limits the leadership role to only those who are building level leaders with a role in administering CTE programs. Leadership in CTE can occur at a variety of levels and in a variety of roles, including teachers, counselors, administrators, district personnel, community college faculty, state level personnel, teacher preparation faculty, and student services personnel. No scale currently exists to study the broader self-efficacy beliefs of this broader group of CTE leaders.

Scale Development Methodology

Scale development consisted of three phases. In phase one, a review of the ACTE Quality program of study framework (Imperatore & Hyslop, 2018) was reviewed by one of the researchers and a content expert working with the Association for Career & Technical Education (ACTE) to determine what leadership knowledge and skills were needed for leadership in CTE programs. The knowledge and skills identified cut across 17 themes including understanding CTE federal funding, utilizing Perkins accountability data for decision making, building an inclusive culture for underserved populations in CTE, recruiting and retaining CTE faculty, developing business and industry partnerships, etc.

To classify the themes in the quality program of study framework, the skills approach to leadership first proposed by Katz (1955) was consulted. Katz (1955) defines technical skill as those skills needed "to accomplish the mechanics of the particular job" (p. 42), human skill as those skills related to "working with others to be an effective group member and to be able to build cooperative effort with the team he leads" (p. 42), and conceptual skill as the skill "to recognize the interrelationships of the various factors involved in his situation" (p. 42). In a later explanation of Katz's approach, Northouse (2019) defines these as, technical skills deal with things, human skills deal with people, and conceptual skills deal with ideas. Moving these skills into categories of technical, human, and conceptual skills aligns well with other CTE frameworks (i.e., academic, technical, employability skills). Table 1 provides an overview of how each skill set aligned with the ACTE quality program of study framework.

Phase two consisted of identifying possible scales that could be utilized to determine self-efficacy in CTE leaders. One scale emerged with the closest relationship to CTE leadership, which was the CTE Administrator's Self-Efficacy Survey (CASES) (Yost et al., 2019). Other scales exist, but relate more broadly to leadership or other aspects of education, such as leadership traits for organizations and the workforce (Gardner, Cogliser, Davis, & Dickens, 2011), and Tschannen-Moran and Gareis' (2004) research of school principals and their ability to handle school reform efforts. The original 51-item CASES (modified with permission) was

reviewed to identify which items fit within each skill set (technical, human, and conceptual) for the knowledge and skill themes that emerged from the ACTE quality of study framework (used with ACTE permission). Following review with the content expert of the item fit within the skill sets, fourteen of the original scale items were retained. Three additional items were included, but modified for broader CTE leadership application. In all three items, the phrase "school/district" was changed to either "CTE program or school community" or "educational" to become more inclusive of the various environments where CTE programs exist. Revisiting the ACTE quality program of study framework and the Katz (1955) skills approach then led to the development of an additional ten items, bringing the total number to 28 items.

In phase three, the team of researchers were asked to review the 28 items and the ACTE quality program of study framework to validate the existing content and to determine if there were any gaps between the framework and the 28 items. Following this review, an additional seven items were added to address these gaps and ensure the items were representative of the skills needed to lead a high-quality CTE program. The final scale then was 35 items.

Table 1
Skills aligned with the ACTE Quality Program of Study Framework.

Technical Skills: "knowledge about and proficiency in a specific type of work or activity" (Northouse, 2018, p. 44); "technical skills deal with *things*" (Northouse, 2018, p. 45) Corresponding Elements from ACTE HQ Framework: #1 – Standards-aligned and Integrated Curriculum #3 – Student Assessment #7 – Facilities, Equipment, Technology and Materials #12 – Data and Program Improvement
Human Skills: "knowledge about and ability to work with *people*" (Northouse, 2018, p. 44) Corresponding Elements from ACTE HQ Framework: #4 – Prepared and Effective Program Staff #5 – Engaging Instruction #9 – Student Career Development #10 – Career and Technical Student Organizations (CTSOs)

Conceptual Skills:
"skills involve the ability to work with *ideas*" (Northouse, 2018, p. 45); "A leader with conceptual skills is comfortable talking about the ideas that shape an organization and the intricacies involved" (Northouse, 2018, p. 45)

Corresponding Elements from ACTE HQ Framework:
- #2 – Sequencing and Articulation
- #6 – Access and Equity
- #8 – Business and Community Partnerships
- #11 – Work-based Learning

Pilot Study Data Collection and Analysis

In Spring 2020, practicing career and technical educators were accessed using CTE national and state organization listservs, as well as through university CTE programs. These educators were asked to complete the scale to determine its alignment with ACTE's high-quality framework. The 35-item CTE leadership self-efficacy scale was administered electronically via SurveyMonkey and took approximately five to ten minutes to complete. Data collection was slow, presumably due to the COVID-19 pandemic, so the survey remained open through Fall 2020 with additional emails sent out to possible new participants or listservs.

An informed consent statement was included as the first item, followed by the 35 CTE leadership scale items along with seven demographic items (gender, state, age, race, total years of CTE experience, content area, and current position). The self-efficacy items utilized the question stem, "As a CTE leader, to what extent can you . . ." and participants were asked to indicate their self-assessment of each item by marking: 1 - Not at all, 2 - Not much (<50%), 3 - Some (50-70%), 4 - Often (70-80%), or 5 - A great deal (>80%). For access to the full CTE Leadership Self-Efficacy Scale, see Murray State Digital Commons (https://digitalcommons.murraystate.edu/faculty/74/).

Following data collection, participants with missing data were eliminated, and data were entered into SPSS statistical software for analysis.

Pilot Study Participants

The convenience sample for this study consisted of a total of 204 participants from 20 states as self-identified from state and national listservs and university CTE programs. The total number of participants could not be obtained as listserv membership can vary daily, and student information was not collected to encourage participation. Of those 204 participants, however, 154 (75%) completed all 35 items and were included in the analysis.

The final sample consisted of 49.4% men and 50.6% women. 93.5% of participants identified as Caucasian, with other races identifying as African American (2.6%), Asian (1.3%), Hispanic/Latino (.6%), and other (1.9%). The majority were CTE teachers in secondary classrooms (40.3%) or CTE teachers in post-secondary classrooms (11%). Other participants included CTE teacher in another environment (2.6%); CTE building/district level coordinator (4.5%); CTE administrators in an area career center (7.8%), in a comprehensive school environment (5.2%), and in another environment (.6%); career services counselor or support services (1.3%); postsecondary CTE coordinator or administrator (5.2%); CTE educator preparation faculty (11%); state level administrators (1.9%); or other (1.9%). Four participants did not answer.

Half of the sample was from West Virginia and 19.5% of the sample from Missouri. The remaining (30.5%) states identified included Texas, Nevada, California, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Nebraska, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, and South Carolina. Sample size was the primary limitation of this study. Although there were greater numbers of participants from two states, upon reviewing the data, the researchers determined that for an exploratory study (Vogt & Johnson, 2016, p.152), the sample appears to be representative of patterns of the CTE population in general.

A broad range of CTE content areas were included among the participants, including Agriculture (19.5%), Business/Marketing (13.6%), Family Consumer Science (5.8%), Construction Trades (5.8%), Health Science (7.8%), Automotive Fields (3.9%), and other fields (31.9%). Eighteen participants (11.7%) did not answer the content area question. Total years of CTE experience also ranged from those identifying as having five years or less of experience at 27.9%, 6-10 years at 19.5%, 11-20 years at 27.3%, 21-30 years at 14.3%, to those with over 31 years in CTE at 11%.

Reliability Analysis of the Scale

The 35-item CTE leadership self-efficacy scale returned a Cronbach's Alpha of .944. The items were sorted into the three categories of technical, human, and conceptual skills as were identified by Katz (1955). Table 2 provides descriptive statistics for each item. Items have been grouped into the three categories.

Items that were developed for each of the skills areas of the ACTE quality program of study framework were also analyzed for reliability with Cronbach's Alphas reporting as: Technical skills = .842, Human skills = .883, and Conceptual skills = .827.

Table 2
Means and Standard Deviations for Each Item Grouped by Skill Area.

Technical Skill	M	SD
3. Effectively establish program recruitment plans?	3.78	.9235
11. Promote ethical data usage among educational leaders?	3.88	1.072
12. Ensure program equipment and technology reflect current workplace practices?	4.08	.9071
19. Set a new direction for a CTE program or school community?	3.73	1.031
22. Integrate core subjects into CTE curriculum?	4.14	.8435
23. Creatively solve new or unusual organizational problems?	3.90	.9342
30. Build reliable assessments into a CTE program to ensure student learning?	4.21	.8321
31. Effectively utilize data and research to develop CTE best practices?	3.95	.9060
32. Develop and carry out an institutional improvement plan?	3.85	1.008
Human Skill		
1. Handle the time demands of your job?	4.35	.8520
2. Identify my strengths and weaknesses?	4.25	.6524
7. Utilize technology in CTE program delivery?	4.16	.8866
15. Confidently build an effective group?	4.21	.7727
17. Communicate with counselors to support appropriate student decision making?	3.95	1.034
18. Identify strengths and weaknesses in staff members?	3.87	1.027
20. Engage students through a variety of instructional approaches (PBL, WBL, inquiry, authentic scenarios, etc.)?	4.19	.8839
21. Integrate CTSO activities into CTE programs?	3.78	1.062
24. Go straight to the matter when communicating with others?	4.25	.8289
25. Change things within a group not under my direct control?	3.15	.9887
27. Change the attitudes and behaviors of others when objectives aren't met?	3.64	.8758
28. Support the transition to teaching by non-traditional instructors?	3.87	1.095
33. Prioritize among competing demands of the job?	4.18	.9012
34. Accept personal and professional constructive feedback to enhance my career?	4.45	.6864
35. Motivate and raise enthusiasm of a group starting a new project?	4.31	.7261
Conceptual Skill		
4. Develop effective programs of study for CTE programs?	4.00	.9597
5. Promote an inclusive culture for underserved populations in CTE?	3.94	.9682
6. Effectively communicate with diverse groups?	4.11	.8673
8. Explain CTE policy to colleagues?	3.94	.9575
9. Effectively meet the needs of your community?	4.05	.7809

10. Generate enthusiasm for a shared vision for CTE program or school community?	4.12	.8267
13. Influence CTE political issues?	3.06	.9883
14. Promote a positive image of your CTE program?	4.63	.5471
16. Provide accommodations/modifications to meet accessibility requirements?	4.12	.8881
26. Meet federal requirements (Perkins funds and reporting)?	4.12	1.094
29. Work with business and industry (workplace) partners (advisory committees, meeting industry needs for workers, developing internship possibilities, etc.)?	4.13	.9507

The first research question for this study addressed the relationship of CTE leader self-efficacy to high-quality CTE programs. This connection is further divided among three categories of skills: technical, human, and conceptual. As indicated in Table 2, means ranged from a low of 3.06 to a high of 4.63, indicating that participants' beliefs in their ability to accomplish the tasks indicated ranged from "sometimes" to "often." The task item that participants were least efficacious about (M = 3.06, SD = .9883) was 'the ability to influence CTE political issues' (conceptual skill). The task item with the highest mean (M = 4.63, SD = .5471), indicating highest efficacy, was 'promote a positive image of a CTE program' (conceptual skill). Additionally, the relatively low standard deviation indicates that participants were consistent in their beliefs about their ability with respect to this task item. This could be attributed to the specific job responsibilities of participants, given that the greatest number of participants were CTE secondary or postsecondary teachers (51.3%). Many of the standard deviations ranged between 0.8 and 1.1, indicating that there was variability in the degree to which participants believed in their ability to accomplish task items. There is tremendous variability in job descriptions of CTE leaders among teachers, administrators, state leaders, and university faculty, as well as the variability due to the range of CTE locations (high schools, standalone career centers, community colleges, other sites, etc.), leading to potential wider deviations on any individual item. As the focus of this exploratory study was scale development, pursuing these variabilities was left for future studies.

Discussion

Educational leadership standards in preparing leaders in CTE are quite different from traditional K-12 educational administration (Zirkle & Jeffery, 2017). CTE leaders must be capable and believe in their ability to perform cognitive and behavioral functions necessary to move others toward attaining set goals essential to meeting student educational achievement (McCormick, 2001). CTE programs need leaders who understand the unique needs and characteristics that shape high-quality programs. The framework developed by ACTE gives guidance on the qualities and criteria for high-quality CTE programs of study, but leaves open the question of the skills and abilities needed to lead the development and operation of these programs. Katz's (1955) skills approach to leadership (technical, human, conceptual) closely aligns with the skill

concepts used in CTE (technical, employability, academic), making it a realistic basis on which to build an instrument specifically to assess leadership skills for high-quality CTE programs.

Connecting the ACTE Quality Program of Study framework with Katz's skills approach to leadership then, provides a specific domain to measure CTE leadership self-efficacy beliefs. The goal of the instrument developed in this study is for anyone taking a leadership role in CTE programs. In its present form, the instrument could be used to guide professional development for CTE administrators, instructors, service coordinators, etc. who want to identify growth areas. It could also be used as a pre-post measure for CTE college preparation programs to determine strengths or potential areas for further development in the curriculum.

As the paradigm of "born leaders" has shifted to a recognition of leadership development based on skills acquired through life experiences (Katz, 1955; Northouse, 2019), future research in CTE leadership self-efficacy should include different groups of educational professionals. CTE leaders are found among teachers, district leaders, state personnel, and university faculty. The CTE leadership self-efficacy scale, would likely benefit from further validation with a larger national sample including leaders from secondary CTE charter schools and private post-secondary CTE institutions. Also, a larger sample may provide a more robust assessment of CTE leaders' skills based on selected demographic and background variables. A follow up study for a longer duration of time would also be recommended.

Enhancing CTE leader knowledge and skills will likely bring about beneficial changes for CTE stakeholders and students. The CTE leadership self-efficacy scale provides a means for validating these leadership skills. Sound CTE leadership training and assessments are essential to the success of educational leaders as it directly impacts the success of CTE as a whole.

References

Association for Career and Technical Education. (2020). High-quality CTE framework development. https://www.acteonline.org/professional-development/high-quality-cte-tools/high-quality-cte-development/

Association for Career and Technical Education (2018). 2018 ACTE quality CTE program of study framework: Self-assessment instrument. https://www.acteonline.org/wp-content/uploads/2019/09/HighQualityCTEFramework2018_WithRubric_LowRes.pdf

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2),191-215.

Bandura, A. (1986). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-215.

Bandura, A. (2001). Guide for constructing self-efficacy scale (Monograph), Stanford University, Stanford, CA.

Bobbio, A., & Manganelli, A. (2009). Leadership self-efficacy scale. A new multidimensional instrument. *TPM,16*(1), p. 3-24. http://www.tpmap.org/wp-content/uploads/2014/11/16.1.1.pdf

Gardner, W.L., Cogliser, C.C., Davis, K.M., & Dickens, M.P. (2011). Authentic leadership: A review of literature and research agenda. *The Leadership Quarterly, 22*, 1120-1145.

Imperatore, C., & Hyslop, A. (2018, October). 2018 ACTE quality CTE program of study framework. https://www.acteonline.org/wp-content/uploads/2019/01/HighQualityCTEFramework2018.pdf

Katz, R. L. (1955). Skills of an effective administrator. *Harvard Business Review, 33*(1), 24-39.

McCormick, M.J. (2001). Self-efficacy and leadership effectiveness: Applying social cognitive theory to leadership, *Journal of School Leadership, 8*(1), 22-23.

Mumford, M. D., & Connelly, M. S. (1991). Leaders as creators: Leader performance and problem solving in ill-defined domains. *The Leadership Quarterly, 2*(4), 289-315.

Mumford, M. D., Todd, E. M., Higgs, C., & McIntosh, T. (2016). Cognitive skills and leadership performance: The nine critical skills. *The Leadership Quarterly, 28*, 24-39.

Mumford, M. D., Zaccaro, S. J., Connelly, M. S., & Marks, M. A. (2000). Leadership skills: Conclusions and future directions. *Leadership Quarterly, 11*(1), 155-170.

Mumford, M. D., Zaccaro, S. J., Harding, F. D., Jacobs, T. O., & Fleishman, E. A. (2000). Leadership skills for a changing world: Solving complex social problems. *Leadership Quarterly, 11*(1), 11-35.

Neck, C.P., & Houghton, J.D. (2006). Two decades of self-leadership, empowering yourself for personal excellence. *Journal of Managerial Psychology, 21*(4), 270-295.

Northouse, P. G. (2019). Leadership: Theory and practice (8th Ed.). Sage.

Tschannen-Moran, M, & Gareis, C. R. (2004, April). Principals' sense of efficacy and trust. Paper presented at the annual meeting of the American Educational Research Association, San Diego.

Vogt W. P., & Johnson, R. B. (2016). The SAGE dictionary of statistics & methodology: A nontechnical guide for the social sciences. (5th.ed.). SAGE.

Yost, D. M., Conrad, M., Watkins, L., Parr, K., & Gordon, H. R. D. (2019). A pilot survey of a self-efficacy tool for career and technical education administrators. *Journal of Leadership Education, 18*(3), 70-81. DOI: 10.12806/V18/13/R5

Zirkle, C.J. & Jeffery, J.O. (2017). Career and technical education administration: Requirements, certification/licensure, and preparation. *Career and Technical Education Research, 42*(1), 21-33.

Management Analyst Career Path Exploration

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Introduction

This article provides information for those who may be interested in a career as a management analyst. This is a position that requires creativity in order to develop solutions that a company can use to solve a problem, no matter the size. The following information about the management analyst career will be presented in this order: responsibilities, how to become one, pay and benefits, job outlook, and an interview with a professional currently working in a related field.

Responsibilities of Management Analysts

According to the U.S. Department of Labor (2020), recommending ways to improve an organization's efficiency is the primary duty of a management analyst. A management analyst focuses on providing strategies for managers to increase profitability and good corporate citizenship through increased revenue and reduced costs (U.S. Department of Labor, 2020).

Management analysts conduct work similar to consultants, in which they gather and organize information by interviewing personnel and holding onsite observations to help determine what new methods, equipment, or personnel may be required to increase efficiency, and analyze financials and employment reports to help determine a solution for whatever problem the company may be facing (U.S. Department of Labor, 2020). After the research and development phase, management analysts display their recommendations to leadership in a presentation or written format, and then follow up with leaders to ensure their changes are effective (U.S. Department of Labor, 2020). All of these responsibilities require management analysts to have incredible critical-thinking and problem-solving abilities, since these skills will be utilized on a daily basis (Rasmussen College, 2018).

Not all management analysts work as consultants with a contractual agreement to an outside company, some work for their own internal organization (U.S. Department of Labor, 2020). Management analysts tend to specialize in certain areas to help stand out among one another, and sometimes certain jobs require more than one analyst to give the organization a better chance at extracting something useful; this varies from project to project (U.S. Department of Labor, 2020). For example, in government, management analysts may specialize based on the type of agency, like the department of education (U.S. Department of Labor, 2020). Scientific and technical consulting services is the most common specialty employing management analysts, according to DATA USA (2020).

How to Become a Management Analyst

According to the U.S. Department of Labor (2020), an entry-level requirement of a management analyst is to have at least a bachelor's degree; however, employers are more apt to hire those who achieved a master's degree in business administration. Since management analysts are required to assess a wide range of fields, a background in another field in addition to having experience in business can prove quite useful: telecommunications, psychology, etc. (U.S. Department of Labor, 2020). Although management analysts are currently not required to get certifications, the Institute of Management Consultants USA offers a Certified Management Consultant certification for those who meet the minimum levels of experience and education (U.S. Department of Labor, 2020).

Usually, new management analysts have been in a related occupation for several years (U.S. Department of Labor, 2020). Tax firms will often prefer to hire a candidate who previously specialized in work related to accounting and auditing, while software companies would consider hiring people who are more technologically inclined and have prior experience in the IT field (U.S. Department of Labor, 2020). In terms of advancement, the more experience a management analyst gains, the more responsibilities they take on; slowly leading to a position like a senior-level analyst (U.S. Department of Labor, 2020). According to the U.S. Department of Labor (2020), a high-quality management analyst possesses good analytical, communication, interpersonal, problem-solving, and time-management skills.

Securing a contract as a management analyst is not easy, as one will be competing against others in a bidding conference after writing a proposal (U.S. Department of Labor, 2020). The proposal will specify how much services will cost, how the work will be completed, and the schedule of the proposed project (U.S. Department of Labor, 2020). After said proposals are presented, the organization will select the proposal that best fits its budget and needs (U.S. Department of Labor, 2020). Additionally, management analysts and other analysts of the relatively same nature are often considered expendable at a company, unlike an employee who embodies all of the technical aspects an organization may need; therefore, management analysts must continue to bring value to the organization, well after being hired. (Canavan & Schneider, 2015)

Pay and Benefits

Management analysts tend to work under strict deadlines and work many hours with some working more than 40 hours per week, however this likely won't yield overtime pay (U.S. Department of Labor, 2020). In May 2019, the reported median annual wage for a management analyst was $85,260, with the lowest 10 percent earning less than $49,700, and the highest 10 percent earning more than $154,310 (U.S. Department of Labor, 2020).

Looking at the industry as a whole, the median annual wages for management analysts in in scientific and technical fields earned $91,160; in finance and insurance they earned $84,940; in

management of organizations and enterprises they earned $84,390; and in the government sector they earned $79,720 (U.S. Department of Labor, 2020). Self-employed analysts are usually paid directly by their clients, and sometimes by the project or the hour; however, management analysts that work for consulting firms are usually paid a salary, with an additional year-end bonus (U.S. Department of Labor, 2020). According to DATA USA (2020), the highest paying industry is the motor vehicle and motor vehicle parts and supplies wholesalers, which pays an average salary of $200,000 to management analysts.

Job Outlook

According to the U.S. Department of Labor (2020), management analyst employment numbers are projected to increase 11 percent from 2019 to 2029, which is considerably faster when compared to the average of all occupations. This is due to speculation that demand for consulting services will climb as markets become more competitive and when companies need to find ways to cut costs (U.S. Department of Labor, 2020). For the demand for management analysts is expected to grow in most fields, but the highest growth is likely to occur in fields such as health care and information technology, with their highly regulated environments and rapidly improving technology respectively (U.S. Department of Labor, 2020). Over 87,100 management analyst job openings are expected each year, on average, for the decade to come (U.S. Department of Labor, 2020).

Interview with Sarah, Senior Business Analyst at Digital Management, LLC. 2013 Graduate of the Center for Information and Communication Sciences (CICS) at Ball State University.

1. What previous experience prepared you for this position?

I feel like it's all been building blocks that got me here. There were a couple significant pivots, but mostly it was a general drive to be a good communicator and ensure that I understood the technology used in businesses today. I studied journalism at first and that's what made me fall in love with writing and communicating. During my time in my undergrad, I also managed the Newsroom on Ball State's campus; I was the editor of the school paper and I liked being the organizer. Then after that, I wanted to further my education in communication and management, so I chose to go to CICS. Besides that, good work gets rewarded along with a good attitude.

2. What does a typical work day look like for you?

Since there is such a wide variety of business analysts that question can be answered differently by all, but in my case, we start our day off doing what we call a "standup." Which is a meeting I hold with my dev team which is about eight people. Typically, it's a short meeting discussing what we did yesterday, what we're doing today, and what our current blockers are for the day. Because the standup is in mid-morning, I usually have an hour before that to follow up on Slack with any new messages I may have received, follow up on emails I may have received from stakeholders, and get some requirements figured out and answered prior to truly starting my day. After that's all said and done, I find some quiet time in the afternoon to myself to write out requirements and follow up on all the things that are remaining in my notepad that I started on in the morning.

I'm learning that it's my responsibility to define boundaries and make time to get work done – especially finding time to do "deep work" – which comes from a book I'm reading with the same title.

3. What is your favorite part about your daily work?

My favorite parts of the day are when I interact with my dev team and celebrate their accomplishments, when I come away from a meeting and have had a good interaction about how to make something better and can walk away with tangible and clear plans, and when I feel successful writing stories.

4. How incentive driven is this position with regard to compensation?

Not very much. I have a consistent salary. However, we get a bonus and merit increase each spring, so I guess I am incentivized to do better work, to get a raise. If you want incentive-based income then you're likely better off in sales.

5. What are the main challenges you encounter with your daily work?

Distractions! So Slack for example, Slack may say I have three new messages and they may be important or not, and either way if I read them it takes my focus away from what I'm supposed to be doing. Another challenge would be unclear expectations or conversations where you don't know how to wrap it up or who has ownership over it. Always have a goal in mind when you set up your own meeting. Additionally, the more teams there are on a big project, the harder it is to establish ownership over certain things, and it's frustrating.

6. What kinds of fun technology do you get to use as a Senior Business Analysts at Digital Management; LLC?

Physically, all I use is a computer, a mouse, and a speaker. But in terms of software I use many different things. Like previously mentioned I use Slack to keep in close contact with my team and clients, I use JIRA and Azure Dev Ops to manage the backends of the projects we are currently working on, I use Figma to manage mockups that we use to develop the web page we're building, and screen capture tools, for which my favorite is TechSmith Capture.

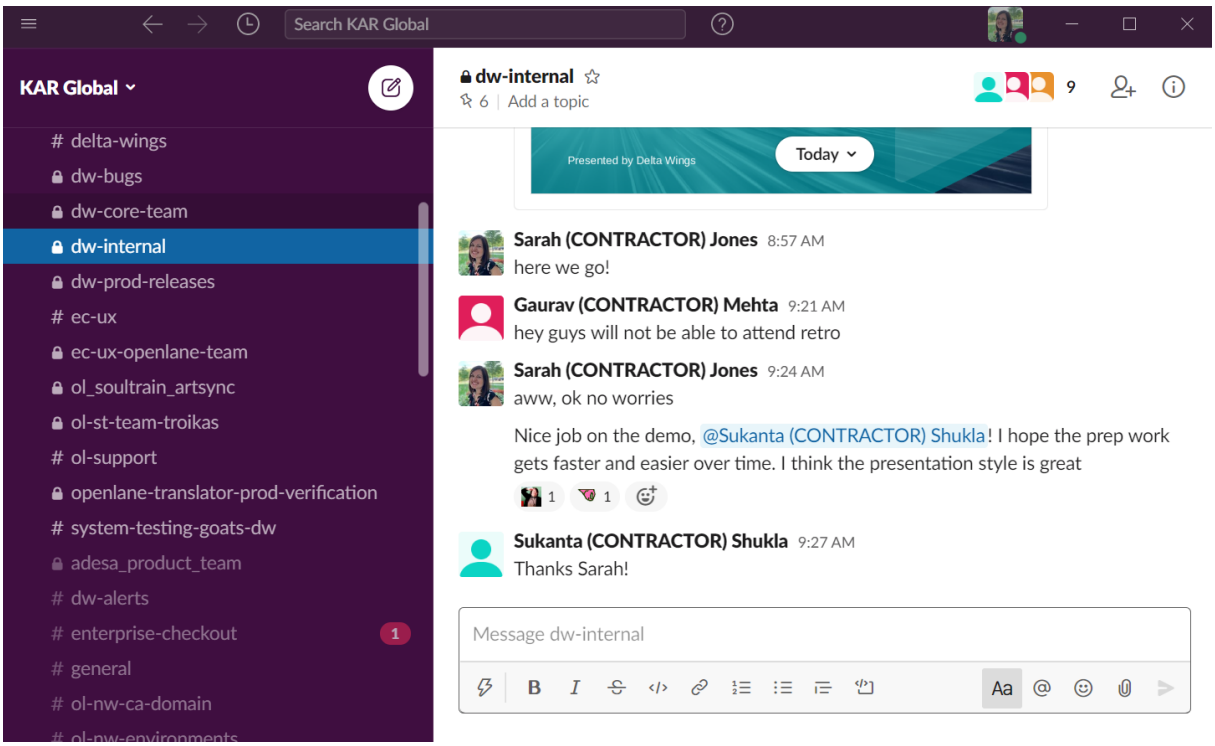

Figure 1
Slack is for team collaboration, jokes, and sharing memes to lighten up the workspace, and having as much personal interaction as possible while working from home.

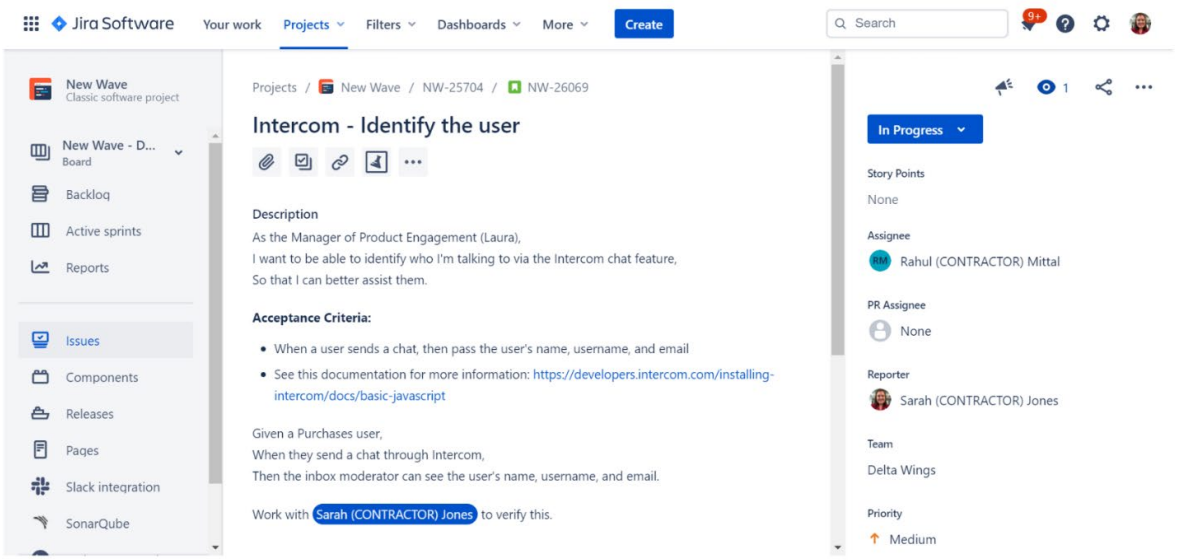

Figure 2
JIRA is used for managing the back logs, along with Azure Dev Ops which is something I also use.

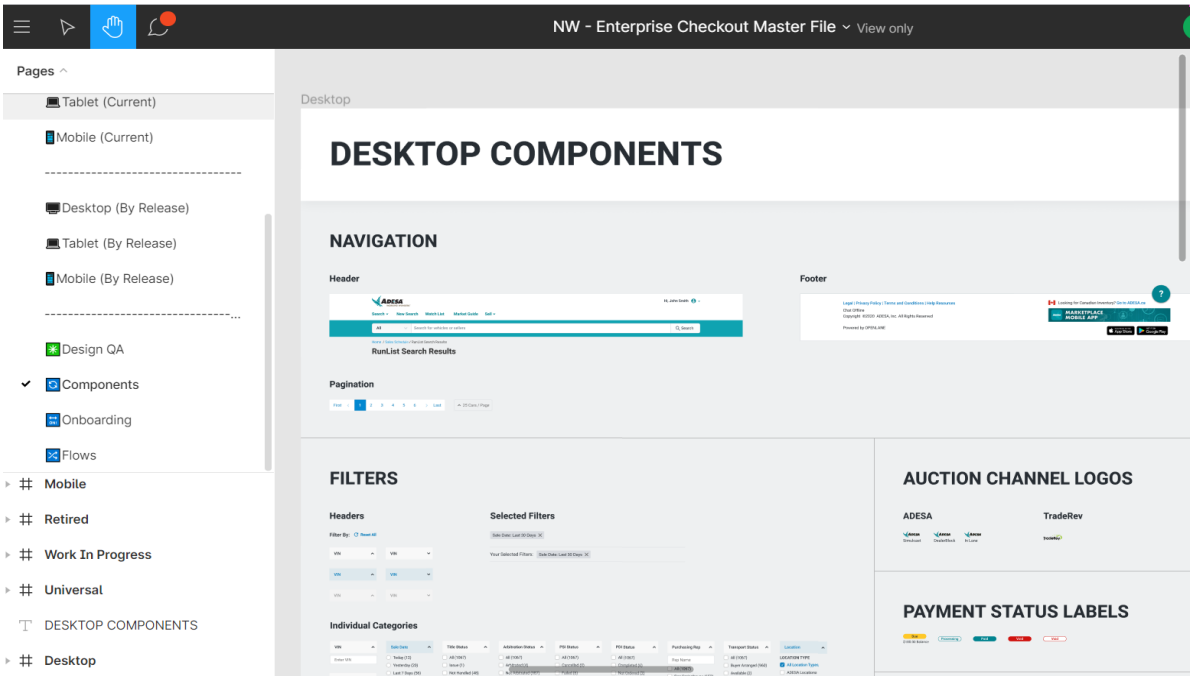

Figure 3
Figma is for managing mockups for the web page we're building.

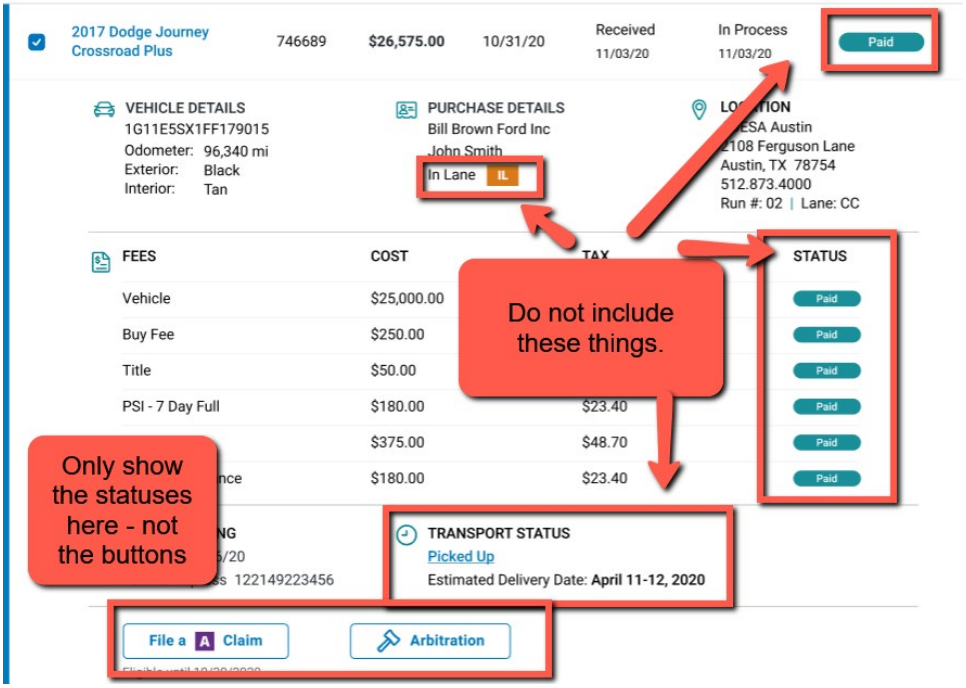

Figure 4
Expanded Drawer is a screen capture tool that allows the user to also annotate with on the fly.

7. What advice would you give someone who would like to get into this career?

I would say, aim big. Have an ambitious goal. Don't settle for a company that asks for just a "business analyst," but really, they just want someone who can push buttons. Find a job where you are working directly with customers, engaging real people, and helping businesses solve problems. Know what your options for career growth are. If it's a path of Agile Business Analyst > Product Owner > Product Manager, or if there are opportunities for leadership, then that's what you want! If you're going to be holed up somewhere updating Excel files and there is a vague answer on career growth, don't go for it.

Conclusion

Management analysts help keep businesses viable with creative thinking and agile methods. This career is best for those who have a competitive edge and are confident in their abilities. For those considering a career as a management analyst, there is projected to be a steady increase in the number of jobs available in this field. Those individuals who wish to venture into this career path should reach out to those already in the field, ask questions, shadow them, or maybe even secure an internship with a consulting firm to gain foundational experience.

References

Brooks, A. (2018, April 10). *What Is a Management Analyst? And 4 Other Questions About This Career*. Retrieved October 18, 2020, from Rasmussen College: https://www.rasmussen.edu/degrees/business/blog/what-is-management-analyst/

Bureau of Labor Statistics, U.S. Department of Labor. (2020, September 1). *Management Analysts*. Retrieved September 7, 2020, from https://www.bls.gov/ooh/business-and-financial/management-analysts.htm

Canavan, C., & Schneider, M. (2015). Bringing UNICORNS to the Federal Government. *Journal of Government Financial Management*, 64(3), 12–16. Retrieved October 19, 2020

DATA USA. (2018). *Management Analysts*. Retrieved October 18, 2020, from https://datausa.io/profile/soc/management-analysts

Jones, S. (2020, October 7). Senior Business Analyst. (S. P. Miller, & E. J. Lazaros, Interviewers)

School Superintendent and Assistant Superintendent Career Path Exploration

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Introduction

This article will outline information related to a career in education administration as a school superintendent. The purpose of this article is to help inform prospects of the intricacies of the career and allow them to make informed decisions about whether this career is right for them. This article will cover the following information related to a career as a school superintendent, in this order: responsibilities, how to become one, pay and benefits, job outlook, and an interview with someone currently in the position of assistant school superintendent.

Responsibilities of School Superintendents

School superintendents are the chief executive officers (CEOs) of their respective districts, and act as administrators at the district level (Teacher.org). As such, superintendents oversee school administrators at lower levels, and are often tasked with hiring, placing, and evaluating principals within their district. Superintendents also make decisions related to budgets, such as choosing educational programs and staffing different facilities (Teacher.org).

While superintendents do not primarily work within school buildings, they do need to familiarize themselves with each school within their district, and often visit buildings in order to gain a sense of where changes need to be made related to faculty, budgeting, and allocation of other resources. Otherwise, superintendents generally spend much of their time working from a central office or meeting with board members and other administrators (Teacher.org).

How to Become a School Superintendent

School superintendents are expected to have at least a master's degree or higher; this degree is typically in education administration or education leadership. Some states also require candidates to pass an exam and have a certain number of years of experience in school administration, as a principal or something similar (Teacher.org). Because of this, a superintendent will have had to complete teaching licensure requirements, including a bachelor's degree in an education field, a licensure exam, and any relevant background checks. They would likely also have taken additional classes related to leadership in order to have been hired as a principal (Teacher.org).

Pay and Benefits for Superintendents

According to Salary.com, the average base salary earned annually by a school superintendent is $159,352, and the range of actual earnings is between $130,168 and $192,275. This is at odds

with other sources, such as the School Superintendents Association (AASA), which reports a mean salary of $125,096 across all superintendents in the 2007-2008 school year; adjusted for inflation, this is slightly less than the lower limit provided by Salary.com. AASA also reports that the mean annual salary for assistant school superintendents was $112,587 the same year; assistant superintendents typically earn less annually than superintendents do.

Job Outlook for School Superintendents

Limited information is available in regards to job outlook specifically in regard to school superintendents; however, the United States Department of Labor predicts that the rate of growth for all education administrators will be eight percent from 2016 to 2026, which is approximately the same as the average across all occupations (2019). As in all education-related jobs, employment is expected to grow for administrators as student enrollment continues to increase as well.

According to Top Education Degrees, the demand for school superintendents will most likely be highest in public school districts, as opposed to private, charter or parochial schools. However, districts may face challenges related to growth as federal funding to education is cut or otherwise limited. This will affect assistant superintendents more so than superintendents, as this position is often contingent on available funding for additional personnel (Top Education Degrees).

Interview with Dr. David Sturgeon

1. How did you come to be in your current position in Yorktown Community Schools?

I am currently the Director of Education Initiatives (an assistant superintendent role). I was hired by Dr. Jennifer McCormick before she ran for election for her current elected position as our State of Indiana Superintendent of Schools. I served as an interim superintendent for 6 months as I was not interested in keeping it and asked to move back into my director's role. I have been with Yorktown Schools as a middle and elementary teacher, assistant middle school principal and athletic director, middle school principal and now my current central office role (D. Sturgeon, personal communication, June 10, 2019).

2. What do you most enjoy about your job?

I enjoy my job responsibilities and that I get to work with all levels of teachers and building principals—I get to say yes to most things and the "no's" are handled by the superintendent (D. Sturgeon, personal communication, June 10, 2019).

3. What does a typical day at work look like for you?

Much of my day consists of returning emails and/or in-person meeting with our technology integration specialist or technology coordinator, meeting with elementary principals, school

district psychologist, etc. I also am in charge of all federal and state grants (applying for and implementing as well as working with my grant coordinator to follow). I am in charge of high ability for the district—mostly in the identification process (D. Sturgeon, personal communication, June 10, 2019).

4. How do you use technology in a typical work day?

Email, phone calls, MacBook and Apple software for developing online professional learning opportunities within Canvas (our learning management system), occasional WebEx meetings and trainings, several online portals for grant applications and tracking, and utilizing educational websites for supports for teacher needs or principal needs (D. Sturgeon, personal communication, June 10, 2019).

5. What is the biggest challenge you face on a daily basis?

Getting timely responses from people outside of the district; I may need timely responses back to be able to move forward on pieces of some grants (D. Sturgeon, personal communication, June 10, 2019).

6. What makes your position in Yorktown Community Schools unique?

I wear many hats and that makes my position unique. Also, many people don't fully understand what goes into the grant process or curriculum making decisions for the district (D. Sturgeon, personal communication, June 10, 2019).

7. What advice do you have for someone who wants to become a superintendent?

Having served in that role for 6 months and knowing that I do not want that position I would say a person needs to be fully aware of the political dimension that the role of superintendent holds. They need to be politically savvy and able to work with and communicate effectively with their board members who are elected into those positions, community and business members, community groups such as the local Chamber of Commerce, etc. I would also recommend a future superintendent serve in a role of building principal for several years and in a central office business or assistant or director's role to have a better understanding as to the demands of the superintendency (D. Sturgeon, personal communication, June 10, 2019).

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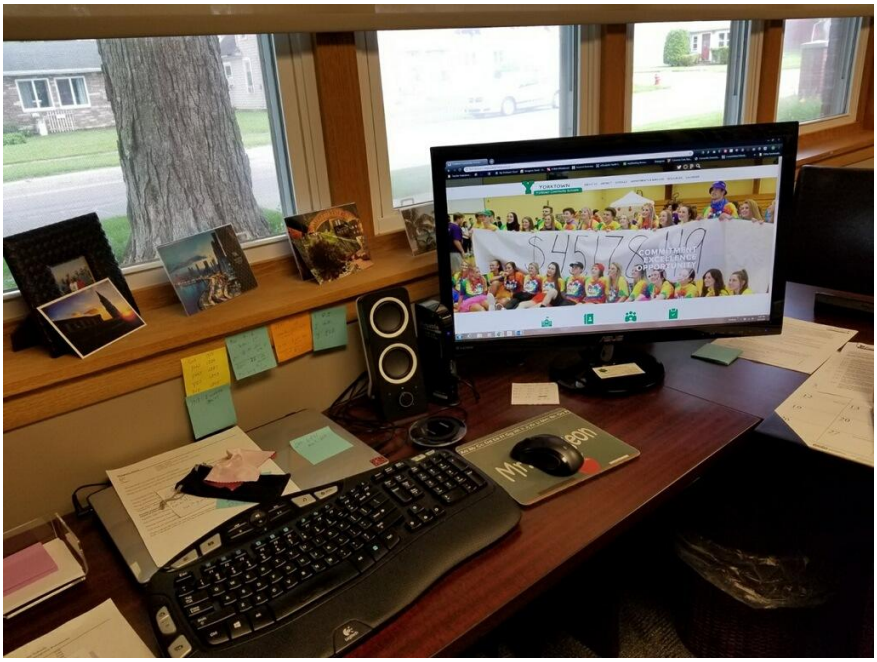
Dr. David Sturgeon sits in his office, where he works throughout the day when he isn't visiting schools or in meetings.



Dr. David Sturgeon's desk, including his desktop computer, where he's visiting the Yorktown Community Schools official website.

Conclusion

Chris Gaines, president of the School Superintendents Association (AASA), says that "we know now, perhaps more than ever, that all learning doesn't have to look alike." This, to him, is part of what school superintendents can help create: innovative ways to educate students, starting at the district level. School superintendents have a vast array of responsibilities as the district-level administrators of their respective schools. School administrators almost always need to have worked as classroom teachers and as principals prior to being hired as superintendents, so they must be experienced and dedicated to education at the classroom, school, and district levels. Someone fitting this description who pursues an education-related master's degree or higher would be a good fit for a career as a district-level school administrator.

References

D. Sturgeon, personal communication, June 10, 2019.

Salary.com. (n.d.) School Superintendent Salary in the United States. Retrieved June 6, 2019 from: https://www1.salary.com/school-superintendent-salary.html

School Superintendents Association. (n.d.) School Superintendent Salary Data. Retrieved June 7, 2019 from: https://www.aasa.org/content.aspx?id=3030#

Teacher.org. (n.d.) How to Become a Superintendent. Retrieved June 6, 2019 from: https://www.teacher.org/career/superintendent/

Top Education Degrees. (n.d.) Job Profile: School Superintendent. Retrieved June 7, 2019 from: https://www.topeducationdegrees.org/job-profiles/school-superintendent/

United States Department of Labor. (2019, April 26). Elementary, Middle, and High School Principals. Retrieved June 7, 2019, from: https://www.bls.gov/ooh/management/elementary-middle-and-high-school-principals.htm#tab-1

Construction Safety Professional Career Path Exploration

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Abstract
Construction is a leading industry in terms of economics but is one of the most dangerous for its employees. The construction safety professional plays an important role in helping protect employees from work-related injuries and fatalities. This article considers key aspects of the construction safety professional career: typical job responsibilities, how to become one, pay and benefits, and job outlook. Additionally, interviews with two current construction safety professionals are included to help provide real-world details on the career such as daily routines, technology used, and challenges.

Keywords: *safety professional, construction safety, occupational safety, occupational safety and health professional*

Introduction

There are a variety of job titles used in this field of construction safety such as *safety director, safety manager*, *occupational health and safety specialist, safety consultant,* and others. For simplicity, this article uses the term *construction safety professional*. The purpose of this article is to introduce the reader to the construction safety professional career. Key aspects of the career of construction safety professional (typical job responsibilities, how to become one, pay and benefits, and job outlook) are discussed below.

The job responsibilities of the construction safety professional are similar to other safety professionals who work in industries like manufacturing and mining. However, construction work presents special circumstances in that workplace conditions change dramatically over the course of a project, the work requires a group of subcontractors working in the same location, and often involves the use of heavy equipment. To help illustrate the career of construction safety professional, questions and answers produced by interviews with two construction safety professionals are provided. It is possible that the information given here will help the reader make an informed career choice.

Responsibilities of Construction Safety Professional

The construction industry is one of the largest industrial sectors in the United States, with about 680,000 employers and over 7 million employees (Association of General Contractors, 2021). Construction projects range from simple home repair jobs to very complex high-rise buildings and include infrastructure projects like highways, dams, and bridges. Unfortunately, construction work can be very hazardous and involve accidents leading to serious injuries and fatalities among employees. Such accidents are not only tragic but can be very expensive to a construction company due to the medical expenses, lost productivity, lawsuits, government fines, and other costs that occur as a result. The total costs of injuries and fatalities in the construction industry in 2002 were estimated at $11.5 billion (Waehrer et al., 2007). Many construction companies have found it cost effective to employ one or more construction safety professionals tasked with preventing workplace accidents.

The construction safety professional's job duties fall into four main categories: conducting safety audits, providing training to employees, conducting accident investigations, administering the employer's safety program. These duties will be discussed in detail next.

1. Conducting safety audits

Construction safety professionals conduct safety audits (also called *inspections*) of the construction projects that their company is working on. Safety audits involve walking the entire construction site to make sure that hazardous conditions are not present and that employees are following the company's safety rules. If hazards are discovered (such as unguarded live electrical equipment) the construction safety professional will make sure that the problems are corrected so that no one gets hurt. There may also be disciplinary action taken against employees who are found to have broken the safety rules. Safety audits are usually documented by taking photos, interviewing employees, and collecting other key information. The findings of the safety audit will then be reported to the company's upper management officers (Roughton & Crutchfield, 2008).

2. Training employees

The construction safety professional will provide training over safety issues to the company's construction workers and managers (Haight, 2012). In some cases, this training may also be provided to the subcontractors hired by the company. Classroom-style training commonly covers the safety regulations required by the Occupational Safety and Health Administration (OSHA) as well as the employer's own safety rules. Hands-on safety training typically involves instructing employees on practical safety tasks like how to use fire extinguishers and personal protective equipment. Training is a form of communications and public speaking, both which are mentioned in further in the two interviews with construction safety professionals below.

3. Conducting accident investigations
Construction safety professionals investigate work-related accidents to determine what happened and prevent it from reoccurring. Investigations are conducted when employees get hurt or killed and when company-owned equipment like trucks, backhoes, and cranes get damaged. These investigations involve collecting information about the accident by interviewing witness, taking photographs of the accident scene, inspecting equipment that was involved, etc. The information gathered during the investigation will be organized by the construction safety professional into a report for upper management. The accident report may also be used for filling insurance claims for medical bills and equipment repairs (Crittenden, 2009).

4. Administering the company's safety program
The construction safety professional is responsible for keeping the company's safety program up to date. The program includes all the documentation produced by the activities mentioned above: safety audits, employee training, accident investigations, and other records. Some documents may be in writing, but many are digital, so construction safety professionals must also be comfortable with using computers. Handheld computers are used in in for field work, while report writing using word processing programs, recordkeeping using spreadsheets, and internet research into technical safety issues is accomplished using a desktop or laptop computer.

Becoming a Construction Safety Professional

Education
Many construction companies prefer that construction safety professionals have a safety-related bachelor's degree. There are approximately 27 universities in the United States which offer degree programs related to occupational safety. Many of these are offered completely online (BCSP, 2021a). Some of the most prestigious safety degree programs are accredited through the American Board for Engineering and Technology (ABET, 2021).

Ongoing training
Construction safety professionals will continue their own training and education because construction safety involves a range of complex and constantly changing issues. Construction safety professionals may take courses on topics such as fall protection, heavy equipment use, electricity, and hazardous chemicals to keep their knowledge of these and other issues current and learn about new safety issues.

Safety training courses are available through providers like the OSHA Outreach Training Institute Education Centers (OSHA, 2021). The OSHA 10- and 30-hour Outreach Training

courses are widely recognized in the construction industry and may be required by some employers.

Professional certifications

Professional certifications such as the Certified Safety Professional (CSP) designation are prestigious and can lead to higher wages for construction safety professionals. To qualify, the construction safety professional must have been in the career for several years and pass a challenging certification test. Other safety-related certifications include the Construction Safety and Health Technician (CHST) and the Occupational Hygiene and Safety Technician (OHST). The CSP, OHST, and CHST designations are administered by the Board of Certified Safety Professionals (BCSP, 2021b).

Pay and Benefits for the Construction Safety Professional

The U.S. Department of Labor (2019) reported that the median annual wage for the *occupational health and safety specialist* (which includes construction safety professional) was $74,100. Similarly, the Board of Certified Safety Professionals and National Safety Council (2020), found that the median salary for safety professionals in the construction industry was $72,000 per year. This salary was specific to persons working for 5 or fewer years in a safety-related position, and included all possible job titles (i.e., *director/manager/etc., branch/division/area/regional mgr./supervisor, professional, consultant, other*). Salary information can be substantially different according to location, type of company, education, and other factors.

Job Outlook for Construction Safety Professional

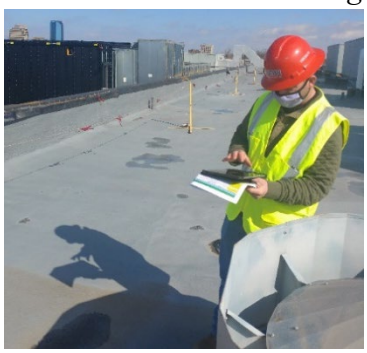
Overall, the job outlook for construction safety professionals should be considered as equal to or better than all other jobs. The projected growth of jobs for *occupational health and safety specialists* (a group that includes construction safety professionals) is between is 4% per year from 2019-2029, which is the same growth projected for all other jobs (U.S. Department of Labor, 2019). Safety and Health magazine found that its readers considered the job outlook as being "better" (54%), "the same" (40%), and only 6% "worse" (Vargas, n.p., 2019). Overall, this indicates a good job outlook for construction safety professionals.

Interview with Construction Safety Professional: Derrick Pittman

Background: Derrick Pittman works for a successful general contractor engaged in construction projects in the southern United States. Derrick Pittman's title is *Safety Manager*. He is currently pursuing a Bachelor of Science degree in Occupational Safety. Derrick Pittman was interviewed by Dr. David Stumbo on February 12, 2021. You can read the questions that Derrick Pittman was asked about his career in the following sections.

1. **What do you like most about your job?**
   "*I like getting out and going to jobs. Visiting the site, not just spending time in the office.* (See Figure 1.) *And I like making my company better by making sure employees stay safe."*

   Figure 1
   Derrick Pittman conducting a safety audit of a construction worksite.

2. **What is your daily routine like at this job?**
   "I usually start off in my office. I check on email and then see what jobs are going on. That determines where I'm where headed that day and maybe the day after. I usually visit one or two job sites each week. On safety audits, I will probably spend about four hours just walking the jobsite. On average, my travel time for site visits ranges from 30 minutes up to 2½ hours each way."

3. **What would you say to someone who was looking to get into this type of career?**
   "I recommend it. I really like it because it's not limited to just office work or working outdoors the whole time. Working outdoors every day is rough in the cold and heat. This job is the best of both worlds, both office and outside."

4. **What do many people not understand about this field?**
   "They probably don't understand just how much work goes into construction safety. People might also not understand how important training is. Safety training is an ongoing part of our work and it take a lot of time. There are a lot of OSHA regulations and a whole new bunch of requirements came with COVID-19. I do short weekly meetings (called 'toolbox talks') that help train employees about safety issues. I also have a monthly safety meeting. I have to keep up my own training, too. I just finished an OSHA 30-hour class where I learned quite a bit. I'm also working on a bachelor's in

occupational safety. I take it online because I'm working this job full-time. It seems like my CEO wants me to go on a start on a master's in safety after that.

5. **What kind of technology do you get to work with in this career?**
   "*I use computers a lot in the office. I use MS Teams for virtual meetings, track all the employee training using an Excel spreadsheet, and use PowerPoint to present information to my executive directors. My company uses specialized project management software that lets me know which construction projects I need do safety audits on. Also, I have a safety management software package that I use for site audits that runs on my iPad. It allows me to document hazards that I find with photos attached* (See Figure 2) *and puts everything in a report that I send to the project managers and subcontractors."*

   Figure 2
   An empty fire extinguisher discovered by Mr. Pittman during a construction safety audit

6. **What are some of your biggest challenges in your career?**
   "*There is a pretty big learning curve coming in. I had to learn a lot about safety. I'm still going to training and taking college classes. The other thing is that I have to do a lot of speaking in front of people, training employees and giving presentation to my supervisors. I'm still getting used to that."* (D. Pittman, personal communication, February 12, 2021.)

Interview with Construction Safety Professional: Devan Hale, GSP

Background: Devan Hale has been working as a construction safety professional since earning bachelor's degree in occupational safety in 2016. He works for a construction company located in the southern United States and his job title is *Site Safety & Health Officer.* Devan Hale was interviewed by Dr. David Stumbo on February 12, 2021. You can read the questions that Devan Hale was asked about his career in the following sections.

1. **What do you like most about your job?**
   "In the construction industry it is something new every day; not the same facility and faces. Lots of subcontractors. Different faces. And I really care about keeping people safe. Part of the reason I chose safety was because of a tragedy involving a cousin of mine."

2. **What is your daily routine like at this job?**
   "Generally, I start early and, in some locations, at daybreak to beat traffic. It will be at least an 8-hour day, regardless of start time. The exact work hours are kind of random, longer or shorter, depending on what's going on at that time with the project. When there is a lot of work, really busy, it might require a 10-hour day or longer. It took me a while, but I learned to anticipate about how long the day would be, based on what was planned for the jobsite.

   When I get to the site there is a job trailer and then I'll have a mix of office and field time. How much time you spend on each is up to you. For some jobs, the owner or general contractor may require that will be a morning meeting every day where we review the job and safety issues with subcontractors. On some projects there may be a bunch of subcontractors. A company for concrete, company for crane operations, another for electrical, another for plumbing, dry wall, paint, and maybe more. We more or less have to keep up with what they're doing in terms of safety.

   Traveling is part of the job. With construction some jobs can last a long time and you may get moved around without much notice. For over two years, I lived in the same city where my company had multiple projects going. I traveled in a 150-mile radius during that time. My company was pretty nice about it and provided extra pay to offset some of my living expenses."

3. **What would you say to someone who was looking to get into this type of career?**
   "*Make sure that you have some passion about safety...don't pick this one just to get done deciding on your career. I would say that you should make sure to get an internship as soon as you can. Absorb as much as you can. My safety internship got me my first job. It didn't come easy; I got turned down for 5 internships at first.*"

4. **What do many people not understand about this field?**
   "*You have to be able to enjoy folks. It's a people-type job. Some may think it's based on regulations & rules. But with those, there's a lot of grey area. What's really big is connecting with people; being able to communicate. If you can talk and build a*

relationship, then you can get their buy-in for safety. Then you can create a good safety culture…and get folks to protect themselves even when the safety manager is not around."

5. **What kind of technology do you get to work with in this career?**
   "*One company I worked for had me do jobsite visits where I would take photos/record all the good safety practices going on and the safety problems. We would then compile all the observations and analyze the data. What was the costliest incident? Is it ladders? Or some other issue? Whatever the main issues were, we'd then set up our training programs to address them.*

   For safety I use an air meter, what we call a 'breather.' It carries a monitor that checks for 10 different gasses…CO, CO2, explosive gasses…for confined space entry operations. That makes sure the air in the space is safe for workers. I use a computer in the office with MS Word for reports and Excel for tracking training and budgets."

6. **What are some of your biggest challenges in your career?**
   "*Getting adjusted to construction life, in terms of not knowing where you're going to be sometimes. There's quite a bit of uncertainty. That's more about construction overall, not safety. Also, not being able to speak Spanish! I have struggled with that. There are so many Spanish-speaking construction workers. I've taken some college classes, but honestly I think I have learned more from a language app on my phone that I use a lot*." (D. Hale, personal communication, February 12, 2021.)

Conclusion

The career of construction safety professional provides a variety of job responsibilities, as well as the underly purpose of protecting employees, that students may find appealing. Although a degree in safety is not universally required, it is likely to help those seeking a position. Completing a bachelor's degree is likely to be worthwhile because the salary and job growth outlook are good for construction safety professionals. Each person will need to consider their circumstances and personal preferences when selecting a career. Discussing these issues with a career counselor or construction safety professional can help make the best decision.

References

American Board of Engineering and Technology. (2021). *Why ABET accreditation matters*. https://www.abet.org/accreditation/what-is-accreditation/why-abet-accreditation-matters/

Association of General Contractors. (2021). *Construction data*. https://www.agc.org/learn/construction-data

Board of Certified Safety Professionals. (2021a). *BCSP credentials at-a-glance*. https://www.bcsp.org/safety-certifications/at-a-glance

Board of Certified Safety Professionals. (2021b). *Academic program directory*. https://www.bcsp.org/resources/academic-database

Board of Certified Safety Professionals & National Safety Council (2020). *The 2020 SH&E Industry Salary Survey and Calculator*. https://www.bcsp.org/resources/salary-survey

Crittenden, P., (2009). *Supervisors' safety manual* (10th ed.). National Safety Council. ISBN-13: 978-0879122881.

Haight, J., (2012). *Hazard prevention through effective safety and health training*. American Society of Safety Engineers, Park Ridge, Ill.

Occupational Safety and Health Administration (2021). *OSHA training institute education centers*. https://www.osha.gov/otiec/

Roughton, J., & Crutchfield, N. (2008). *Job hazard analysis: A guide for voluntary compliance and beyond*. Burlington, MA: Elsevier.

U.S. Department of Labor. (2019). *Occupational outlook handbook.* https://www.bls.gov/ooh/healthcare/occupational-health-and-safety-specialists-and-technicians.htm

Vargas, S. (2019). *2019 Job outlook:'Selling' the safety profession*. https://www.safetyandhealthmagazine.com/articles/18254-job-outlook-2019

Waehre, G.M.; Dong, X.S., Miller, T., Haile, E., Men, Y. (2007). Costs of occupational injuries in construction in the United States. *Accident Analysis & Prevention*. Nov; 39(6):1258-66. doi: 10.1016/j.aap.2007.03.012.

Expanding College-Connected Apprenticeships to Improve Social Equity and Inequality

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Abstract
The events of 2020 in the U.S have brought economic inequality and social justice to the forefront of society. Literature suggests that apprenticeship can serve as a pathway to access higher education, remove financial barriers, and give economic opportunity to all. The program's earn and learn structure creates a framework for a participant to receive not only a debt-free education but also a sustainable wage throughout the process. Prior to COVID-19, the U. S. economy saw unprecedented growth and historically low unemployment rates; however, wages low and middle-skill workers stagnated for decades (Zessoules & Ajilore, 2018). While productivity and profitability increased, gains have largely been realized by only by the upper tier of Americans, exasperating the persisting income inequality gap and creating an ominous outlook for the future middle-class standard of living. The share of American adults who live in middle-income households has decreased from 61% in 1971 to 51% in 2019 (Schaeffer, 2020). Moreover, gaps in both employment and income by race and gender have disproportionate labor market consequences for certain groups. Despite higher educational attainment, wage gaps and growing income inequality divide along racial lines. The New Jersey Institute of Social Justice (NJIST, 2020) sees apprenticeship as a way to help bridge the inequality gap while creating more equity and opportunity for people of all gender, race, and socioeconomic background.

Introduction

Economic inequality in the United States is a central issue in mainstream popular culture, political commentary, and scholarly research. The subject of inequality and the economic mobility of people with low socioeconomic status took center stage in the public discourse in the years following the Great Recession (Lerman, 2016). Experts subsequently focused on two aspects of inequality. The first aspect concerns the separation of the 99% of society from the rising concentration of incomes of the top 1 %. Piketty (2014) found data indicating the trend toward income inequality will persist due to the increase in income from capital investments. The second factor contributing to economic inequality proliferation is the differences in educational attainment. The three career pathways available to the American worker are straightforward: the high school pathway, the middle-skills pathway, and the bachelor's degree pathway (Carnevale et al., 2018). Throughout a career lifetime, a worker with a high school diploma earns on average $1.3 million, a bachelor's degree earns $2.3 million, a Doctor of Philosophy nets $3.3 million, and a professional degree earns $3.7 million. (Carnevale, 2016) Although there have been overall gains in college completion, those results still bring weak

results for low-income and minority students. This paper explores an alternative approach: expanding college-connected apprenticeship as the primary means for reducing wage inequality and increasing opportunity for economic mobility for all people regardless of race, gender or social class.

Apprenticeship is an employer-driven, earn and learn model that combines on-the-job training provided by the employer that hires the apprentice, with job-related instruction in curricula tied to the attainment of national skills standards. The model also involves progressive increases in an apprentice's skills and wages (DOL, 2020). Since apprenticeships require far less of a financial investment than college for the participant, there are fewer barriers to entry, more attainable for low-income students, and more likely to lead to valued occupational credentials. Apprentices typically pay little or nothing for their classroom-based education and experience no opportunity cost due to the lost earnings during the skill development period (Lerman, 2016). At the same time, not only do college students forego substantial amounts of earnings but also many have to pay significant amounts for their formal education. Many apprenticeship programs result in the completion of a college degree paid for by the sponsoring employer (DOL, 2020).

In the U.S., the modern concept of apprenticeships is categorized as a work-based learning (WBL) strategy. The apprenticeship frameworks are classified as Registered Apprenticeships (RAs) regulated by the U.S. Department of Labor (DOL) who awards a federal certificate upon completion. The DOL Registered Apprenticeship (RA) program covers over a thousand occupations; however, many of the occupations outside of the skilled trades are relatively new programs to the federal registry. DOL defines an RA program as innovative work-based learning and post-secondary earn-and-learn models that meet national standards set by DOL. These standards must meet five essential criteria (DOL, 2020):

1. Participants are paid by employers during training.
2. Programs meet national standards for registration with the U.S. Department of Labor.
3. Programs provide on-the-job learning and job-related classroom or technical instruction.
4. On-the-job learning is conducted under the direction of one or more of the employer's personnel.
5. Training results in an industry-recognized credential that certifies occupational proficiency.

Systemic societal structures create barriers to access career advancement opportunities for people of low socioeconomic status (NJISJ, 2020). The paper will suggest through findings in the literature how apprenticeship can play a part in leveling the playing field. To begin, this paper will chronicle apprenticeship's expansion from colonial America to its modern reemergence as a popular policy initiative. Next, it will explore how apprenticeships intersect with economic and

social theories to give a foundational understanding of the advantages and drawbacks from a theoretical perspective. Lastly, opportunities for apprenticeship's alignment with established higher education pathways give potential solutions for addressing economic inequalities and social equities.

Apprenticeships' Journey in the New World

Apprenticeships are perhaps the oldest form of knowledge transfer and educational structure known to civilization. Tracing its roots back to the 18th century B.C., the Code of Hammurabi of Babylon obligated artisans to pass down their crafts to the next generation workers. The ancient Greeks and Egyptians held apprenticeship in high regard as a way to pass along the skills needed to build their timeless structures. In Medieval Europe, apprenticeships were essential to Europe's rise through programs established in guilds such as blacksmiths, stonemasons, and leather smiths (Rolland, 2016). Prior to the industrial revolution, skills were tacit, and the only method to transfer knowledge was to learn from a master craftsman. Few people in ancient times could read, so learning by doing was the most effective pedagogy (Jacoby, 1991).

By the time European settlers established colonial America, apprenticeship was a staple of European culture. As those craft workers immigrated to the colonies from European countries, they brought with them the same system to pass along their craft and trade to youth going up in their communities. Some master artisans even went so far as to teach their apprentices reading, writing, and arithmetic. Some of the country's most well-known forefathers benefited from this system, such as George Washington (surveyor), Benjamin Franklin (printer), and Paul Revere (silversmith) (Lorenzo, 2017). However, with the arrival of the Industrial Revolution in the mid-1800s, the need for apprentices began to diminish because virtually no skills were needed for factory mass-production jobs. Only jobs that required some type of handicraft or specialized knowledge maintained an apprenticeship culture.

As the construction boom swept across early 20th century America, apprenticeships started to reenter the mainstream through the specialized building trades. Occupations such as machinists, ironworkers, pipefitters, and electricians began to form labor unions and organize a system of training their new members into the profession. Beginning in the 1920s, the legislative success in Wisconsin created a groundswell of support for a uniform national apprentice system from government officials, educators, labor organizations, and national employers. As a result, the Federal Committee on Apprenticeship was appointed by the Secretary of Labor appointed to recommend a unified national system for apprenticeship (Apprenticeship.gov, 2020). Codified into existence in 1937, Congress passed the first national piece of unifying legislation for apprenticeship. Known as the 'Fitzgerald Act,' the National Apprenticeship Act mandated the Department of Labor to formulate the continuance of labor standards necessary to safeguard the welfare of apprentices and to cooperate with the States in the promotion of such standard (Apprenticeship NC, 2020).

Modern American apprenticeship movement. Apprenticeships have languished in the United States for decades ever since due to being typecast as applying only to blue-collar professions (Jones, 2011). The system has experienced upswings and downturns that paralleled economic trends in the economy, but it has never grown to more than .02 % of the workforce according to the Committee for Economic Development (CED) (2019). The original arbiters of the apprenticeship system, the skilled trades union, have resisted sharing the mantle with other sectors of the workforce out of fear that the expansion would dilute the quality and rigor that they have fought for generations to build (Lerman, 2012**)**. Despite that long-held resistance, the program has seen bipartisan support and funding appropriations in recent years, since 2016 over $500 million has been allocated at the federal, state and local levels to expand apprenticeships to the now approximately 1000 occupations recognized by the Department of Labor (NSC, 2020). With a goal to reach one million new apprentices by 2022, the DOL saw its best year in 2019, reaching a record of 585,000 active apprentices (DOL, 2020). It remains to be seen how the trajectory of apprenticeship will be impacted by the economic downturn caused by COVID-19. It is possible that the recent uptick was propelled by employers seeking new hiring tactics during an era of record-low unemployment. Once the job market resets, employers may not be motivated to maintain the complexities of an apprenticeship training program, choosing instead to hire in more conventional ways if at all.

Nonetheless, the United States appears to finally be embracing the concept of apprenticeship as a key component of its workforce development; however, it has long been an essential career pathway across most of the developed world. In countries such as Australia, France, Germany, Norway, Switzerland, and the United Kingdom, apprenticeships serve as a mainstream and coveted career opportunity. For example, in Switzerland, 70% of all students choose apprenticeships, and 40% of companies participate (Hoffman & Schwartz, 2015). The country also boasts a 58% college enrollment rate, suggesting that apprenticeships are a complement to, rather than a detractor from, college education (Amoyaw & Brown, 2018; Hoffman & Schwartz, 2015). Contrary to the ubiquity of apprenticeship in Switzerland, in 2012, just shy of 150,000 Americans began an apprenticeship (Steinberg & Gurwitz, 2014). If the United States had the same rate of participation as Switzerland, that figure would rise to 3.1 million. These numbers suggest that U.S. employers are barely leveraging the potential of apprenticeships (Amoyaw & Brown, 2018).

In terms of significance, prestige, and public funding in the United States, degree-granting higher education institutions own the career and workforce development landscape that is designated to prepare students with the skill demands of a 21st-century economy (CED, 2019). Yet more than 30% of high school graduates under the age of 24 are not enrolled in college, and approximately 40% of students who enroll in college fail to successfully complete a degree within six years (Shapiro et al., 2018). Such statistics underscore the need for policy and pedagogical improvements in the secondary and higher education systems in the US. Even with the challenges the higher education sector faces with high costs and degree completion rates, the

only decision more expensive than going to college is not going to college (Carnevale, 2016). There is a systemic "…lack of focus on the functioning of, support for, and concerns surrounding alternative pathways to help students who do not secure a college degree to transition to careers, thereby ensuring a skilled workforce" (CED, 2019, p. 1).

Apprenticeship's Intersection with Social and Economic Theory

The lack of emphasis to support those left out of conventional career pathways helps to create a widening income inequality gap in the United States not experienced by many other industrialized nations (Symonds et al. 2011). In Europe, for example, after World War II, leadership knew they had to build out a decidedly regulated relationship between their education and the economy to ensure employment, especially for war veterans. An efficient training system was a central component of the plan. Therefore, Europeans very quickly built out things like apprenticeships, job guarantees, employment guarantees, and three-to-five-year unemployment insurance (Fadulu, 2017). In post-World War II America, the economy has done fairly well, so there has never been any threat that a working-class revolution which would motivate a comprehensive workforce protection system like the Europeans implemented. The apprenticeship model thrives in European countries such as Germany, partly because wages vary less across industries than they do in the U.S (Lerman, 2012). In the U.S., apprenticeship programs have struggled to gain a foothold because Americans use job-hopping as a means for career advancement. They are more likely than their European counterparts to leave a job for a different one that offers better wages. The average American will change jobs twelve times throughout their career (BLS, 2020). The risk of investing tens of thousands of dollars in someone who may leave for a better salary is a gamble few employers are willing to take (Fadulu, 2017). The pervasive mindset of business stakeholders in this country leans toward choosing near term profitability over long term sustainability.

This self-serving mentality displayed by the business community is attributed by scholars to the rise of neoliberalism in the United States (Saunders, 2007). Neoliberalism is a socioeconomic theory that dominates the commodification of public goods, material acquisition, and many of the consumerism behaviors in the United States. Proponents of the theory reject governmental regulation and economical intervention on any level (Giroux, 2004). Neoliberalism is derived from the term, liberalism, from the invisible hand, liberal economic theory conceived by Adam Smith and the Manchester School in the eighteenth century. The foundation of the theory centered around the free flow of supply and demand as a determinant market driver and focused on laissez-faire economic policy (Palley, 2005). The neo addition to the term liberalism took hold of the country in the 1980s. The modern incarnation of the theory is a stronger focus on the individual's property rights, combined with the scrutiny of governmental market intervention in the quest to maximize profitable returns (Saunders, 2007).

Adam Smith, to whom neoliberalism attributed, was an unrelenting critic of apprenticeship. Smith's opposition is based on his assertion that the institution of apprenticeship was both

inefficient and unjust. Rothschild (2001) groups his arguments about apprenticeship into four categories.

> The first, which is the closest to what would later have been thought of as an economic argument, is that exclusive apprenticeships tend to obstruct competition and to damage the public interest by keeping up wages and profits in particular industries, employments, or locations. The second argument is also, in part, about efficiency. Smith favored universal, obligatory education; he argues that apprenticeship is an unsatisfactory means of training workers either in particular skills or in habits of industry. The third argument is about both efficiency and equity; it is that apprenticeship, which is a restriction on personal liberty, is unjust to workers within apprenticeship relations and to other workers who are excluded from these regulated trades. The fourth argument is the closest to what would now be considered a purely political argument, although it is central, as will be seen, to Smith's account of economic change. It is that apprenticeships are unjust because they reflect an oppressive combination of public laws and corporate bylaws - a "corporation spirit" - in which laws are enacted for the benefit of the powerful, and enforced at the caprice of magistrates, masters, overseers, and churchwardens (p. 87-88).

Due to the nation's alignment neoliberal leanings, it can be attributed to this philosophy that apprenticeship has never taken hold, and the income inequality gap continues to widen.

Economic expansion and growing income disparities. Prior to COVID-19, the U. S. economy saw unprecedented growth and historically low unemployment rates; however, wages low and middle-skill workers stagnated for decades (Zessoules & Ajilore, 2018). Pew Research (2020) found that "Over the past 50 years, the highest-earning 20% of U.S. households have steadily brought in a larger share of the country's total income. In 2018, households in the top fifth of earners (with incomes of $130,001 or more that year) brought in 52% of all U.S. income, more than the lower four-fifths combined." While productivity and profitability increased, gains have primarily been realized by only the wealthiest tier of Americans, exasperating the persisting income inequality gap and creating an ominous outlook for the future middle-class standard of living. The share of American adults who live in middle-income households has decreased from 61% in 1971 to 51% in 2019 (Schaeffer, 2020).

The gaps in both employment and income by race and gender have disproportionate labor market consequences for certain groups. Despite higher educational attainment, wage gaps and growing income inequality divide along racial lines. As an illustration, earning a bachelor's degree or higher has not translated to the reduction of either the black-white or the Latinx wage gap (Wilson & Roger, 2016). Meanwhile, employers are spending less on their internal workforce professional development training, and usually, the training is industry-specific, resulting in non-transferable skills or credentials (Zessoules & Ajilore, 2018).

The division sewed by corporate employment practices led to a polarization of the workforce, stagnant wages, persistent systemic racial, and gender income inequality, and inequities in social mobility (Zessoules & Ajilore, 2018). The United States is becoming an increasingly diverse nation that consists of a majority of people of color. Achieving more parity in the workplace is essential to reflecting national demographic shifts and to filling future workforce demands. Yet, the country continues to see a declining workforce participation rate that is partially driven by legal and structural barriers to employment (Glover & Bilginsoy, 2005). A declining participation rate means more people of color and low socioeconomic status are being left behind. As economic gains increasingly go to the wealthiest, the financial situation for all other families become more precarious. More than four in ten adults (41%) are unable to spend $400 to cover an emergency expense, and a major life event such as losing a job, a health issue, or another unexpected loss of income or sudden expense will cause 62% of Americans to live in poverty at some point in their life (FederalReserve.gov, 2019). As a result, the already economically disadvantaged continue to experience rising economic inequality and less economic mobility, making it more challenging for an increasing number of people in the United States to afford a college or graduate education necessary for their advancement.

College-Connected Apprenticeships

Registered Apprenticeship programs, which is one of the few issues in Washington D.C. to have bipartisan support, aim to address this issue by providing Americans real opportunity with access to decent-paying jobs. The nation faces an increasing skills gap between technically trained job seekers and available jobs, particularly for middle-skill jobs and jobs in emerging industries. In fact, several industries are unable to operate at capacity and realize their full economic potential because they cannot fill critical openings (NJISJ, 2020). These middle-skill occupations are defined as jobs that require significant training beyond a high school diploma but less than a four-year college degree (National Skills Coalition, 2020). The training required can involve an associate's degree, diploma, professional certificate, or other specialized licensing or credential making them the perfect candidate for apprenticeable occupations. Middle-skill jobs constitute a vast segment of the employment spectrum. They make up more than half of the U.S. labor market (National Skills Coalition, 2020). Job titles range from dental hygienists and critical care nurses who earn $70,000 a year to CNC Machinists who earn $53,000 a year (ONET, 2019). Only 43% of the nation's workforce is trained at the middle-skill level; however, these occupations make up 53% of jobs in the United States, creating a middle-skills gap (Johnson & Spiker, 2018).

Even with a larger portion of students going on to attain higher education following high school, existing traditional college models of skill development and training will still fail to support the full scale of school to work pathways (CED, 2019). The lack of alternative pathways is harming large percentages of the population. This continued failure is disproportionately affecting the most vulnerable and disadvantaged youth. The US Department of Education's Education Longitudinal Study (2013) found that a youth from the highest quartile of socioeconomic status,

as determined by their parents' education and family income, was three times more likely to have received a college degree during cohort's observational timeframe than a child from the lowest quartile. This data conveys that the goal of college-for-all approaches to postsecondary education cannot be limited to four-year degrees. In part, this is because traditional higher education institutions do not have the infrastructure and support to affordably serve the needs of most minority and low-income workers and their employers who seek talent and skills that do not necessarily require a degree (CED, 2019).

Apprenticeship has a storied history in assisting with the upward mobility of minorities and economically disadvantaged the U.S. In 1881, Booker T. Washington was selected to open a new vocational, private industrial institution called Tuskegee based on the principles of cognitive problem-solving skills and learning by doing. The school was placed on 2,300 acres with 123 buildings and vocational programs ranging from electricity, machine shop, and bricklaying to painting and basket making (Standafer, 2019). After the Civil War, Washington and Frederick Douglass spoke about expanding vocational training for African Americans. They held the belief that industrial education would build economic self-reliance and better integrate people into industrial America. However, other Black leaders of the time, like W. E. B. DuBois, spoke out that this ideology was an acceptance of a substandard of living for the Black race (Hinman 2005). These philosophies differentiated Du Bois from more conservative black voices like Booker T. Washington. Dubois introduced the idea of "double consciousness," in which African Americans are required to consider not only their view of themselves but also the view that the world, particularly whites, has on them during all parts of life (Hinman, 2005).

American apprenticeship's degree pathway to upward mobility. The United States' European counterparts have long since acknowledged this problem of a skills mismatch with respect to the workforce and educational offerings. In countries like Austria, Denmark, Germany, Great Britain, Norway, Netherlands, and Switzerland, a dual education or 'dual-study' model of apprenticeship education is used to ease the school to work transition for the out-of-school and underserved youth population. Apprenticeships are as prevalent in these countries as internships are in the United States (Lerman, 2018). The literature on all aspects of European apprenticeship is extensive and encompasses several decades of research (OECD, 2017). Credited as the primary catalyst to European apprenticeship expansion, the dual education model combines classroom education in a post-secondary program of study with an employer-based multi-year apprenticeship arrangement (Hoffman & Schwartz, 2015). In this model, the education and training take place both in theory at the post-secondary institution and through WBL on-the-job training provided at the partnering apprenticeship company facility (Messing-Mathie, 2015).

This dual-education (or student-apprentice or degree-apprentices as it is known in the United States) model creates a learn and earn relationship between the employee (student) and the employer (workplace) (McCarthy et al., 2017). As apprentices, students apply directly to a firm, which has an agreement with an institution of higher education that provides the theoretical or

academic portion of the training. The renewed interest in developing apprenticeship models in the United States is oriented around this model of integrated post-secondary training providers into the apprenticeship framework and facilitation. Presently, community colleges and technical schools are the primary sector of higher education that functions as the organizers of apprenticeship programs (Messing-Mathie, 2015). These definitions create a massive opportunity and a direct pathway for the integration of higher education into newly innovative apprenticeship frameworks.

Conclusion

America has a long dysfunctional history with apprenticeship. For over a century, American families repeatedly rejected attempts to mainstream vocational education because technical education often precludes their school-age children from aspirational careers as doctors, lawyers, business executives, and scientists (Labaree, 2017). As a traditional four-year college pathway became the accepted gateway to elite professions throughout the early to mid-1900s, apprenticeships fell out of favor with America's upwardly mobile culture (Ferenstein, 2018). This mindset stigmatized the term as being synonymous with blue-collar construction trades. Experts say that Switzerland's apprenticeship system is the 'gold standard' because it is uniquely able to align the most prestigious careers with apprenticeships (Hoffman & Schwartz, 2015). If a successful American apprenticeship system is to be realized, the country needs the upper echelon of high-tech, growing companies to embrace the concept and place apprentices alongside graduates of the elite academic institutions. (Ferenstein, 2018). A connection with higher education is essential for that partnership to flourish as an advanced degree is often required for career growth within these elite organizations. The policymakers have a growth-oriented set of statutes in place for apprenticeship regulations. Higher education is in a position where low growth and high costs burden the sector, so a new vibrant program could help remove barriers to entry and give wider access to everyone willing to work for it. Lastly, the participants (students and employers) gain a partnership that streamlines the bureaucracy that plagues new program expansion efforts.

The timing is perfect for a mutually beneficial system that propels all sides of the apprenticeship triangle forward. The primary attraction to apprenticeships is the open access to the opportunity offered by an employer-sponsored career path and educational plan. For many participants who experience systemic social inequity and economic inequality, apprenticeships level the playing field and grant access to a world once thought unobtainable. Through a broadening of apprenticeship to growing and affluent occupational sectors like STEM and healthcare, all people, regardless of race, social class, gender, background, or sexual orientation, can have access to a system that is as invests as much in their future as they do. Apprenticeship empowers individuals to become self-reliant and realize that the helping hand they have been looking for is right at the end of their own arm. America has right now, perhaps its last, best chance to learn from the past apprenticeship failures and turn them into positives by leveraging the best higher

education community in the world. By granting unencumbered access to higher education credentials, the U.S. system could fast become the new 'Gold Standard' of apprenticeship.

References

Amoyaw, M., & Brown, D. (2018). Apprenticeship America: An idea to reinvent postsecondary skills for the digital age. *Third Way.* Retrieved online September 10, 2019 from https://www.thirdway.org/report/apprenticeship-america-an-idea-to-reinvent-postsecondary-skills-for-the-digital-age

Apprenticeship NC. (2020). History. Retrieved online May 31, 2020 https://www.apprenticeshipnc.com/about/history

Apprenticeship.gov. (2020). How to become an apprentice. Retrieved online May 31, 2020 from https://www.apprenticeship.gov/become-apprentice

Bureau of Labor Statistics (2020). Number of jobs, labor market experience and earning growth. Results from a longitudinal survey. Retrieved online May 31, 2020 from https://www.bls.gov/news.release/pdf/nlsoy.pdf

Carnevale, A. P. (2016). Credentials and competencies: Demonstrating the economic value of postsecondary education. *Georgetown Center for Education and the Workforce.* Washington D. C. Retrieved from https://cew.georgetown.edu/wp-content/uploads/Parchment-Credentials-Competencies-Issue-Brief.pdf

Carnevale, A. P., Strohl, J., Ridley, N., & Gulish, A. (2018). Three educational pathways to good jobs: High School, Middle Skills, and Bachelor's Degree. *Georgetown Center for Education and the Workforce.* Washington D. C.

Committee for Economic Development (US)(CED). (2019). Improving noncollege pathways to skills and successful careers. Committee for Economic Development of The Conference Board, Arlington, Virginia. Retrieved online May 31, 2020 from https://www.ced.org/reports/improving-noncollege-pathways-to-skills-and-successful-careers

Fadulu, L. (2017). Why the U.S. fails at worker training. *The Atlantic.* Retrieved online from https://www.theatlantic.com/education/archive/2017/11/why-the-us-fails-at-worker-training/545999/

Ferenstein, G. (2018). How history explains America's struggle to revive apprenticeships. Brookings Institution. Washington, D.C.

Giroux, H. (2004). The terror of neoliberalism: Cultural politics and the promise of democracy. Boulder, CO: Paradigm Publishers.

Glover & Bilginsoy (2005). Registered apprenticeship training in the US construction industry. *Education + Training* 47 (4/5): 337–349.

Harvey, D. (2005). A brief history of neoliberalism. New York: Oxford University Press.

Hinman, Bonnie. (2005). A Stranger in My Own House: The Story of W.E.B. Du Bois. Greensboro, NC: Morgan Reynolds

Hoffman, N & Schwartz, R.(2015). Gold standard: The Swiss vocational education and training system. Washington, DC: National Center on Education and the Economy.

Jacoby, D. (1991). The transformation of industrial apprenticeship in the United States. *The Journal of Economic History*, 51(4), 887-910. doi:10.1017/S0022050700040158

Johnson, M., & Spiker, K. (2018). Broadening the apprenticeship pipeline. *National Skills Coalition*. https://tacc.org/sites/default/files/documents/2018-08/broadening-the-apprenticeship-pipeline_web.pdf

Jones, D. A. (2011). Apprenticeships back to the future. *Issues in Science & Technology*, *27*(4), 51–56.

Labaree, D. F. (2017). *A perfect mess: The unlikely ascendancy of American higher education*. University of Chicago Press.

Lerman, R. I. (2012). Can the United States expand apprenticeship? Lessons from experience. *Institute for the Study of Labor*. Retrieved from http://ftp.iza.org/pp46.pdf

Lerman, R. I. (2016). Reinvigorate apprenticeships in America to expand good jobs and reduce inequality. *Challenge*, *59*(5), 372-389.

Lorenzo, J. (2017). The rise of the modern American apprenticeship. *Public Policy Initiative.* University of Pennsylvania, Wharton. Retreived online from https://publicpolicy.wharton.upenn.edu/live/news/2196-the-rise-of-the-modern-american-apprenticeship#_edn10

McCarthy, M., Palmer, I., & Prebil, M. (2017). Eight Recommendations for connecting apprenticeship and higher education. *New America Foundation: Washington, DC, USA*.

Messing-Mathie, A. (2015). Building apprenticeship systems for middle-skill employment: Comparative lessons in innovation and sector-based strategies for apprenticeships. National Academies Board. Retrieved May 27, 2020 from https://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_170050.pdf

National Skills Coalition. (2020). Fiscal Year 2020 Appropriations provide moderate – but important - boost to workforce and education programs. Retrieved May 31, 2020, fromhttps://www.nationalskillscoalition.org/news/blog/fiscal-year-2020-appropriations-provide-moderate-but-important-boost-to-workforce-and-education-programs

New Jersey Institute for Social Justice (NJIST). (2020). Becoming the United States of Opportunity: the economic equity and growth case for apprenticeships. Retrieved online May 31, 2020 from https://www.njisj.org/equitycaseforapprenticeships#_ftn3

Occupational Information Network (ONET). (2019). Job zone three: Medium preparation needed. Retrieved online September 30, 2019 from https://www.onetonline.org/find/zone?z=3&g=Go

OECD (2017), Education at a glance 2017: OECD indicators, OECD Publishing, Paris, https://doi.org/10.1787/eag-2017-en.

Palley, T. I. (2005). From Keynesianism to neoliberalism: Shifting paradigms in economics. *Neoliberalism: A critical reader*, 20-29.

Piketty, T. (2014). Capital in the twenty-first century. Cambridge, MA: Harvard University Press.

Rolland, K. (2016). Apprenticeships and their potential in the US. *Cascade*, *1*. The Philadelphia Federal Reserve. Retreived online November 30, 2019 from https://www.philadelphiafed.org/community-development/publications/cascade/90/01_apprenticeships#footnotes

Rothschild, E. (2001). Economic sentiments: Adam Smith, condorcet and the enlightenment. Cambridge, MA: *Harvard University Press*, 2001.

Saunders, D. (2007). The impact of neoliberalism on college students. *Journal of College and Character*, *8*(5).

Schaeffer, k. (2020). 6 facts about economic inequality in the U.S. Pew Research. Retrieved online October 11, 2020 from https://www.pewresearch.org/fact-tank/2020/02/07/6-facts-about-economic-inequality-in-the-u-s/

Shapiro, D., Dundar, A., Huie, F., Wakhungu, P. K., Bhimdiwali, A., Nathan, A., & Youngsik, H. (2018). Transfer and mobility: A national view of student movement in postsecondary institutions, Fall 2011 Cohort. (Signature Report No. 15). *National Student Clearinghouse*.

Standafer, E. (2019) Skilling up: the scope of modern apprenticeship. *Urban Institute.* Retrieved May 27, 2020 from https://www.urban.org/sites/default/files/publication/101353/skilling_up_the_scope_of_modern_apprenticeship_0.pdf

Steinberg, S. & Gurwitz, E. (2014) The underuse of apprenticeships in America. Center for American Progress. Retrieved online September 5, 2019 from https://www.americanprogress.org/issues/economy/news/2014/07/22/93932/the-underuse-of-apprenticeships-in-america/

Symonds,W., Schwartz, R., & Ferguson, R. (2011). Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century. Cambridge, MA: Pathways to Prosperity Project, Harvard University Graduate School of Education.

U.S. Department of Labor (DOL). (2020). Apprenticeship. Retrieved online May 31, 2020 from https://www.doleta.gov/oa/data_statistics2018.cfm

Wilson, V. and Roger, W. (2016). Black-white wage gaps expand with rising wage inequality. Washington: Economic Policy Institute.

Zessoules, D., & Ajilore, O. (2018). Wage Gaps and Outcomes in Apprenticeship Programs: The Effects of Gender, Race, and Region. *Washington: Center for American Progress*.

Privacy Issues Concerning Biometrics in Grades K-12

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Abstract
Biometrics are a large step forward in securing information and data. With these advancements, there is the desire to implement biometric technology everywhere. In most places, it would be a straightforward implementation, but in K-12 schools it could pose a risk to children's privacy. The biometric information utilized by the school administration could be stolen or used maliciously. Along with the security risks, Family Educational Rights and Privacy Act (FERPA) issues could prevent schools from using the biometrics. The purpose of this paper is to discuss the privacy concerns of biometric technology in a K-12 environment.

Introduction

As a society that adapts to technology improvements, people are always looking for better ways to secure information. Biometrics are an excellent way to keep data safe and out of the hands of cyber criminals. With that extra security comes some potential risks. To be able to use biometrics, a person would need to give the machine a very personal part of their identity (e.g., fingerprints, voice patterns). Doing this prevents others from accessing the same data, but if taken by someone else, would be devastating to the owner. In this article, several biometric technologies and their concomitant issues are explored as they relate to deployment in K-12 schools.

The idea of implementing biometrics in schools is of potential benefit. Added security and personalized access is important for an organization that deals with the development of children. The downside to this would be that the minor's data would be stored by the school. The fingerprints and facial scans would be part of the school's data. This can pose a risk of getting hacked and having access to this personal information. Along with issues in storing the data, parents can opt-out completely. FERPA allows parents to opt-out their children from technologies such as a biometric scan.

Literature Review

With the advancement of computer technology over the last decade, the use of biometrics in authentication has gained much attention. The idea was first introduced in the 1980s when the US was pursuing approaches to tightening drug smuggling from southern borders (Andreas, 2000). Its application then expanded to identifying legal and illegal immigrants in the 1990s (Ceyhan, 2008; Bigo, 2002). After 2000 and with the widespread use of Web-based systems, it

has become popular in implementing secure systems.

One noted aspect of biometric security techniques is the lack of susceptibility to standard attacks. Other security measures such as username/password authentication, CAPTCHA, and security questions are more vulnerable to traditional cyber-attacks such as brute force, social engineering, and dictionary attacks and therefore underperform biometric techniques in authentication (Kowtko, 2014).

Biometric security is considered one of the best options for children and older adults due to its relative ease of use. The number of IT users among older adults is increasing. They use the Internet for a variety of purposes such as access to news sources, telehealth, and E-commerce websites. Given the recent outbreak of COVID-19, a large percentage of students take online classes and therefore use the web to connect to their classes and do their assignments. Regular authentication measures such as username and password, CAPTCHA, and security questions cause confusion for elementary students and as a result will create an unpleasant experience of online learning. Biometric security can facilitate delivering online materials especially in terms of efficient authentication and ease of use. In spite of its potential, there are downsides to biometrics such as implementation cost and security concerns (Kowtko, 2014).

Biometric data is sensitive personal data and its leakage can cause serious risks. It is suggested in several articles that biometric information such as iris, face, handshape, and fingerprint can be reproduced from biometric reference template (JGalbally, 2013) (Adler, 2003) (Gomez-Barrero J.G.-G, 2014) (Cappelli, Maio, Lumini, & Maltoni, 2007). As a result, approaches such as irreversible facial reference, and Bloom filter have been proposed to address the issue (Gomez-Barrero C. R., 2014).

Types of Biometric Technologies

Biometrics are widely popular and easily accessible, but some more than others. There are numerous implementations of biometric systems. The most common and probably most well-known is the fingerprint scan. The fingerprint scan is a visual biometric. It takes the ridges of the finger to determine who is trying to gain access to the information. Another common biometric system is facial recognition. This can be used in CCTV (Closed-Circuit Television) and is used with video surveillance in many places, such as schools. Facial recognition software scans a person's face and identifies traits that only that person has, such as distinct patterns and facial structure. The last common form of biometric is gait. This goes along with facial recognition because it can be used with CCTV. Gait detection is a behavioral biometric. It recognizes the way someone walks and carries them self and determines who that person is without having to see their face.

Privacy Issues

Although biometrics are a large step toward a more secure environment, there are many concomitant privacy concerns (Leaton, 2018). The first issue is what happens to that data when it is compiled. The data that is taken to use biometrics, is stored somewhere. With that data being stored, there is the potential to have it stolen or misused. The biometric data is extremely personal and can become an issue if it is exploited (especially for minors). Having a liability as serious as minors' privacy can make the implementation of biometrics complicated.

FERPA. FERPA is a privacy act implemented by the US department of education in 1974. This was made to protect minors from privacy issues and moral dilemmas (Frank & Wagner, 2018). An issue that arose before FERPA was a school could student files that they may not be compelled to provide to the parents. When FERP was implemented, parents had more control of records disclosure. FERPA is an important factor when considering biometrics. Also, FERPA mandates that the parent would need to consent to collect or provide their child's information.

How the UK navigates privacy issues. The United Kingdom has had little issue implementing biometric technology within their schools as they do not have privacy acts as strict as FERPA. The main form of biometric technology used in the UK is fingerprint scanning. Gait recognition and facial recognition are also used within some schools.

Legal Issues Impacting Biometrics

Although FERPA is an issue when trying to implement biometrics in the US, other privacy issues arise with specific states. In the US, some states have biometric privacy regulations, and other states have banned the technology outright. In 2016, the state of Florida decided upon a ban of biometrics in schools because it could pose a privacy risk.

Of the many legal and societal prohibitions, FERA is the largest barrier in implementing biometrics within the US school systems. Although FERPA prevents some schoolwide implementations, another barrier is individual state restrictions. As mentioned before, Florida has a ban on biometrics in schools, but they are not the only state that has made this decision. Maryland has a ban on collecting any biometric data from students that attend public schools in Carroll County (Senate Bill, 855). The bill prohibits any physical collections of biometric data. This includes fingerprints, facial recognition, and vocal characteristics.

US Laws Governing Privacy

The US, comparatively speaking, does have significant privacy legislation as well as FERPA protection. Where other country's schools have liberty over biometric technology adoption, the US does not.

In the US, specific laws that prohibit biometrics from K-12 schools are more statewide than they are countrywide, FERPA notwithstanding. Florida and Maryland both have laws prohibiting biometrics in schools. Legal compliance in protecting the students' data makes the school responsible for any data misuse. Implementing biometrics increases the liability of the school regarding students' privacy and data. Careful research is required in order find biometric services that protect the students' data and are compliant with all applicable legal requirements.

Analysis of Biometric Technologies and Implementations

Biometric devices and technologies can be classified into several implementations. These classifications range from, chemical, visual, behavioral, and auditory. Some examples of these would be DNA matching (chemical), iris recognition (visual), gait detection (behavioral) and voice recognition (auditory) (Biometric Institute, 2018). The most readily implementable biometric technology for most schools would be fingerprint scanning. In some schools, primarily in Europe, the fingerprint scans are used for events such as meals or signing into school (Mayhew, 2015). Another type of biometric technology that is used within schools are vein readers or palm readers. These are used for the same purpose as the fingerprint scanners. However, there are sanitation issues with all the students touching the same device.

For the biometric scanning technology, there exists several categories. The chemical biometrics are DNA matching scans. These are unused in schools and are found more in the medical field. Visual biometrics range from ear scans, eye scans, face scans and fingerprint scans. These are the most popular and are used in some schools. Behavioral scanning is mostly confined to gait detection. This is used in many places paired with CCTV to recognize how someone carries themself. Auditory scans are for voice recognition. This type of technology is used over phones or videos to determine who is talking.

Positive aspects of biometrics. The benefits of biometric systems in any organization are immense. The most well-known and obvious strong suit of using a biometric system is that the data being presented to the device is nearly impossible to spoof or replicate. It also cannot be shared with anyone like a password or a token. Another advantage of using biometrics to an organization is that the user cannot forget or misplace their login information. The information is biologically permanent. Finally, biometrics are significantly more convenient. Without having to remember a password or carry a token, the inconvenience of logging in somewhere is virtually eliminated.

Negative aspects of biometrics. There do exist detriments to the adoption of biometric technology. Chief among those is the fact that even biometrics can still leave an account compromised. The first underlying issue is that if an account gets compromised, there is no way to change the login information. The human body cannot change its information. Fingerprints and facial recognition cannot be changed, even if the account has been compromised.

Another negative aspect is accuracy. With an alphabetical or numeric password, if it is typed correctly, it is one hundred percent accurate. The issue with biometrics is that it is impossible to be perfect. A misread of an iris or a smudge fingerprint can result in a denied login.

The last roadblock concerning biometrics is the price. Implementing a set of biometrics devices can be pricey. The average cost of fingerprint and iris scanners can range from two thousand dollars to ten thousand dollars. A hefty price to pay for any organization given that the technology does have accuracy issues.

K-12 Adoption

Adoption of biometrics in the United States consists mostly of CCTV and other forms of less intrusive biometrics. There are not many implementations of personal data saving biometric systems that are allowed in US schools because of statewide restrictions. The closest analog to seeing how these technologies would work in a K-12 school would be to look at the United Kingdom. The United Kingdom, instead of having FERPA, has the Protections of Freedoms Act of 2012. This act does not prevent the use of biometric technology but requires the school to notify the parents of any student under eighteen that is subject to biometric equipment. The parent could object, and the school is required to stop. This law makes it much easier to adopt biometrics in Europe than it does the United States. A state-of-the-art biometric device that is implemented in K-12 in Europe is the vein reader. The students use the reader to track their attendance when entering the school. The schools then store this data in a database for reference. This data, however, can be deleted if the parent or child wishes to do so in accordance with the Protections of Freedoms Act of 2012.

Best Practice Model

A particular point of contention (and derivation) is the choice between a default opt-in model or a default opt-out model. In the UK, the best practice model is a default opt-in. The authors of this paper recommend adopting that model in the US. However, that most likely will not be possible given the legal distinctions between those two countries as outlined in this research article.

The best practice for implementing biometrics in US schools would be acquiring parental consent. This is virtually impossible as there would be some parents who would refuse. If the US could find a way to implement rules like the UK, the US could use biometrics by default and if the parent did not want their child in the database they could refuse. A slow implementation of biometric devices and an opt-in model would benefit most schools. The added security for the child coupled with safe data storage practices would be excellent incentives for most parties. If statewide restrictions were overridden, there would be room to gradually add in biometric devices. A slow and gradual adoption of devices, until fully implemented, would be one of the best strategies to implement biometrics.

Conclusions

Biometrics are an effective way to provide security. It is both personal and safe, but with it being so personal, it can run the risk of a privacy breach. With biometrics keeping personal data, such as fingerprints, iris scans and face scans, schools face many challenges implementing this technology. FERPA and other privacy acts in the US prevent these possible privacy breaches. With parental permission, biometric technologies could be incorporated into schools. However, it is a difficult task to get enough parents to consent to that for their children. Statewide laws also prevent implementation of biometrics in some jurisdictions due to privacy issues. Many schools in the UK implemented biometrics by a default opt-in policy and having parents actively opt-out their child's biometric information if they do not agree. Overall, biometrics provide a great amount of personal security but have several issues with technology adoption, especially with minors.

References

Adler, A. (2003). Sample images can be independently restored from face recognition templates. CCECE (pp. 1163-1166). IEEE.

Andreas, S. (2000). The Wall Around the West: State Borders and Immigration Controls in North America and Europe. Boston: Rowman and Littlefield.

Bigo, D. (2002). Security and Immigration: Towards a Critique of the Governmentality Unease. Alternatives, 63-92.

Cappelli, R., Maio, D., Lumini, A., & Maltoni, D. (2007). Fingerprint image reconstruction from Standard Templates. IEEE Transactions on Pattern Analysis and Machine Intelligence, 29(9), 1489-1503.

Ceyhan, A. (2008). Technologization of Security: Management of Uncertainty and Risk in the Age of Biometrics. Surveillance & Society, 5(2), 102-123.

Frank, R., & Wagner, L. (2018). Understanding the Importance of FERPA & Data Protection in Higher Education. Retrieved November 11, 2020, from https://digitalcommons.lasalle.edu/cgi/viewcontent.cgi?article=1037&context=mathcompcapstones

Javier Galbally, A. R.-B.-G. (2013). Iris image reconstruction from binary templates: An efficient probabilistic approach based on genetic algorithms. Computer Vision and Image Understanding, 117(10), 1512-1525.

Kowtko. (2014). Biometric Authentication for Older Adults. IEEE Long Island Systems, Applications and Technology (LISAT) Conference 2014 (pp. 1-6). Farmingdale, NY: IEEE. doi:10.1109/LISAT.2014.6845213

Leaton Gray S. (2018) Biometrics in Schools. In: Deakin J., Taylor E., Kupchik A. (eds) The Palgrave International Handbook of School Discipline, Surveillance, and Social Control. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-71559-9_21

Marta Gomez-Barrero, C. R. (2014). Protected Facial Biometric Templates Based on Local Gabor Patterns and Adaptive Bloom Filters. 2014 22nd International Conference on Pattern Recognition (pp. 4483-4488). Stockholm, Sweden: IEEE.

Marta Gomez-Barrero, J. G.-G. (2014). A novel hand reconstruction approach and its application to vulnerability assessment. Information Sciences, 268, 103-121.

Mayhew, S. (2015, December 14). UK school using biometric technology to verify students identity and register attendance. Retrieved December 11, 2020, from https://www.biometricupdate.com/201512/uk-school-using-biometric-technology-to-verify-students-identity-and-register-attendance

Senate Bill 855. (2013) Education, 2013 Reg. Sess. (MD. 2013).

Biometric Institute. (2018, December 14). Types of Biometrics. Retrieved November 05, 2020, from https://www.biometricsinstitute.org/what-is-biometrics/types-of-biometrics/

Wencheng Yang, J., Yang, J., Wang, S., & Shu, L. (2013). Biometrics for Securing Mobile Payments: Benefits, Challenges and Solutions. Retrieved December 10, 2020, from https://www.researchgate.net/profile/Song_Wang10/publication/269239385_Biometrics_for_securing_mobile_payments_Benefits_challenges_and_solutions/links/556bad5d08aefcb861d61190.pdf

Skill-sets and Their Impact on Long-term Employment in Manufacturing

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Abstract

The skill-sets necessary for employment in a modern manufacturing environment are quite varied. Technology has shifted the burden of monotonous tasks away from humans and that of higher-level creative processing to humans. Nine occupations in the state of Indiana, were found using the Frey and Osborne (2013, 2017) model, four of which are non-susceptible to automation. The most important tasks of each non-susceptible job were identified and classified based on skill-set required. Susceptibility referred to the presence of factors related to worker and job-oriented characteristics that were more prone to be automated in the future, while non-susceptibility was the opposite. A better understanding of mathematical skill-sets and their relation to product design and process operations are crucial for working modern manufacturing environments. This paper acts as starting point for the upgrading of manufacturing programs, here in Indiana, in the preparation of undergraduate students for the workforce.

Introduction

Technology acts as both an augmenter and a replacement for skills, possessed by humans, by modifying their nature. It does this by mastery of a codified task within a job, ultimately shifting the distribution of tasks from the human to itself (Autor, 2013). During its adoption, technology can have a profound impact on the social norms of an organization, forcing its workforce to acquire skills that are more creative, adaptable and collaborative. Gone are the days in which education garnered in college led to a semi-permanent job. Today's view of an occupation is one

in which a more specialized on-demand type of education is required (National Academies of Sciences, Engineering, & Medicine, 2017a). Since the Great Recession, which ended in 2009, the fastest growing occupational categories have been in the professional fields of management, STEM and healthcare. A majority of these jobs had at a minimum, a Bachelor's degree requirement with earnings in the upper third of all occupational median wages. On the other hand, occupational categories in the lower third of all occupational median wages, considered low-wage, entailed food, personal services, sales and office support, and blue-collar jobs. These jobs were mostly held by workers with some college or an Associate degree holder (61% of these jobs) (Carnevale, Jayasundera, & Gulish, 2015).

The nature of the skill-sets needed for jobs in these occupational categories are not well understood (Autor, 2013). In particular, manufacturing related occupations are of particular concern as the skill-sets necessary for undertaking these jobs have changed over the past fifty years. During this period, the adoption of automated and robotic machinery has enabled many manufacturers to become more price competitive, due to increases in productivity and quality. Automated machinery has allowed efficiencies to be extracted via improved quality and reliability on tasks that are routine and structured. These technical systems have had a profound effect on the nature of work, which has resulted in a reduction in the sector's employment numbers over the past 50 years. In 1970, 28% of US private sector employment was in manufacturing. Today the sector employs 11% of the private sector workforce (U.S. Bureau of Labor Statistics, 2019). The next phase of manufacturing productivity will come from a boon in the usage of technical systems that are able to overcome difficulties with operating in unstructured environments (Mckinsey Global Institute, 2017). Robotic systems, unlike automated systems, emphasize intelligence and adaptability in an effort to cope with unstructured environments enabling further cost reductions and faster delivery times (Computing Community Consortium & Computing Research Association, 2009). The addition of robotic systems in manufacturing environments has, by some estimates, led to a reduction of direct employment in the sector by about 6.2 workers per robot, between 1993 to 2007 (Acemoglu & Restrepo, 2017). The impact of the adoption of new technologies on productivity can take several decades as new business practices; infrastructure and other complementary social and economic mechanisms are fulfilled. Once adoption has taken hold they have the added impact of an acceleration in productivity growth which also supports the theory of reduced need for human effort (Syverson, 2013).

Purpose

Robotic systems are increasingly being used in manufacturing environments to complement or substitute human labor in tasks considered routine or repetitive in unstructured settings. As these systems become more widely adopted and utilized, workers will be force to acquire skills that accentuate creativity, adaptability and collaboration, if they desire to be in the upper median of wage earners in the future. The exact nature of these skill-sets are not well understood, as are the details of what should be taught and how. This paper seeks to identify skill-sets needed for future

employment in the manufacturing field, in the state of Indiana, by reviewing the likelihood of an occupation's demise through the use automated or robotic systems. As a starting point, the skill-sets that will be impaired by continued robotic system adoption must be understood with a content model. By utilizing the Occupational Information Network (O*NET) as the source of job information requirements the necessary skill-sets for a particular occupation was determined. To determine the occupations most likely to be impacted by automation and robotics the Frey and Osborne (2013) task model was employed to identify 71 occupations in the manufacturing sector, in the state of Indiana. The task model provided a probability for the utilization of automated and robotic systems to replace entire occupations within the sector. It is with this basic piece of information that this paper then seeks to use to determine the skill-sets that will be in most demand by manufacturers, in the state, in the future.

Problem Statement

The decade, starting in 2015 and ending in 2025, will see the US manufacturing sector add nearly 3.4 million jobs. Of these jobs, 2 million will go unfilled due to an expected skills gap in the workforce. Again, the skill-sets necessary for these jobs are at best a nebulous concept that centers on computer/technical and problem-solving skills. Of greatest worry to manufacturers is that they will not be able to maintain or increase production levels with growing customer demand (82% of the respondents in the Deloitte survey) and or implement new technologies to achieve production targets (78%)(Deloitte Consulting & Manufacturing Institute, 2015; Deloitte Consulting & The Manufacturing Institute, 2018; Mckinsey Global Institute, 2017; McLeod, 2019). A thorough understanding of occupational skill-sets, predicted to be in high demand, is needed. This must take place through a multidisciplinary approach to looking at this problem.

History of manufacturing employment

US manufacturing employment can be broken up into four specific periods, since employment in the field has been tracked (See figure 1) (U.S. Bureau of Labor Statistics, 2019). The first period represents the prewar industrial boom that occurred during the 1930s lasting until the end of the Second World War in 1944. The second era began in 1946, the postwar period, lasting until the middle of 1979. In 1979, the US's manufacturing employment was at a record high of 19.5 million workers. The decades preceding the 1970s saw a huge downturn in US manufacturing employment and this did not end until the beginning of 2010. This period of US manufacturing employment represented a 41% decline or the loss of 8.1 million jobs over three decades. Many researchers and governmental entities have explained this decline as being a side effect of globalization and productivity growth (Autor, Dorn, & Hanson, 2011; Deitz & Orr, 2006; National Academies of Sciences, Engineering, & Medicine, 2017b). The fourth era began in 2010 with increases in employment over the past decade. A notable fact of the decades preceding the fourth era, is that the bulk of manufacturing jobs lost in the US were mostly felt by those workers considered low skilled (Autor et al., 2011; Deitz & Orr, 2006). On the other hand, much of the increases in employment during the fourth era are attributable to jobs that require more high skilled labor (McLeod, 2019).

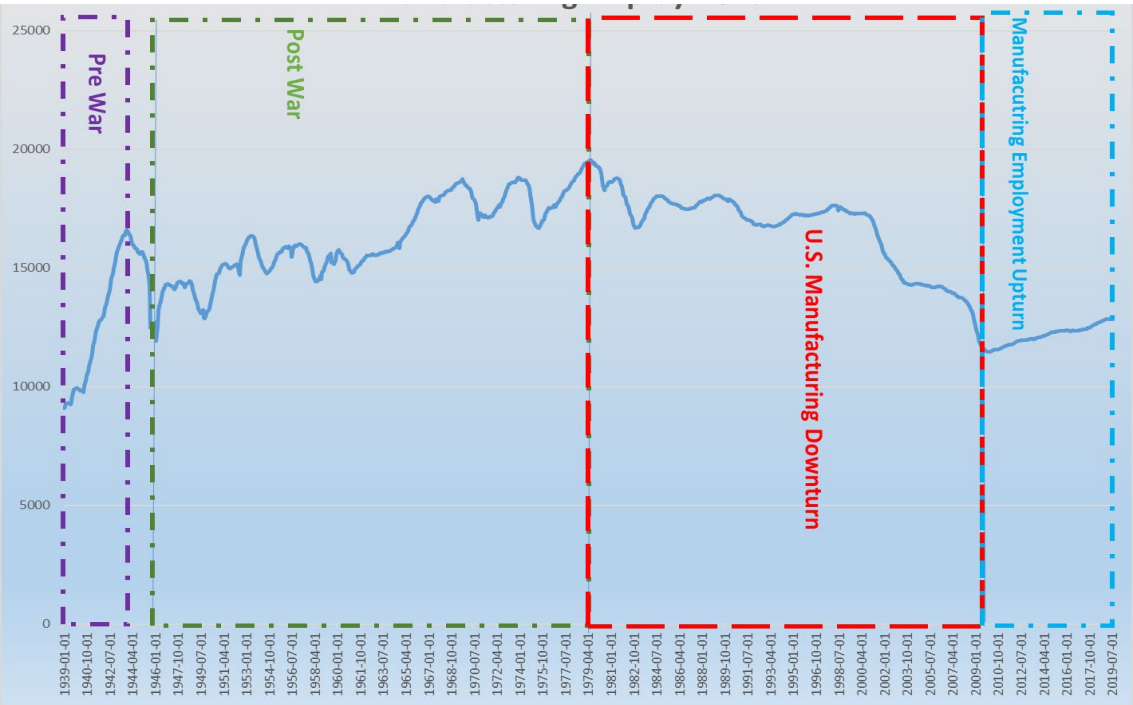

Figure 1. Manufacturing Employment 1939 - 2019 (U.S. Bureau of Labor Statistics)

The era of manufacturing downturn lasted three decades and it was during this timeframe that most manufacturing subsectors experienced a large growth in their share of highly skilled workers (Carnevale et al., 2015; Deitz & Orr, 2006; Mckinsey Global Institute, 2017). In the 20 subsectors of manufacturing studied by Deitz and Orr (2006), only two did not show an increase in highly skilled workers in 2002 when compared to 1983. When employment growth in the manufacturing sector was analyzed between 2001 and 2016 by McLeod (2019), this deficiency seems to have reversed itself. In jobs considered low skilled/low technology intensive, the usage of robotic systems, in its various forms, correlated with increases in employment. At the heart of this trend is the need, by smaller manufacturing entities, to be innovative. Innovation, improves the survivability of small to medium-size manufacturing entities allowing them to avoid price competition with their larger peers and also in serving niche markets that desire specialty products (McLeod, Stephens, & McWilliams, 2016).

Skill-sets manufacturers seek

While the need for highly skilled workers has been widely documented, there has been no consensus on the specific nature of the skill sets needed (Deloitte Consulting & The Manufacturing Institute, 2018; Mckinsey Global Institute, 2017; McLeod, 2019). Frey and Osborne (2013, 2017) have ascribed probabilities to the likelihood of certain occupations and their viability in the future. This has opened a possible path to understanding the nature of the

skill sets that are currently being perceived as being necessary for future employment. By identifying jobs at risk and their opposite counterparts, the usage of the occupational information network (O*NET) content model was deemed necessary. This model is a sociotechnical framework identifying the most important traits of work and then integrating them into a theoretically and empirically sound structure. O*NET categorizes and defines 974 occupations into structured hierarchical taxonomies with six domains. This database is widely used by entities and researchers in the field of human resource management, policy research, economic development, career development and workforce development (National Center for O*NET Development, 2016).

Methodology

The initial phase of analysis involved the identification of 71 Standard Occupation Classification (SOC) codes that were attributable to the manufacturing sector in Indiana. Once the codes were identified probabilities of computerization were assigned to 49 occupations using the results of the Frey and Osborne (2013) study. For the other occupations that had no ascribed probability, they were excluded and the remaining 49 occupations were updated to reflect the number of workers in the state. The remaining occupations accounted for 52% of all manufacturing employees in the state (Bureau of Labor Statistics, 2016). Sorted based on probability of computerization two groups of occupations were created based on the lowest and highest probabilities for automation and then analyzed to determine skill-sets more prone to computerization. The first group is comprised of occupations with probabilities of computerization of 52 percent or less. These occupations seemed to be resistant, according to Frey and Osborne (2013), to computerization and therefore more insight into their nature was sought. Occupations in the second category were more prone to computerization and had probabilities that ranged from 97 percent to 99 percent. Once the two groups were created their non-susceptible inputs were assessed based on the importance of the skill-set to job. Susceptibility referred to the presence of factors related to worker and job-oriented characteristics that were more prone to be automated in the future, while non-susceptibility was the opposite. A count of all similar and dissimilar skill-sets, ranked in importance above 50%, amongst the nine occupations were then analyzed to determine any significant differences.

Broad categories were created for the susceptible and non-susceptible jobs identified. For jobs that were identified as being susceptible six main categories were created. These categories are:

(1) reading and comprehension - this category was based on the domains of worker characteristics and worker requirements,
(2) monitoring - this category was solely based on the domain of worker characteristics,
(3) operation monitoring, control and quality analysis - this category was solely based on occupational requirements,
(4) active listening and service orientation - this category was based on the domains of worker characteristics and worker requirements,
(5) speaking - this category was based on worker characteristics,

(6) critical thinking, coordination judgment decision making, time management, equipment maintenance and troubleshooting - this overarching category was based on worker characteristics and worker requirements.

The susceptible categories were solely based on characteristics that were specific to the worker and interrelated occupational functions, as these occupations considered these characteristics to be off moderate to high importance. For jobs that were identified as being non-susceptible eight main categories were created. These categories encompassed the entire O*NET content model. Worker, interrelated occupational, job and occupation specific characteristics for all utilized to describe these occupations. The categories are:

(1) reading comprehension, English language and writing - this category was based on the domains worker characteristics and worker requirements,
(2) monitoring - this category was based on the domains worker characteristics,
(3) operation monitoring, control, quality analysis, production and processing, operational analysis and systems evaluation - this category was based on the domains occupational and worker requirements,
(4) active listening, service orientation, perceptiveness, persuasion and negotiation - this category was based on the domains worker characteristics, worker requirements and experience requirements,
(5) speaking and instructing - this category was based on the domains worker characteristics, worker requirements and occupational requirements
(6) critical thinking, coordination, judgment decision making, time management, equipment maintenance, troubleshooting, complex problem-solving - this category was based on the domains worker characteristics, worker requirements, occupational requirements and experience requirements,
(7) design and mechanical - this category was based on the domains worker characteristics, occupation specific information, worker requirements and occupational requirements,
(8) Mathematics - this category was based on the domain worker characteristic (National Center for O*NET Development, 2016).

To present the data obtained from this categorization a radar/cobweb chart was created to display the multivariate nature of these categories per occupation. A complete explanation of these ten occupations are then explored in the discussion section. This is done to offer more details on the relevance or insignificance of these occupations.

Results

In the initial phase of this study the number of workers that would be affected by computerization and their associated probabilities according to the Frey and Osborne (2013) model are presented in figure 2. In 2016, there were 522,000 manufacturing jobs in the state. The data gathered was based on a sample that looked at 269,386 jobs in the state that were associated with the probabilities of the Frey and Osborne (2013) model. Of this sample, 1% of the

occupations were rated as being least likely to be automated (probabilities below .52) while the rest (99% of the sample) were rated as being most likely to be automated (probabilities above .61). The top five occupational categories having probabilities above .62, accounted for 13% of the current jobs in the sample. Overall, predicted job losses, from automation, in the state would account for 35% (or 93,541) of all the jobs in the sample. The three occupations that are predicted to have the most job loss are 1) Inspectors, Testers, Sorters, Samplers and Weighers, 2) Machinist, and 3) Packaging and filling machine operators and tenders. These jobs combined are predicted to lose 41,018 employees, of 2016 manufacturing employment numbers.

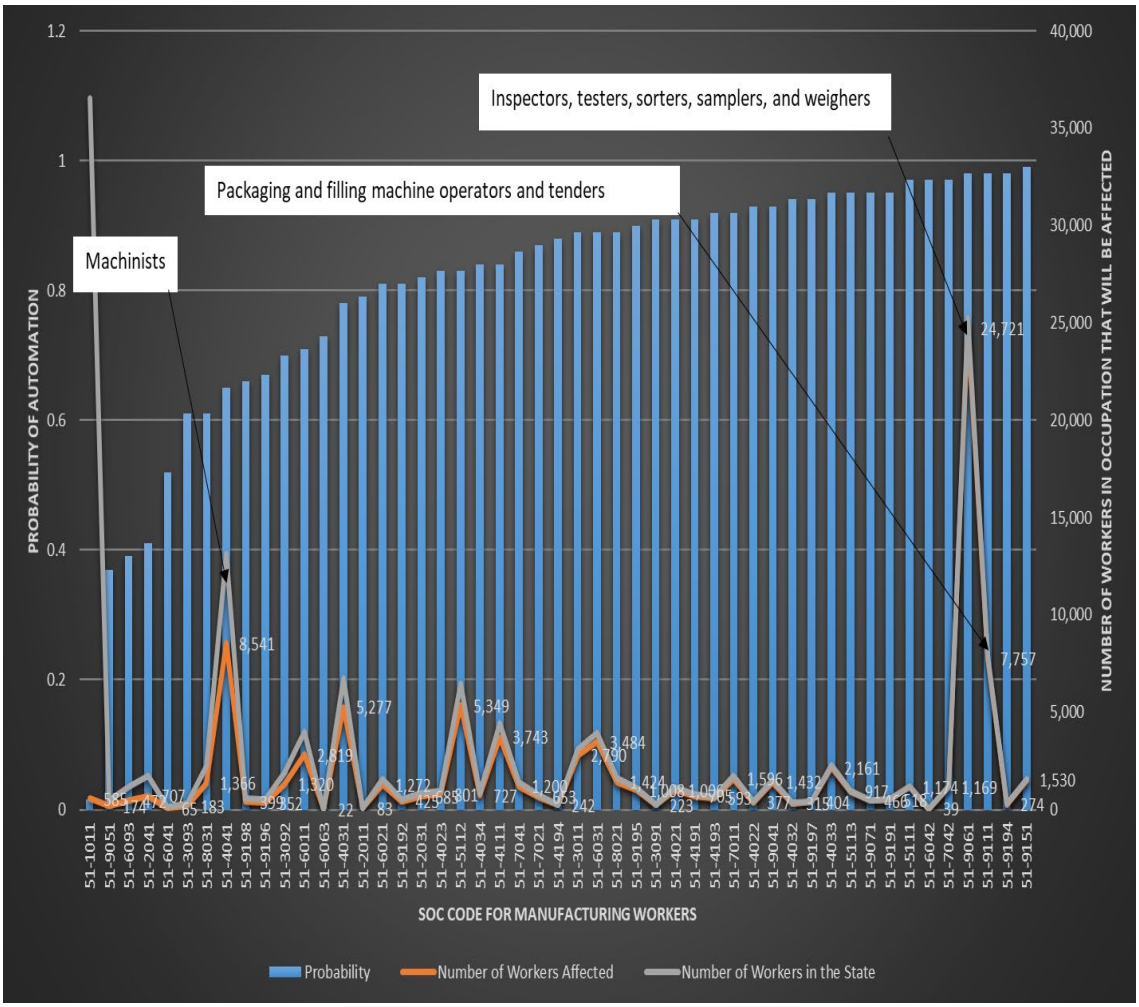

Figure 2. Number of workers affected by computerization and their probabilities

The secondary part of this study resulted in a comparison of the top four jobs least likely to be automated occupation and the lower five occupations most likely to be automated. In this phase,

we identify all the skill-sets with an importance of 50% or more in each of the occupations selected. The lower five occupations that were most likely to be automated are (See figure 3):

(1) Photographic Process workers – had a probability of .99
(2) Etchers and Engravers – had a probability of .98
(3) Inspectors – had a probability of .98
(4) Machine Operators – had a probability of .98
(5) Woodworking machine operators – had a probability of .97

To report the most dominant skill-sets needed by these occupations, a radar chart was chosen. The chart depicts six skill-sets all of which have an importance of 50% and above. If the occupation did not have a 50% importance rating on a particular skill, it was not reported. The highest dominant skill-set reported had an importance of 66%, monitoring of equipment, and this was reported by the Woodworking Machine Operator occupation. Three occupations reported dominant skill-set importance in all six categories collated. These occupations were that of Etchers and Engravers, Inspectors, and Photographic Process Workers. Machine operators had the lowest number of important dominant skill-sets necessary to undertake the occupation, as only three were ranked above 50%.

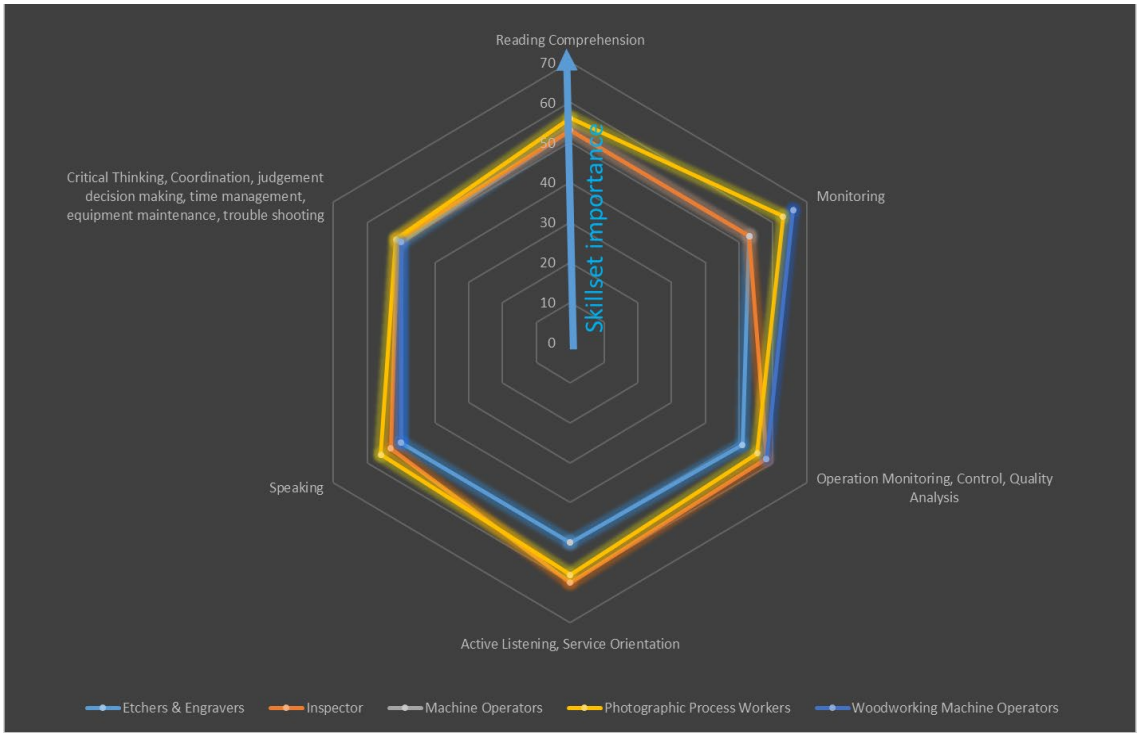

Figure 3. Susceptible occupations and their most dominant skills

The top four occupations that were least likely to be automated were comprised of eight categories representing the dominant skill-sets of that occupation. These occupations are reported in a radar chart (See figure 4) and once again, dominant skill-sets with an importance of over 50% were reported. These occupations are:

(1) Metal Fabricators - had a probability of automation of .41
(2) Upholsterers - had a probability of automation of .39
(3) Furnace Operators – had a probability of automation of .37
(4) First line Supervisors - had a probability of automation of .016

The chart depicts eight skill-sets all of which have an importance of 50% and above. If the occupation did not have a 50% importance rating on a particular skill then it was not reported. The highest dominant skill-set reported had an importance of 68%. Two dominant skill-sets had an importance of 68% and they were: 1) Design and Mechanical and 2) Mathematics. This was reported by the Metal Fabricator occupation. No occupation reported dominant skill-set importance in all eight categories collated. Furnace Operators and First line Supervisors reported six important dominant skill-sets, the most need for an occupation in this group. Upholsterers had the lowest number of important dominant skill-sets necessary to undertake the occupation, as only two were ranked above 50%.

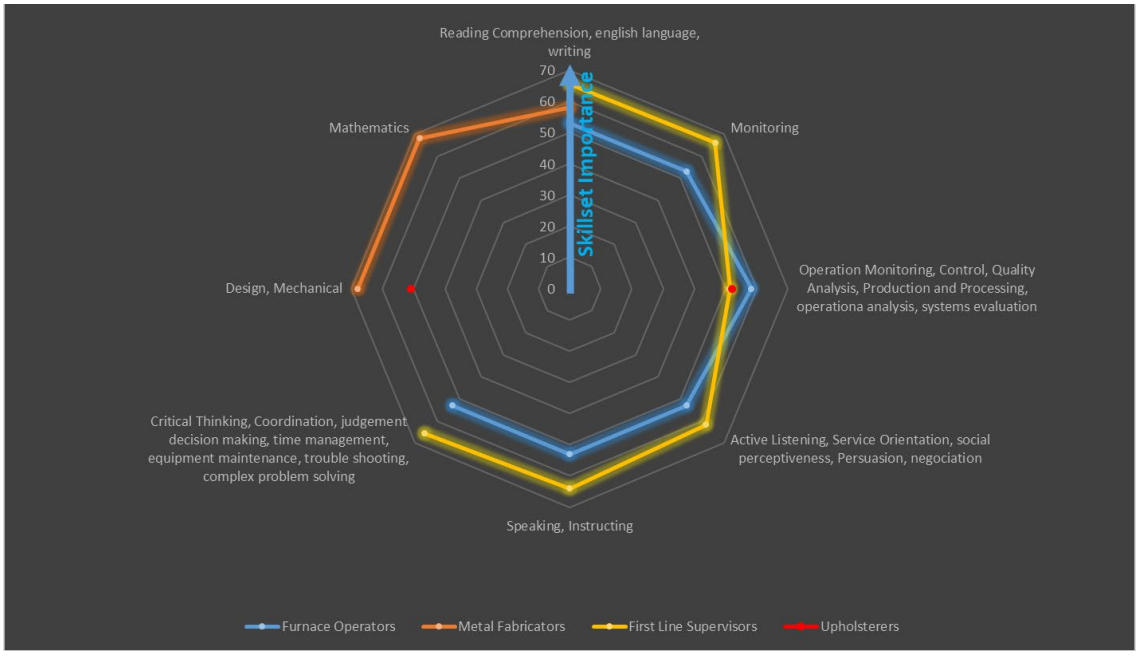

Figure 4. Non-susceptible occupations and their most dominant skills.

Discussion

There are a number of factors external to the Cobb-Douglas production function, used by Frey and Osborne (2013, 2017), that will impact the certainty of occupations future. There is now a clear need to understand skill-sets that will be viable in the future, see Autor (2013), Diamond and Şahin (2015), Houseman, Bartik, and Sturgeon (2014), and Sasser-Modestino, Shoag, and Ballance (2019). Of the nine occupations studied in detail in this paper, the susceptible ones had just the basic requirement of skill-sets that were needed in order to undertake. Basic requirements meant that all these occupations could be broken up by tasks that could be individually analyzed and automated. For example, all occupations, in the susceptible category, ranked monitoring and a highly prized skill. Monitoring involved reviewing information from materials events or environment to detect or assess problems. This skill-set also meant that the task of obtaining the information had to be undertaken by the worker.

Another highly prized skill in the susceptible category had to do with decision management at the local level. This all-encompassing skill-set required: 1) critical thinking, 2) coordination, 3) judgment decision making, 4) time management, 5) equipment maintenance and 6) troubleshooting. Its focus at the local level meant that workers in these occupations are self-driven it pertains to the task they have to undertake. If issues arose surrounding the performance of that specific task then they would be required to find creative solutions to mitigate potential problems. The other skill-sets identified amongst most susceptible occupations is that of operation monitoring, control and quality analysis. The only occupation not rating this skill-set as being important, in the susceptible occupation category, was that of machine operators. Control dealt with the physical activities that were necessary to create machinery or processes that were dearth of automated or mechanical devices. The operation monitoring skill-set meant that the most important thing one had to undertake for this occupation was the watching of gauges, dials and other indicators ensuring proper machine function. Proper machinery function is the skill-set that most modern machines are able to undertake themselves at the beginning of an operation. These machines typically engage in preventative maintenance activities that center on calibration, current machine capability determination (this could be based on tooling or hours of operation for example) and the notification of maintenance teams when the issues are beyond their control. Quality control is another facet of this category and it only required a knowledge of the process such that deviations can be detected in a timely manner.

Being an active listener and having the disposition to offer service to others was also ranked by four occupations as the important skill sets. Only woodworking machine operators did not have this particular skill-set. The active listening skill-set required basic understandings of what was expected during the undertaking of the task with provision for further clarity via questioning. Complementing active listening was service orientation, which meant that the worker was actively looking for ways to help people. Speaking was another category and skill-set that was required by only four occupations. Machine operators did not rank speaking as being a dominant skill in their occupation. For this particular skill set, the ability to communicate information and

ideas to others so that they can understand what is important. This form of communication relates to objectives that may or may not be attainable given the limited operating parameters of production equipment.

Four occupations were identified as being non-susceptible and the skill-sets identified, as being important, represented and expansion of tasks and authority in their undertaking when compared to their susceptible counterparts. An expansion in task and authority within these occupations made the possibility of automation a daunting one. Three occupations, Metal Fabricators, Furnace Operators and First-line Supervisors expanded the basic categories of the occupations that were susceptible. Reading comprehension as a category was extended to include English language and writing. This meant that these employees are now responsible for direct two-way communication between managers and themselves about the operations and task they were in charge of or undertaking. In an effort to improve historical operational data tracking, these workers were also responsible for being able to describe in written form their interpretations of the process. The second category identified as being important by these two occupations was monitoring. This particular skill-set did not have any notable expansion in its tasks or authority when compared to its counterpart in the susceptible skills category. This might be because the worker still has to play some role in monitoring the operations and machinery they are in charge off.

The third skill-set category that was ranked important was done so by all the occupations in the non-susceptible category. Furnace operators, First-line Supervisors, Metal Fabricators and Upholsterers all saw an expansion of the skill-set operation monitoring, control and quality analysis. This skill-set category was expanded to include production and processing, operations analysis and systems evaluation. The expansion of this skill-set category meant that workers were in charge of identifying and creating measures of operational performance. In addition, they would now be in a position to lay the framework for new designs in product development due to their knowledge surrounding effective manufacture and distribution of goods. This particular skill-set has the potential in manufacturing to remove barriers associated with the silo mentality attributable to new product design.

In the fourth skill-set identified, an expansion of the skill-set category active listening and service orientation was noted. Perceptiveness, persuasion and negotiation were added as necessary skill-sets for these occupations. This expanded skill-set seems to be mainly responsible for the expanded role that teams will play in future product development and manufacture. Teamwork requires that members of the team are able to share their viewpoints and accept opposing viewpoints in the formulation of a solution. The fifth skill-set identified was that the speaking and it was expanded to include instructing. This skill-set meant that workers should be able to teach others about activities they carry out on a daily basis. Only two of the non-susceptible occupations, Furnace Operators and First-line Supervisors rated these two particular skill-sets as being important.

An expansion in the sixth skill-set, identified initially in the susceptible occupations, took place with the addition of complex problem solving. The initial skill-set category was comprised of critical thinking, coordination, judgment, decision-making, time management, equipment maintenance and troubleshooting. The addition of complex problem solving to this skill-set category means that these workers are now able to solve novel, ill-defined problems in real-world settings. Due to the expansion of authority afforded in the creation of measures and the design of new products complex problem-solving techniques are therefore crucial. The only occupations requiring this new and enhanced skill-set were Furnace Operators and First-line Supervisors.

The seventh and eighth skill-set categories only pertained to half of the occupations that were non-susceptible. The seven category was design and mechanical and this particular skill-set was needed by the occupations Metal Fabricators and Upholsterers. For this particular skill-set, these occupations required that workers have a knowledge of design techniques tools and principles necessary for the creation of precision technical plans, blueprints, drawings and models. In addition, a thorough understanding of tools and machinery, which includes use design maintenance and repair, is another aspect of this skill-set. Metal Fabricators was the only occupation requiring the eighth skill-set, mathematics. Specifically, this skill-set focused on the application of arithmetic, geometry, algebra, calculus and statistics in product design and manufacture.

Conclusion

The findings of this paper highlighted the need for more empirical studies to prove or disprove the Cobb-Douglas production function, used by Frey and Osborne (2013, 2017). An empirical study would be helpful in determining the true nature of the demand for non-susceptible skill-sets. As for the loss of jobs that require susceptible skill-sets, there is some evidence that points to increased employment in these occupations in addition to increases in robotic/computing systems usage (See Acemoglu and Restrepo (2017) and McLeod (2019)). Whether or not these trends are just short-term needs further examination as interest rates typically set by the Federal Reserve have more of an impact on manufacturing employment than other factors (McLeod, 2019). Furthermore, the seven occupations identified in the study, need to be tracked over a long-term period to determine changes in their employment over time. This study serves as a starting point for academicians in their pursuit of new course and program development. As robotic systems integrate themselves into everyday work-life, more needs to be understood about their effects.

References

Acemoglu, D., & Restrepo, P. (2017). *Robots and Jobs: Evidence from US Labor Markets*. Working Paper Series, (17-04). Cambridge, MA.

Autor, D. (2013). *The "Task Approach" To Labor Markets: An Overview*. Working Paper Series, (13-20). Cambridge, MA.

Autor, D., Dorn, D., & Hanson, G. (2011). *The China syndrome: Local labor market effects of import competition in the US.* Paper presented at the International Trade and Investment program meeting.

Bureau of Labor Statistics. (2016). *Employment, Hours, and Earnings from the Current Employment Statistics survey (National)* (CES3000000001). Retrieved from Washington D.C.: https://data.bls.gov/pdq/SurveyOutputServlet

Carnevale, A. P., Jayasundera, T., & Gulish, A. (2015). Good jobs are back: College graduates are first in line. *Washington, DC: Georgetown Center on Education and the Workforce*.

Computing Community Consortium, & Computing Research Association. (2009). *A Roadmap for US Robitics: From Internet to Robotics*. Retrieved from Washington D.C.:

Deitz, R., & Orr, J. (2006). *A leaner, more skilled U.S. manufacturing workforce*. Retrieved from New York:

Deloitte Consulting, & Manufacturing Institute. (2015). *The Skills Gap in U.S. Manufacturing 2015 and Beyond*. Retrieved from Washington D.C.:

Deloitte Consulting, & The Manufacturing Institute. (2018). *2018 Deloitte and The Manufacturing Institute skills gap and future of work study*. Retrieved from Washington D.C.:

Diamond, P. A., & Şahin, A. (2015). Shifts in the Beveridge curve. *Research in Economics, 69*(1), 18-25.

Frey, C. B., & Osborne, M. A. (2013). The future of employment. *How susceptible are jobs to computerisation*.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: how susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 254-280.

Houseman, S., Bartik, T. J., & Sturgeon, T. (2014). *Measuring Manufacturing: How the Computer and Semiconductor Industries Affect the Numbers and Perceptions*. Retrieved from Kalamazoo, MI: htps://doi.org/10.17848/wp14-209

Mckinsey Global Institute. (2017). *A future that works: Automation Employment and Productivity*. Retrieved from San Francisco, CA:

McLeod, A. (2019). Employment and Technology in Manufacturing. *International Journal of Sociotechnology and Knowledge Development (IJSKD), 11*(3), 14-29. doi:10.4018/IJSKD.2019070102

McLeod, A., Stephens, M. P., & McWilliams, D. L. (2016). Empirical Modeling of Lean Adoption in Small to Medium Size Manufacturers. *Journal of Advanced Manufacturing Systems, 15*(04), 173-188. doi:doi:10.1142/S021968671650013X

National Academies of Sciences, Engineering, & Medicine. (2017a). *Information Technology and the U.S. Workforce: Where Are We and Where Do We Go from Here?* Washington, DC: The National Academies Press.

National Academies of Sciences, Engineering, & Medicine. (2017b). *Securing Advanced Manufacturing in the United States: The Role of Manufacturing USA: Proceedings of a Workshop*. Washington, DC: The National Academies Press.

National Center for O*NET Development. (2016). *The O*NET® Content Model: Detailed Outline with Descriptions*. Retrieved from Washington D.C.:

Sasser-Modestino, A., Shoag, D., & Ballance, J. (2019). *Upskilling: Do Employers Demand Greater Skill When Workers are Plentiful?* Paper presented at the AEA Annual Meeting, Atlanta, GA.

Syverson, C. (2013). Will History Repeat Itself? Comments on" Is the Information Technology Revolution Over?". *International Productivity Monitor*(25), 37.

U.S. Bureau of Labor Statistics. (2019). All Employees: Manufacturing [MANEMP]. Retrieved from https://fred.stlouisfed.org/series/MANEMP. Retrieved September 11, 2019, from Federal Reserve Bank of St. Louis https://fred.stlouisfed.org/series/MANEMP

Teacher's Perception of Student Technology Use

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Abstract
Students in today's public-school system are inundated with technology devices and software applications at an early age. These students are expected to learn from technology; however, they are often not taught to use the device or program. It is a common belief that these students are fully immersed in a world of laptops, tablets, and cell phones before entering the school system and are already prepared to use the devices at school. Evidence concerning the benefits of providing one-to-one devices for each student is limited, yet many schools across the United States have adopted the one-to-one program, providing either a tablet, laptop, or other device for every student. This study reports the perception of business and technology teachers regarding the technology aptitude of students in grades 6-12.

Introduction/Theoretical Framework

For quite some time, there has been a push to include more technology in education. With computer hardware, software applications, and digital productivity tools continuously changing and adapting, teachers are expected to provide students with lessons that include both higher-level thinking and learning, with implementation of the latest technology to reach those goals. Many K-12 educational institutions, both public and private, have transitioned to one-to-one computing in the United States, as well as on the other side of the globe in Asia, Australia, and Europe (Turner, 2019). With this movement, schools are providing each student with full access to an electronic device for educational purposes. The devices can range from tablets to laptops (e.g. iPads, Chromebooks, etc.).

Globally, many teachers feel they have been asked to utilize computer devices, software applications, or other digital programs without proper training and do not feel comfortable with technology (both hardware and software) use in their classroom (Hyndman, 2018). With the implementation of devices for every student, it is possible that this is happening in some educational institutions without proper training for the teachers or students. Research shows that frequent integration of technology devices or programs does not necessarily predict a teacher's continual use in the classroom and is more closely related to the teacher's motivation to use computer hardware and explore different computer software (Kim & Jang, 2020). While there are ways to help teachers ensure their students are actively participating in higher-level thinking with technology such as the Substitution Augmentation Modification Redefinition (SAMR) Model, it is an additional task for teachers when implementing technology devices or programs

in the classroom. The SAMR model is a four-tiered approach designed by Ruben Puentedura (2013) to assist teachers in deciding which level of technology to use to add to a lesson, ranging from the lowest level of substituting an electronic document for pencil and paper to the highest level of redefinition, allowing for creations of new tasks with the hardware or software (Hamilton, Rosenberg, & Akcaoglu, 2016). Again, while this is an extremely helpful model to educators, it can be a daunting undertaking for those who are not already tech savvy.

Purpose and Significance of Study

The purpose of this study is to examine how junior high and high school business and technology teachers perceive students' familiarity with technology and technology skill levels prior to entering a business course. This study recognizes that there will be varying individual interpretations on how students are affected by their device use in and out of the classroom. Factors that were taken into consideration were encouragement of device and software use by the school district, grade level at which students are expected to begin using technology in school, grade level at which students are expected to use technology in the classroom on a regular basis, and teachers' perception of students' technology skills with both hardware and software.

With more schools transitioning to a one-to-one model utilizing laptops, tablets, or Chromebooks, as well as the shift to e-learning due to COVID-19, an understanding of students' technology knowledge and skills is vital. Analysis of the teacher perception in this area could lead to better teaching practices concerning the development of basic technology productivity skills in students. Ideally, skill development would occur prior to requiring students to use computer devices for assignments daily.

Literature Review

Technology in the classroom is a deeply researched subject area. The literature outlined in this review address the studies directly related to teachers' perception of student basic technology skills in the classroom. Topics include technology use by the teacher, digital literacy of students, self-efficacy of the students related to technology use, and the secondary effects of technology use in the classroom.

Teachers' technology use in the classroom is not a new concept. According to a 2016 study, 100% of the participants reported using a computer in their education at least weekly and 93% indicated they were used daily (Carver, 2016). A more recent study (Serin & Bozdağ, 2020) indicated that teachers use technological tools frequently in the education process but use more hardware than software applications. Teachers primarily use computers (62.3%), Smart Boards (57.3%), and telephones (23.2%). This same study showed that specific groups of teachers were more likely to demonstrate frequent use of these hardware devices in their classrooms: 22.7% of primary school teachers, 12.5% of English teachers, and 10.9% of Mathematics teachers utilized this technology on a regular basis. Many teachers feel a push from administrators and even state legislative bodies to integrate computer software and hardware into their lessons. Purchasing the

devices is only one aspect of implementing technology into the classroom, yet at times there seems to be a lack of strategic vision related to an institutional technology plan. Some teachers who have been required to implement various devices have either banned the device or left it on a cart unused because they felt it was more of a distraction than useful for educational tasks (Tucker, 2019). Negative teacher attitudes lead to the assumption that some educators may be using computer hardware or software in the classroom simply for the sake of using technology, regardless of whether it adds value to the lesson. If this push is mandated by administrators as opposed to requested by teachers, negative ramifications are probable. According to a study of early childhood educators by Blackwell, Lauricells, and Wartella (2014), the positive effects of technology are lessened when a teacher's self-efficacy related to the use of hardware is low or their attitude toward the tools is negative.

A study published by Akçayır, Dündar, and Akçayır (2016) on digital literacy status investigated whether basic student demographics played a part in comfort levels of hardware and software use. The participants of the study consisted of 560 students from two universities. A questionnaire was used to find the demographics of the students, amount of time spent on technology use, years of experience with technology, types of devices used by the students, and the level of expertise with technology. The survey results indicated that there was not a large difference between male and female participants. While the differing genders may have different interests with specific software, hardware, or other digital applications, gender did not affect the amount of time or experience they had using the technology tools. However, a difference in results was seen by academic level of the participants, indicating the education attainment significantly increased the comfort level of students and increased their digital native status. The study concluded that use of technology, not age is important to building self-efficacy.

While many students spend leisure time on the computer or other technological devices, many times they are not being taught to utilize the device applications in a way that will benefit their future education or careers. When students enter the workforce, they are finding that they are expected to do tasks with various productivity software to carry out workplace responsibilities; however, these skills are not inherently learned through leisure uses of hardware or software. Employers are voicing a concern related to the proficiency level of technology use in students following their education related to workplace skills. While students may feel comfortable using devices such as a cell phone or tablet, they are not developing the technical and problem-solving skills that are important in the workforce, such as an ability to locate, organize, and evaluate information from multiple sources, locate information to solve workplace problems, and the effective use of computer software (Sparks, Katz, & Beile, 2016).

A student's overconfidence in their perceived comfort levels with technology can lead to other types of issues in the classroom such as attempting to multitask during classroom instruction time. Multiple studies have found that while many schools are implementing the use of technologies in the classroom, it may hinder student progress (Mercimek et al., 2020; Pedro et

al., 2018; & Wood et al., 2012). These studies show that the students tend to use the technology as a multitasking device, creating distraction rather than learning. One important finding is that an increase in time for multitasking demonstrated lost time when switching back and forth between the various tasks. Additionally, students who learn without the distractions created through multi-tasking were able to comprehend the material and apply the learning to new situations. The students who multitasked were not able to apply the new information to new contexts; however, the students were able to find the information and record it on a worksheet or other assessment.

The United States is not the only place interested in the effects of computer hardware and software use in the classroom for students. A Dutch study of 15-year-old students provided findings that may influence educators worldwide to rethink their approaches to technology use in the classroom. This study found that granting students access to their own devices such as e-books, tablets, and laptops in the classroom was associated with lower reading performance. This is not to say that all device use in the educational world is negative. The study also found that the way in which a teacher implements the device into a lesson determines a positive or negative outcome for the learners (Gubbels, Swart, & Groen, 2020). Utilizing technology devices in education can greatly improve learning when individualized to the student. However, as published by the Organization for Economic Co-operation and Development (2015), unnecessarily increasing screen time creates negative effects for students. In adolescence and young adulthood, loneliness, poor attendance, and lower grades can be associated with the excessive presence of hardware devices in learning environments.

In addition to these negative effects for students, there are also negative implications for the teachers. While cheating in education is not new, it can be easier for students to cheat when technology devices are present. A recent study by Burnett, Enyeart, Smith, and Wessel (2016), showed that while cheating decreases in college compared to high school, those same college students admitted to cheating more frequently in online courses when technology devices, such as computers and cell phones, are available. Although students reported an understanding that these methods would constitute cheating, they would often not report this type of cheating if they had witnessed it.

As of September 2020, the Bureau of Labor Statistics indicates rapid employment growth in professional, business, and scientific occupations due to continued technological advancements (Bureau of Labor Statistics, 2020). Despite this growth in the workplace, deliberative instruction in the use of computer hardware, software, and productivity tools related to workplace skills is lacking in K-12 education programs across the United States (Lee, 2020). With an obvious need for these skills at the career level, the next question should be to determine the best place to provide student learning of technology-related workplace skills. This may seem counterintuitive to the findings discussed; however, it is an important question to answer due to the technology-driven nature of the world today. A recent study showed that approximately twenty-six percent

of adolescents were at risk of becoming addicted to their smartphones (Lee et al., 2016). While the study by Lee consisted entirely of high school aged boys in South Korea, it can still shed light on the early cell phone usage for children in other parts of the world.

Methodology

This study used a qualitative method approach to determine teachers' perceptions of student technology use in the classroom. The researcher determined that the interview methodology would be most appropriate for this study to allow the researcher to better understand and explore teacher opinions, behaviors, and experiences, allowing the collection of in-depth data. The sample size was limited to 5 – 8 participants, *a priori,* as small sample sizes are appropriate for focused, qualitative studies. Qualitative studies of this nature are often used to determine how to structure a quantitative study with a larger sample size.

Interviews were conducted with middle and high school teachers who teach business and technology courses. The sample demographics were selected based on the subject in which they teach and the age group of their students. The responses were organized into categories based on common themes following standard manual qualitative thematic coding protocols. Approval was obtained from the Illinois State University (ISU) International Review Board (IRB) in May 2020 and the interviews of this study were conducted in July 2020. The participants were selected from a social media page where business and technology teachers across the world can connect and collaborate; participation was voluntary.

Research Question: What are the teacher perceptions of student technology use in middle and secondary school classrooms?

Three middle school and three high school teachers participated in the study. The subject sample size was kept small to allow for analysis of in-depth answers to the interview questions. Of the participants, four participants had education beyond a bachelor's degree, including one who had obtained a master's degree and administration certification. Four female and two male teachers participated. All teachers taught in the Midwest at small schools of 2,500 students or less.

The participant pool was chosen based on the age group within the teachers' classroom. Business and technology teachers were chosen because of their knowledge of hardware, software, and digital productivity tools and expectations of students in their age group. They were also chosen based on their professional experience or connection with the business and technology industries. While computer hardware and software are used by more than just the business and technology teachers, these teachers are the experts in technology within their individual schools and are expected to teach career readiness skills.

The instrument for this study consisted of a semi-structured interview questionnaire. One-on-one interviews were conducted with teachers by asking questions about their demographics and

experience before moving to the questions about the teachers' perceptions of student technology device and digital application use in their classrooms and schools. Some of the demographic questions were close-ended questions, for ease of data collection. The remaining demographic questions related to the participant's perception of technology use were open-ended questions. See Appendix A for the full interview instrument.

Limitations of Study

Limitations of this study include the sample size. With the qualitative research methodology and one interviewer for consistency of the interview process, the sample size was limited to 5 – 8 participants, *a priori,* as small sample sizes are appropriate for focused, qualitative studies. All interviews were conducted using video conferencing software, so potential participants who initially demonstrated an interest, were hesitant to participate upon learning that the interviews would be recorded. Participants had the option of an audio recording only and one participant requested audio only.

As with any interview setting, the possibility of researcher bias exists. To counteract this possibility, the interview questions were created to avoid leading the participant to a particular answer. Additionally, the questionnaire was reviewed by three objective evaluators prior to the beginning of the interview sessions.

Finally, this study was conducted during the COVID-19 pandemic, which may have influenced some of the teacher's perceptions. If the study had been conducted prior to the pandemic, and before schools switched very quickly to a remote environment that was dependent upon technology for success, the results may have been different. Repeating this study one-year post-pandemic would be beneficial.

Findings

This study sought to determine teacher perceptions of student technology use in middle and high school classrooms. Based on the data analysis, results indicated that while many students are enrolled in a school that has implemented a one-to-one computing program there is often not any formal training on basic technology knowledge, skills, or online safety (see Figure 1).

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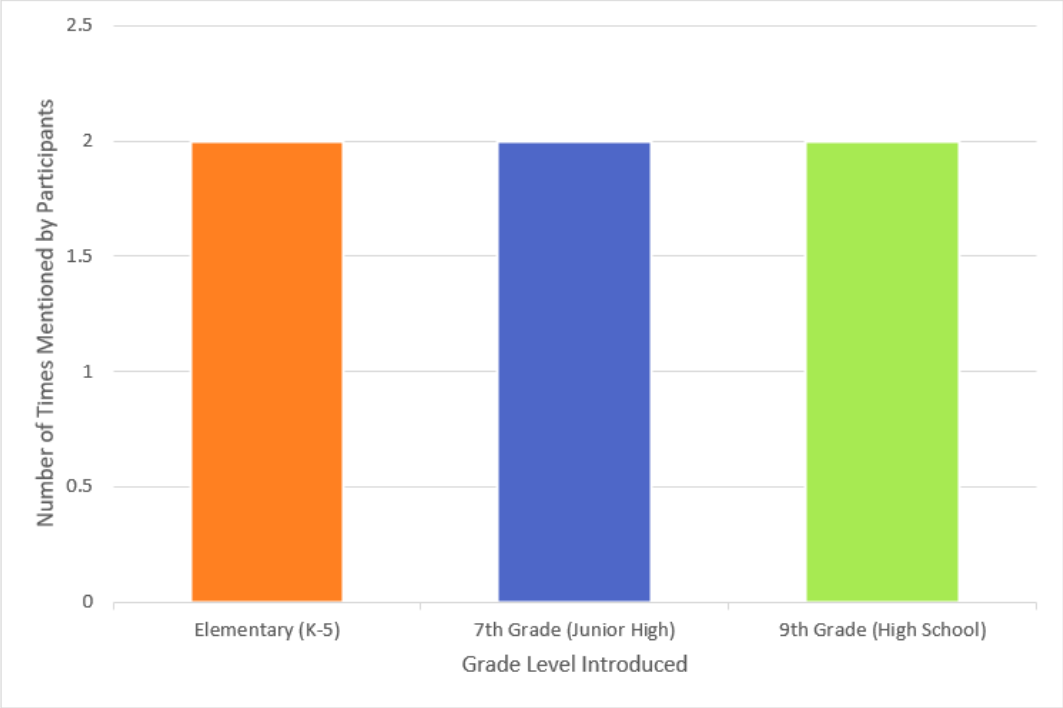
Figure 1

Grade Level Technology is First Introduced to Students



Despite the lack of technology skills/knowledge education, students are expected to utilize various forms of hardware or software throughout their general courses as early as kindergarten (see Figure 2).

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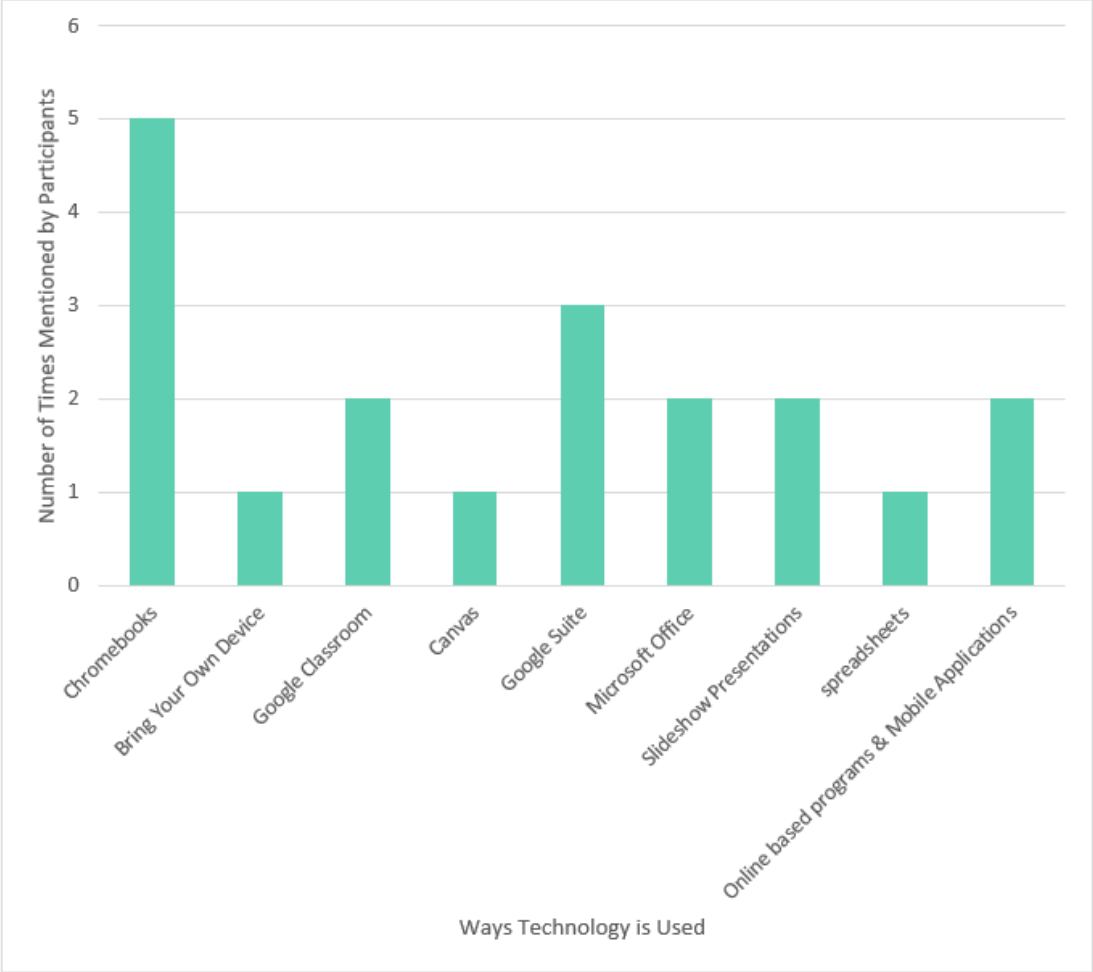
Figure 2

Ways in which Technology (Hardware and Software) is Frequently Used in the Classroom



Although the participants in this study taught a variety of technology skills and content (see Figure 3), these courses are primarily elective courses and/or not taught to all students. Students who do not participate in business or technology courses may never be taught basic computer literacy or digital literacy.

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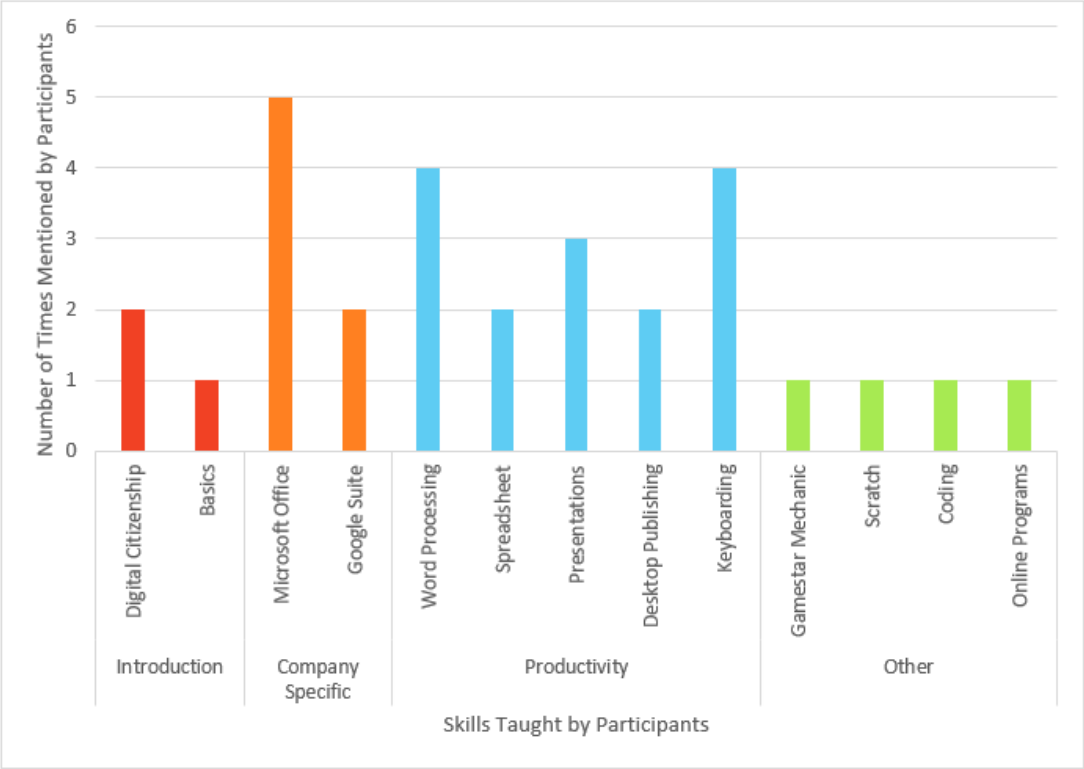
Figure 3

Technology Skills Taught by Study Participants



The results indicated that there is a presumed knowledge of technology hardware and software because the students are considered to be digital natives. A digital native, as defined by Prensky (2001) is someone who has grown up in close proximity with computers, video game consoles, the internet, mobile phones, and tablets; however, in many instances the use of technology does not show increased ability to utilize technology for educational or workplace skills (see Figure 4). Some teachers even felt that this was related to the fact that the school or district was a 1:1 school utilizing either tablets or Chromebooks.

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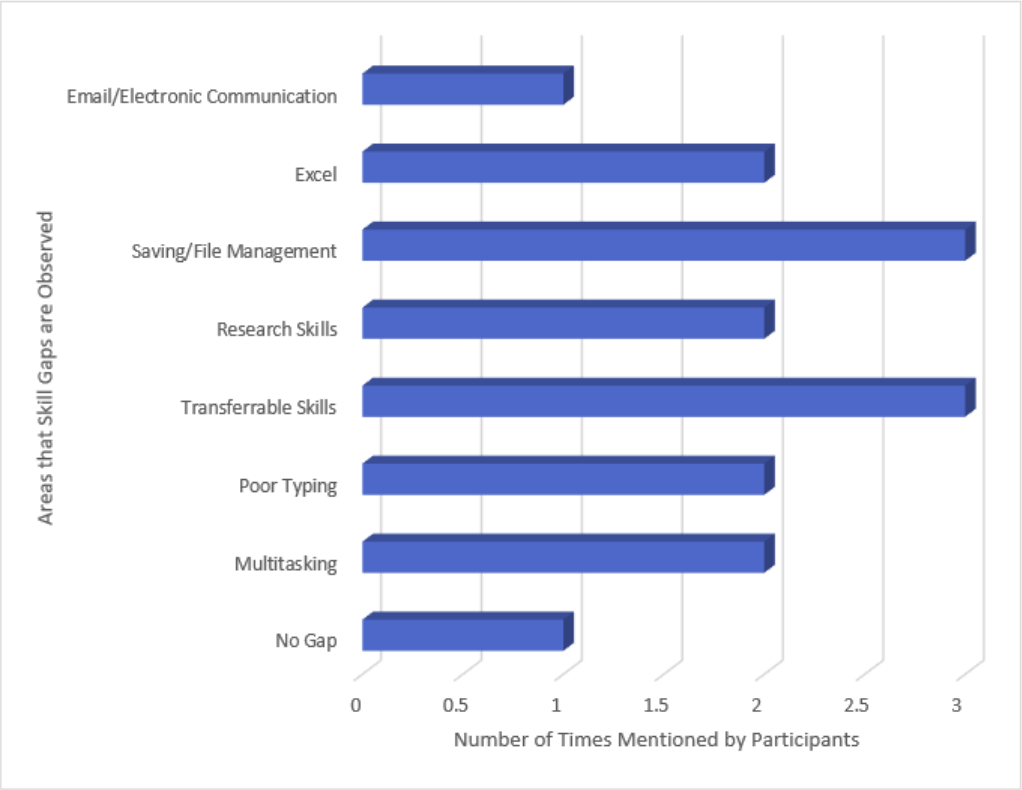
Figure 4

Technology Skill Gaps Observed by Participants



Discussion

After analyzing the data, this topic of teachers' perception of student technology use needs to be addressed and needs further research. While at first glance it seems that adding devices to the classroom would only enhance the learning experience, this study indicates that this may not be true in all instances.

Some of the results of participant's comments in this study confirm results of other studies concerning the use of technology in the classroom. Studies report that school administrators are often the ones who are most excited about devices in the classroom and push technology use requirements into the classroom without sound pedagogical reasons for its use (Tucker, 2019). The participants in this study also felt pressure to use specific technology from their administrators (see Figure 5).

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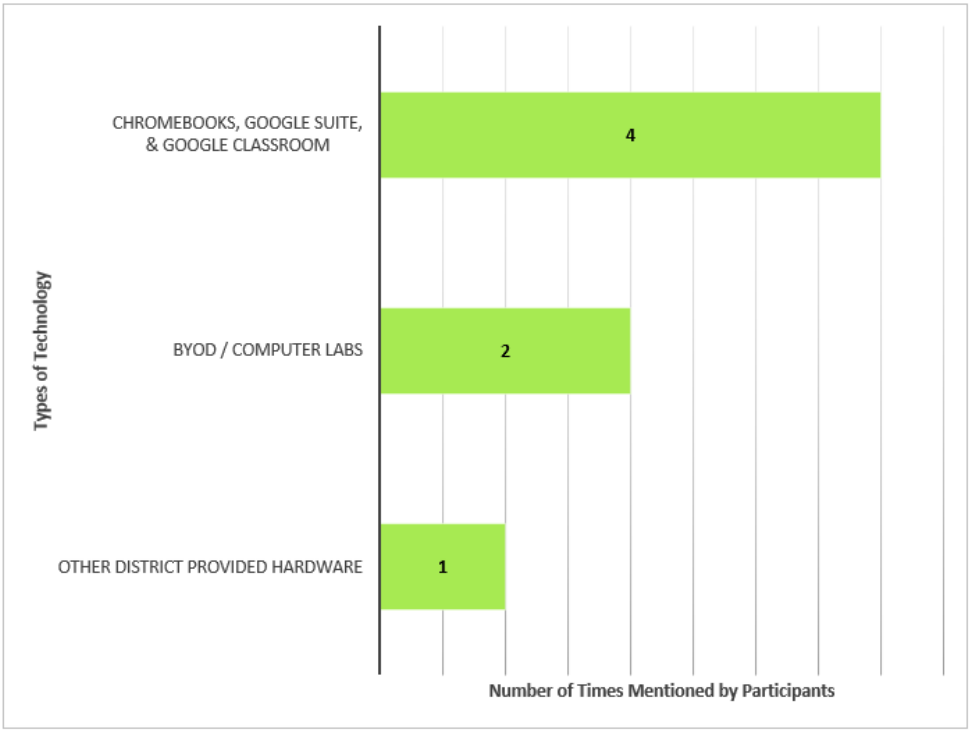
Figure 5

Types of Technology that Teachers are Encouraged to Use by Administration



Specifically, there has been an increase in the use of school funds to purchase devices for student use at home, even though there is little evidence demonstrating a positive relationship between home computer access to improved academics (Vigdor, Ladd, & Martinez, 2014). At other times, teachers lack confidence in their abilities to utilize the devices the school district has provided (Blackwell, Lauricells, & Wartella 2014). While the business and technology teachers in this study indicated a confidence in the use of computer hardware and software, their peers in core classes were not as confident, as evidenced by the business and technology teachers being asked how to use specific devices by their colleagues.

The teachers in this study also indicated that students attempt to multitask often leading to distractions, longer completion times, and lower levels of retention and/or learning. This finding aligns with the study that demonstrated lost time when switching back and forth between various applications on the computer and/or multiple devices such as between a computer and mobile phone (Wood, et al., 2012). This study found that students were introduced to computer software at early ages, but not trained to use the software until later. The impact is that when students are in a technology course, they may struggle with basic skills that the teacher assumes they have.

For example, students who enter a classroom that is teaching Microsoft Office, may not be aware that they need to save a document (and remember where it is saved) as they have been taught using Google tools previously.

This study also discovered heavy usage of one-to-one computing programs, specifically with Chromebooks, even with this small sample size of teachers. The ones that were not currently one-to-one schools with Chromebooks were in the process of becoming a one-to-one school within the year despite the research found that access to individual devices has shown lower reading performance (Gubbels, Swart, & Groen, 2020).

One teacher in this study indicated an issue with cheating in her school using technology devices. She also stated that the students involved did not seem to experience any ethical dilemma about their decision to cheat, nor did they consider it cheating. This coincides with the study wherein college students indicated a tendency to cheat more with a device as well as a lack of urgency to report others who do the same (Burnett, Enyeart Smith, & Wessel, 2016).

Reiterated by the teachers across the study sample was the desire and need for additional technology education for their students. They felt that although there was an assumed knowledge of technology projected onto their students, the students needed to be taught technology skills despite being digital natives (see Figure 6).

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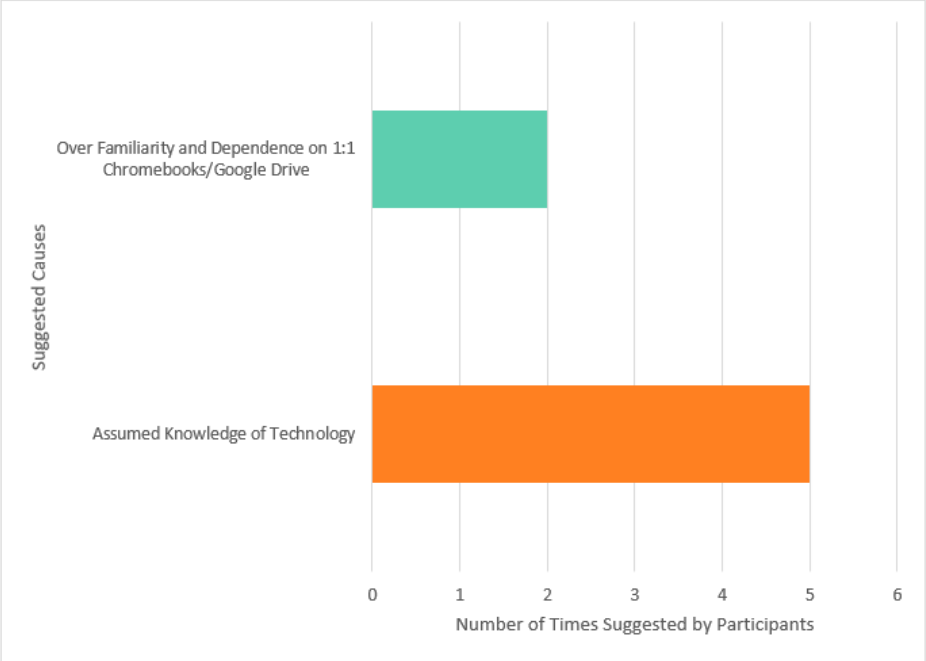
Figure 6

Suggested Causes for Technology Skill Gaps



While students are gaining access to cell phones and other devices at earlier ages in the home, it does not necessarily mean the students know how to transfer the skills to hardware or software that be required in their future careers or academic education. One instructor specifically mentioned a fear that the students leaving high school would not be prepared for an accounting program in college because the students are not learning Excel at the high school any longer, yet Excel is considered a basic skill at the college level.

Using technology just for the sake of using technology is not prudent, educators should strive to be strategic in the lessons taught using hardware and software use just as they are with other aspects of their lesson planning. If students are given the best opportunities to use computer hardware and software, taught how to use different types of hardware and software, and taught how to transfer that knowledge elsewhere, technology can greatly improve the future careers and lives of students.

It is important to note that the findings of this study can only be applied to the participants and not generalized to a broader audience. The purpose of this study was to gather data to inform one or more larger projects in the future as described below.

Future Research

While preparations for this study were being implemented in the spring of 2020, the study truly took place over the course of a month in the summer of 2020, when decisions had yet to be made about fall classes for many schools because of the pandemic. A qualitative study seeking to answer the same research question would provide a wider view and potentially generalizable data related to teacher perceptions of technology use in K-12 schools. Repeating the same qualitative study after the pandemic could potentially shed light on the impact of the pandemic upon technology self-efficacy of both students and teachers.

An important longitudinal study of a school that begins prior to implementation of a one-to-one program through the entire academic career of the students would yield data that potentially leads to deeper understanding of how one-to-one programs impact the students over time. Additionally, a study of this nature would provide data about how teachers perceive technology use and its efficacy within the classroom, potentially leading to enhanced professional development for classroom teachers. Another topic that could be considered for additional research would be to compare two or more school districts with different approaches to technology instruction within the districts.

Conclusion

The central issue is not related to a lack of devices or software or even a willingness to use technology by teachers or students. The issue lies in how technology is used, its pervasiveness in modern-day society, and the assumptions of transferrable skills into the classroom. Although documented through multiple studies, the ability to use a mobile phone, tablet, or computer for social interaction does not lead to an increased ability to utilize the technology for learning or workplace skills. It is assumed that students are digital natives; therefore, they do not need to be taught technology skills. Many students do not recognize their lack of skill to use technology as a learning tool or workplace tool because of an overconfidence in their skills with devices such as cell phones and tablets. The goal for educators is, and always has been, to give the students the best education they can receive so that when the students graduate to the next level of school or into the workforce, they can be successful members of society. As technology remains ubiquitous in students' lives, it is important to teach the students how to use technology devices and software applications to their fullest potential. The responsibility to teach important skills falls on schools. Schools can meet that responsibility with proper training for the teachers, proper training and technology education for students, and the use of quality computer hardware and software.

References

Akçayır, M., Dündar, H., & Akçayır, G. (2016). What makes you a digital native? Is it enough to be born after 1980? *Computers in Human Behavior*, *60*, 435–440. https://doi.org/10.1016/j.chb.2016.02.089

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education, 77*, 82–90. https://doi.org/10.1016/j.compedu.2014.04.013

Bureau of Labor Statistics. (2020, September). Employment Projections 2019-2029. U.S. Department of Labor. https://www.bls.gov/news.release/pdf/ecopro.pdf

Burnett, A. J., Enyeart Smith, T. M., & Wessel, M. T. (2016). Use of the social cognitive theory to frame university students' perceptions of cheating. *Journal of Academic Ethics, 14*(1), 49–69. https://doi.org/10.1007/s10805-015-9252-4

Carver, L. B. (2016). Teacher perception of barriers and benefits in K-12 technology usage. *Turkish Online Journal of Educational Technology, 15*(1), 110–116. https://files.eric.ed.gov/fulltext/EJ1086185.pdf

Gubbels, J., Swart, N. M., & Groen, M. A. (2020). Everything in moderation: ICT and reading performance of Dutch 15-year-olds. *Large-Scale Assessments in Education, 8*(1), 1–17. https://doi.org/10.1186/s40536-020-0079-0

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The Substitution Augmentation Modification Redefinition (SAMR) Model: A critical review and suggestions for its use. *TechTrends, 60*(5), 433–441. https://doi.org/10.1007/s11528-016-0091-y

Kim, H. J., & Jang, H. Y. (2020). Sustainable technology integration in underserved area schools: The impact of perceived student change on teacher continuance intention. *Sustainability, 12*(12), 4802. https://doi.org/10.3390/su12124802

Lee, A. (2020). The association between female students' computer science education and STEM major selection: multilevel structural equation modeling. *Computers in the Schools, 37*(1), 17–39. https://doi.org/10.1080/07380569.2020.1720553

Lee, J., Sung, M.-J., Song, S.-H., Lee, Y.-M., Lee, J.-J., Cho, S.-M., Park, M.-K., & Shin, Y.-M. (2016). Psychological factors associated with smartphone addiction in South Korean adolescents. *The Journal of Early Adolescence, 38*(3), 288–302. https://doi.org/10.1177/0272431616670751

Mercimek, B., Akbulut, Y., Dönmez, O., & Sak, U. (2019). Multitasking impairs learning from multimedia across gifted and non-gifted students. *Educational Technology Research and Development, 68*(3), 995–1016. https://doi.org/10.1007/s11423-019-09717-9

Pedro, L. F., Barbosa, C. M., & Santos, C. M. (2018). A critical review of mobile learning integration in formal educational contexts. *International Journal of Educational Technology in Higher Education, 15*(10), 1–15. https://doi.org/10.1186/s41239-018-0091-4

Prensky, M. (2001). Digital natives, digital immigrants: Part 1. *On the Horizon, 9*(5), 1-6.

Puentedura, R. R. (2013). Ruben R. Puentedura's Weblog: SAMR: Moving from enhancement to transformation. *Hippasus*. http://www.hippasus.com/rrpweblog/archives/000095.html

Serin, H., & Bozdağ, F. (2020). Relationship between teachers' attitudes towards technology use in education and autonomy behaviors. *The Turkish Online Journal of Educational Technology, 19*(3), 60–69. https://doi.org/https://files.eric.ed.gov/fulltext/EJ1261402.pdf

Sparks, J. R., Katz, I. R., & Beile, P. M. (2016). Assessing digital information literacy in higher education: A review of existing frameworks and assessments with recommendations for

next-generation assessment. *ETS Research Report Series*, 2016(2), 1–33. https://doi.org/10.1002/ets2.12118

Stake, R. E. (2010). Qualitative research: Studying how things work (Illustrated ed.). The Guilford Press.

Turner, K. (2019). One-to-one learning and self-determination theory. *International Journal of Instruction, 12*(2), 1–16. https://doi.org/10.29333/iji.2019.1221a

Appendix A: Interview Questions

The following survey is to evaluate the effect of the early usage and implementation of technology in the classroom. Please answer the following questions based upon your personal experience with technology (devices, programs, etc.) as an instructor. Thank you in advance for your participation.

1. What is your gender?
2. What is your age?
3. How many years have you taught?
4. What is your highest level of education?
5. What was the content area of your degree?
    a. Business education
    b. Technology education
    c. Other
6. What grade level do you currently teach?
7. What is the size of your student body?
8. At what grade level are your students introduced to technology?
9. At what grade level are the students expected to complete assignments using technology on a regular basis?
10. How does your school encourage the students' use of technology in the classroom?
11. How are students taught to use technology safely?
12. What technology skills are taught to the students?
13. Do you perceive a skill gap in your students with the use of technology? If so, what skills are lacking?
14. What do you perceive to be the impact this skill gap has for students academically? Beyond academically?
15. Can you share an interaction with a student where you were impressed with a student's technology knowledge?
16. Can you share an interaction with a student where you were disappointed with a student's technology knowledge?

Administrators View of Mathematics Integration in the Agricultural Education Programs

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Abstract

This study was conducted to determine the perceived attitudes and perceptions of Kentucky secondary school administrators on the barriers to integrating Mathematics in Agricultural Education curricula, and administrator support for their Agricultural Education program. The researcher's utilized a Modified Version of Thompson's Integrating Science Instruments. The population for this study included all administrators (n=875) of Kentucky secondary schools. An important finding of the study indicates the administrators felt that mathematics integration would result in more program support across the board. The administrators indicated that the agricultural education teachers would receive more support from their math counterparts, more industry support, and more support from the administration. Ultimately, it is the individual agricultural education instructor's responsibility to remove the barriers that exist and break down the inaccurate perceptions that may exist amongst the administration. If the perceptions identified in the study are an accurate reflection of the local program, then the agricultural education instructor must make an effort to correct those issues before their program faces elimination from the secondary curriculum for not providing the rigor, relevance, and relationships needed to be successful in the eyes of administrators.

Introduction

The study was designed to determine the perceptions of Kentucky secondary administrators on the barriers to integrating Mathematics into the agricultural education curriculum. Curriculum integration is not a new concept, the 20th century educational reformer John Dewey believed in the importance of curriculum integration and the consequences of separating knowledge from application (Young, et al. 2009). Myers and Thompson (2009) examined the barriers to integrating science into the agricultural education curriculum. Their findings indicated insufficient time and support to plan for implementation was the greatest barrier to integration.

They also presented data that suggested administrative support was not a barrier to science integration.

Agricultural Education curriculum that has been integrated with Mathematics has been shown to have a positive effect on student achievement (Young, et al., 2009). Barriers to integrating Mathematics exist, preventing schools from fully integrating Mathematics into the agricultural education curriculum. Smith, et al., (1990) indicated several problem areas for school-based agricultural educator teachers. Increased high school graduation and college entrance requirements in West Virginia secondary schools had become a barrier to administrating agricultural education programs. Another finding of the study was the failure of school administrators to recognize the unique characteristics of vocational agriculture, such as experience programs (Smith, et al, 1990).

Researchers for the National Assessment of Educational Progress (NAEP) stated in a study of high school seniors across the nation that the performance of 17-year-olds on the 2008 Reading and Mathematics assessments was not significantly different from the students' performance in 1971. The study also showed no significant changes in assessment scores during the years of 2004 and 1973 (National Center for Educational Statistics, 2010). This data indicated no significant change in assessment scores in either direction, which also indicated no great improvement in the pedagogy of the curriculum.

The Digest of Education Statistics (2010) studied mathematic scores of 4^{th}, 8^{th}, and 12^{th} grade students, separated by demographics, and compared from 1990 to 2009. The data for 12^{th} grade students was from the period of 1990 through 2000, and the most interesting data was related to the parent's highest level of education. Students raised by parents who did not graduate high school scored between 30 and 40 points lower than those whose parents graduated from college (US Department of Education, 2009). There was no evidence to indicate exactly the cause of this noteworthy difference in testing scores between these groups of students, other than educational background. Other factors such as income level, rural versus non-rural locales, or demographic information could have had an influence on the student's achievement.

Darrow and Henderson, (1987) identified the human acceptance of ideas and innovation as the real carriers of change, and human resistance to these ideas as the real barrier to change. This idea suggested educators had become a barrier to a change in curriculum due to the educators' own resistance to the process. Several possible factors were evident in the study regarding reasoning for the resistance. Low teacher knowledge of new subject matter, limited administrative support, and limited student interest all had played an important role in the perception of barriers to integration (Conroy, 1999).

Myers & Washburn (2008) surveyed school-based agricultural education teachers, who indicated a general lack of sufficient time and support to plan for implementation of integration as a major

barrier to integrating curricula into Agricultural Education. Furthermore, the respondents suggested insufficient funding, concern over large class sizes, and personal lack of experience with integrating curricula were also barriers to integration. Data regarding school-based agricultural educators' perceptions and theories concerning curriculum integration of core principles had been discussed for their correlation to this study and had been deemed relevant to understanding how one group views school-based agricultural education. However, administrators represented another vital segment of the educational equation. The authors needed to focus on administrator's attitudes and opinions regarding Mathematics integration into the agricultural education curriculum in order to fully understand how improvements to curriculum and teacher relations can further benefit agriculture programs and ultimately benefit the students.

The attitudes and perceptions of these administrators are crucial in understanding the dynamic relationships that are created in secondary schools in Kentucky between administrators and educators (Hallinen, 2015). A study by Dodson (2009) examined administrators' perceptions of the role of school counselors in the Rocky Mountain region of the United States. The research pointed out that many administrators have little to no opportunity to understand the re-conceptualization of their role. The Agricultural Educators' support network of guidance counselors, principals, vice-principals, superintendents and professional development personnel aid in the process of selecting curriculum for each school system. These administrators are instrumental in assisting the School-Based Agricultural Educators in creating a relevant and relatable curriculum based on logical principles and contextual learning methods. As cited in a study by Thompson (2001), principals are key decision makers in the curriculum at their respective schools and are influential in the continuation of the agricultural education program. Although they do not have full control over curriculum, their influence has great impact and their perceptions of Agriscience courses determine its success (Johnson & Newman, 1993).

Administrators are significant in supporting or eliminating agricultural education curriculum from school systems based on relevancy and/or student and community interest. If administrators have an accurate perception of the school counselor role, administrators and the counseling department can move in a new direction with regard to the counselor's role (Dodson, 2009). Agricultural education and the agricultural education curriculum hinge on the notion that secondary schools will always offer students the option of taking agricultural education courses as part of their career path. Without the support of these administrators, agricultural education could be removed from secondary education all together. Administrators' involvement is essential in the agricultural education curriculum, as well as being involved in the classrooms, to understand that CTE courses are a viable source for core curriculum reinforcement.
Dyer & Osborne (1999) researched the influence of Illinois guidance counselors at a student-teaching center in regard to agricultural education, including how students plan for an education and career. The researchers stated, equally important is knowledge of the attitudes of counselors toward some of the best agriculture programs. Counselors denoted a positive attitude toward Agriculture as a career path, believed to be highly technical, and school-based agricultural

education programs are beneficial in preparing students for college agriculture courses. These findings are contradictory to Dyer & Osborne (1994), which found guidance counselors from general secondary schools in Illinois indicated uncertainty as to whether there was any benefit to agricultural education programs.

Although the concept of local agricultural education supervisors is not widespread, school-based agricultural education teachers are supervised by others at the local level, including principals, superintendents, head teachers and/or others (Barrick, 1986). The study concluded that there were misconceptions concerning teachers' views of the current and expected roles of the Agricultural Educator's supervisor, either principal or CTE director, which could lead to conflicts between the educators and administrators (Barrick, 1986). Barrick's study also found local CTE supervisors estimated spending 60% of the time improving the curriculum. Martin (1986) however, indicated communication levels between administrators and teachers do not seem to be open, there was a need for candid and clear communication between principals and teachers about the true essence of vocational Agriculture. Martin further suggested principals supported their agriculture program, while Agricultural Education teachers felt principals exaggerated the interest in Agricultural Education (Martin, 1986).

The conceptual framework for this study was provided by Greenwald (1989). The study concluded that when certain individuals favor a situation or a subject with a positive attitude, they tend to evaluate them positively. Using this framework, administrators' support could be measured by analyzing their beliefs on the subject of integrating Mathematics into agricultural education. If these administrators have a positive attitude toward the integration of Mathematics into agricultural education curriculum, they will most likely support the efforts of the school-based agricultural educator teachers and also most likely support the concept of integrating Mathematics into the curriculum.

Theoretical Framework

Fishbein and Ajzen's theory of reasoned action was utilized to guide this study, a description of attitude is explained as a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object. Fishbein and Ajzen (1975) describe four classifications which categorize predispositions:

- Affect (feelings, evaluations): A favorable or unfavorable evaluation of an object. (attitude)
- Cognition (opinions, beliefs): Information a subject has of an object, thus linking a belief of the object to an attribute.
- Conation (behavioral intentions): A subjects intention to perform various behaviors, based on strength of intention.
- Behavior (observed overt acts): Observable act, reaction, or response.

Any response to a questionnaire or verbal survey is considered a behavioral instance. The responses can be used to aid in creating inferences regarding beliefs, intentions or attitudes. The fourth category, however, is used to measure a particular overt behavior in order to understand the details relating to it (Fishbein & Ajzen, 1975). This theory suggests prior exposure to a subject would have an effect on the perceptions of respondents. Positive experiences would tend to lead researchers to infer positive attitudes, and negative experiences would lead to negative attitudes. Knowledge of a subject, the respondent's own belief system, and personal opinions all serve to guide the respondent behaviors in regards to completing the survey instrument.

Greenwald (1989) supported this theory by concluding that individuals, who showed a positive favor towards a situation or an issue, also tend to evaluate the situation in a positive manner. This concept suggested that if an administrator had a positive attitude in relation to the integration of Mathematics in the agricultural education curriculum, administrators would tend to be more supportive of school-based agricultural educator teachers' efforts to integrate Mathematics into the curriculum. In theory, changing a person's attitude regarding a subject could change the level of support that would be offered for that subject.

Purpose/Objectives

The purpose of this study was to provide an assessment of the attitudes and perceptions of administrators of Kentucky secondary schools regarding Mathematics integration in the agricultural education curriculum. The research objectives of the study were:

1. Determine the demographic features and characteristics that the responding administrators possessed.

2. Determine the Administrators attitudes toward Agricultural Education Instructors Teaching Integrated Mathematics

3. Determine attitudes of administrators regarding barriers to integrating mathematics into the Agricultural Education curriculum.

Procedures

The population for this quantitative study consisted of Kentucky secondary administrators. The researchers collected electronic contact information for all administrators in the school districts that offered agricultural education. A total of 130 superintendents, 78 assistant superintendents, 170 principals, 369 guidance counselors and 128 professional development coordinators were identified for a total of 875 participants. A census study was utilized to reduce sampling errors and to describe the entire population.

Instrumentation
The data collection instrument was developed by Thompson (2000) and was modified by the researchers to collect mathematics integration data electronically. The instrument was divided into two sections the first section asked respondents to answer 71 statements regarding different aspects of Mathematics integration and the agricultural education curriculum. Their responses were measured using a five-point Likert-type scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The second section asked the participants to answer a series of 17 demographic questions designed for a greater understanding of background information and school population characteristics.

The reliability and face validity were examined through the field study. The reliability of the instrument was found to be "very good" according to DeVellis (1991) with the Cronbach's alpha coefficient score falling between .80 and .90 from the results of the study yielding an (α=.895). Murray State University pre-service agricultural education teacher candidates and selected faculty members served as the panel for review of the instrument due to their background in agricultural education. The student and faculty panel was asked to review the instrument to establish face and content validity.

Methods
Dillman's (2007) data collection methods were utilized for this study. After five contact attempts, a response rate for individual administrative positions included superintendents having 31.53%, assistant superintendents with 28.21%, principals with 28.82%, professional development coordinators having 28.13%, and guidance counselors indicating a 9.21% response rate. The guidance counselors' response rate was responsible in lowering the overall response rate to 20.80% (n=182). The response rate prior to inclusion of this administrative group indicated a rate of 29.24%. Non-response error was a concern; therefore, the researchers utilized Lindner, et al., (2001) recommendations by comparing early to late respondents to find no significant differences. Data was analyzed using PSAW 24.0.

Findings
Respondent demographic data was analyzed through a series of 17 questions. The age range of the respondents was between 41 and 60 years old (77.46%). A majority of the respondents had less than ten years of experience as an administrator (73.57%). The results revealed a high majority of administrators were relatively new to administration, while only 26.43% of administrators of Kentucky secondary schools had more than 10 years employed as an administrator. However, they indicated 47.13% had been employed in their current school district for more than 16 years. Over 93% of the respondents had at least a Masters plus thirty credit hours as their indicated level of education.

Gender of secondary school administrators was nearly evenly distributed, with male administrators a slight majority (52.02%). Nearly half (45.67%) of Kentucky secondary

administrators indicated having grown up on a farm. Less than 30 % (28.90%) grew up in a town/city, while the rest (25.43%) grew up in a rural/non-farm location. Administrators' enrollment in agricultural education during high school was questioned, indicating 86.21 % of Kentucky secondary administrators indicated not taking agricultural education as a high school student. When asked of involvement in 4-H as a youth, 51.46 % indicated having been involved. The largest frequency of administrators currently lived in a rural/non-farm area (41.71%), while a majority of respondents currently lived in a town smaller than 10,000 residents (53.26%).

Kentucky secondary school demographics showed the highest percentage of students enrolled in the schools were between 501 and 1,000 students (38.86%), while most agricultural education programs were between 101 and 150 students (32.56%). Two agricultural education teacher departments were the most frequently reported (45%). Over 64% of the administrators reported attending three or more in-service workshops related to academic integration.

Six statements regarding agricultural education program support were identified as favorable in improving program support. Overall, the administrators felt that mathematics integration would result in more program support across the board. The administrators indicated that the agricultural education teachers would receive more support from their math counterparts (M= 3.97; SD 0.68), more industry support (M= 3.85; SD 0.74), and even more importantly additional support from the administration (M= 3.60; SD 0.80), guidance counselors and parents (M= 3.57; SD 0.78, 0.83 respectively) if agricultural education teachers increased their efforts to integrate mathematics as outlined in table #1.

Table 1
Agricultural Education Program Support (n=182)

	M	SD
Mathematics teacher support will increase if Agriculture teachers integrate more Mathematics into the Agricultural education curriculum.	3.97	0.68
Agriculture industry support will increase if Agriculture teachers integrate more Mathematics into the Agricultural curriculum.	3.85	0.74
My support as an administrator will increase if Agriculture teachers integrate more Mathematics into the Agricultural curriculum.	3.60	0.80
School counselor support will increase if Agriculture teachers integrate more Mathematics into the Agricultural curriculum.	3.57	0.78
Parental support will increase if Agriculture teachers integrate more Mathematics into the Agricultural education curriculum.	3.57	0.83
Community support will increase if Agriculture teachers integrate more Mathematics into the Agricultural education curriculum.	3.54	0.83

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

Ten statements regarding *Barriers to the integration of Mathematics into the secondary Agricultural Education curriculum* were identified in this study. Respondents indicated a lack of in-service workshops for school-based agricultural education teachers was the statement administrators most agreed with from this section, with a mean score of 3.69 (SD 0.88). The administrators also indicated that a lack of integrated curriculum (M= 3.67, SD 0.88) and educational materials (M= 3.63, SD 0.93) were two of the top three barriers identified.

Administrators indicated the lack of a helpful Mathematics teacher, with a mean score of 2.95 (SD 0.93), and the lack of an institute of higher learning in close proximity, with a mean score of 2.67 (SD 1.05), were the least supported statements of the section. Administrators rated both of these statements with a neutral rating, indicating no definitive positive or negative opinion of either statement. The administrator's responses the barriers regarding mathematics integration into the agricultural education curriculum can be found in Table #2.

Table 2
Barriers to Integrating Mathematics (n=182)

	M	SD
The lack of Agriscience in-service workshop(s)/course(s) for Agricultural Education teachers is a barrier to integrating Mathematics into the Agricultural education program.	3.69	0.88
The lack of an available integrated curriculum is a barrier to integrating Mathematics into Agricultural education programs.	3.67	0.90
The lack of appropriate educational material is a barrier to integrating Mathematics into the Agricultural education program.	3.63	0.93
The lack of adequate funding from federal, state or local government is a barrier to integrating Mathematics into the Agricultural education program.	3.52	1.00
The lack of Agricultural competence or background in Agriculture among Mathematics teachers is a barrier to integrating Mathematics into Agricultural education programs.	3.44	0.97
The lack of competence in Mathematics among Agriculture teachers is a barrier to integrating Mathematics into Agricultural education programs.	3.42	0.95
The lack of student preparation in Mathematics (prior to enrolling in Agricultural education courses) is a barrier to integrating Mathematics into Agricultural education programs.	3.37	0.97
	3.23	0.93

The philosophical differences between the Mathematics and the Agricultural education department have been a barrier to integrating Mathematics in the Agricultural education program.		
The lack of a Mathematics teacher who is willing to help integrate mathematical concepts has been a barrier to integrating Mathematics into Agricultural education programs.	2.95	0.93
The lack of higher education institutions in close proximity to our school is a barrier to integrating Mathematics into the Agricultural education program.	2.68	1.05

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

Conclusions

The purpose of this study was to provide an assessment of the attitudes and perceptions of administrators of Kentucky secondary schools regarding Mathematics integration in the agricultural education curriculum. School-based agricultural education teachers' perceptions and theories concerning curriculum integration of core principles have been well documented on how one group views agricultural education. However, administrators represented another vital segment of the educational equation. A focus needed to be placed on administrator's attitudes and opinions regarding Mathematics integration into the agricultural education curriculum in order to fully understand how improvements to curriculum and teacher relations can further benefit agriculture programs and ultimately benefit the students. The results of this study indicate that the administration is willing to provide more support to the agricultural education program if the agricultural education instructor invested the additional time and effort necessary to integrate more mathematics into the agricultural education curriculum. This may require the school-based agricultural education teachers to improve their own mathematics content knowledge (McNall & Rice, 2020).

The researchers cannot not stress enough about how the administrators are significant in supporting or eliminating agricultural education curriculum from school systems. School-based agricultural education and the agricultural education curriculum hinge on the notion that secondary schools will always offer students the option of taking agriculture education courses as part of their career path. Without the support of these administrators, school-based agricultural education could be removed from secondary education all together.

The school-based agricultural education teacher's support network of guidance counselors, principals, vice-principals, superintendents and professional development personnel aid in the process of selecting curriculum for each school system. These administrators are instrumental in assisting the school-based agricultural education teachers in creating a relevant and relatable curriculum based on logical principles and contextual learning methods. As cited in a study by Thompson (2001), principals are key decision makers in the curriculum at their schools and are influential in the continuation of the agricultural education program. Although they do not have

full control over curriculum, their influence has great impact, and their perceptions of school-based agricultural education courses determine its success (Johnson & Newman, 1993). At a time when administrators are being forced to cut programs for both academic and budgetary reasons it is essential to work with administration and the mathematics department to ensure that the local agricultural education program is answering the demand to improve student academic learning. With this in mind, it is essential that school-based agricultural education teachers need to be proactive in working with their respective administrators to ensure they have an accurate perception of the efforts being made to integrate mathematics.

School-based agricultural education teachers have indicated that they do indeed make an effort to integrate mathematics into their curricula. One of the content areas that are rich in mathematics is agricultural mechanics; this is especially highlighted in the agricultural mechanics career development event. Perhaps there is a disconnect between perception in the administrative offices and the reality in the agricultural education classroom. If this disconnect exists, then it is the researchers recommendation that you invite your administration to assist you in judging the next local or state agricultural mechanics career development event. This activity should result in several benefits for agricultural education instructors and their programs. First and foremost this activity provides the administrators with much needed exposure to a career development event rich in mathematics that showcases rigor. Secondly, the activity highlights the academics that are overseen in a "vocational" content area that is loaded in relevancy. Last, but not least this activity allows your administrators to observe how your students develop relationships, enhance their team building skills, and fine-tune their problem-solving abilities.

It should be important to note that the administrators identified several barriers that exists that could infringe on the school-based agricultural education teachers' ability to integrate mathematics. They identified *The lack of Agriscience in-service workshop(s)/course(s) for Agricultural Education teachers is a barrier to integrating Mathematics into the Agricultural education program* the biggest barrier. It is the researcher's opinion that there are three sectors responsible for reducing this barrier; the post-secondary institutions, the state staff, and most importantly the state agricultural education teachers association. Each of these three entities could put additional effort towards developing courses, workshops, and professional development activities which aligns to the recommendations of McNall and Rice (2020).

The administrators also indicated that *The lack of an available integrated curriculum is a barrier to integrating Mathematics into Agricultural education programs* and *The lack of appropriate educational material is a barrier to integrating Mathematics into the Agricultural education program.* One of the more popular agricultural education teacher's mottos has always been "why reinvent the wheel"; with that said, it is vital that successful agricultural education teachers make more of an effort to share additional lessons, activities, and other materials more frequently on the National Association of Agricultural Educators *Communities of Practice* website. The researchers also recommend that NAAE COP facilitators highlight outstanding materials each

month. The researchers would also point out the availability of the CASE curriculum as a potential avenue for local schools to pursue as well. We recommend that administrators and school-based agricultural education teachers place an emphasis on enrolling the agricultural education teacher in CASE courses. School-based agricultural education teachers could explore additional opportunities adopt inquiry-based learning. Thoron and Myer (2011) found students experienced higher levels of achievement in inquiry-based learning courses.

Ultimately, it is the individual agricultural education instructor's responsibility to remove the barriers that exist and break down the inaccurate perceptions that may exist amongst the administration. If the perceptions identified in the study are an accurate reflection of the local program, then the agricultural education instructor must make an effort to correct those issues before their program faces elimination from the secondary curriculum for not providing the rigor, relevance, and relationships needed to be successful in the eyes of administrators. We recommend promoting the STEM-based skills that agricultural education students are learning through their classes, supervised agricultural experiences, and FFA activities through social media and traditional media outlets to inform administrators, teachers, and industry stakeholders as recommended by Hallinen (2015).

References

Barrick, R. (1986). Current and expected roles of Agriculture supervisors. *Journal of Agricultural Education 27*(2), 44-52. https://doi.org/10.5032/jaatea.1986.02044

Conroy, C. (1999). Identifying barriers to infusion of Aquaculture into secondary Agriscience: Adoption of a curriculum innovation. *Journal of Agricultural Education,* 40(3), 1-10. https://doi.org/10.5032/jae.1999.03001

Darrow, E., & Henderson, J. (1987). Curricular Innovations in Aquaculture, Curricular Innovations for 2005: Planning for the Future of Our Food and Agriculture Sciences. Washington, DC: United States Department of Agriculture.

DeVallis, R. (1991). *Scale development*. Newbury Park, NJ: Sage.

Dillman, D. (2000). *Mail and Internet Surveys: The tailored design method.* New York, NY: Wiley and Sons.

Dodson, T. (2009). *Advocacy and impact: a comparison of administrators' perceptions of the high school counselor's role. The Free Library*.

Dyer, J., & Osborne, E. (1994). The influence of Science-based Agriculture courses on the attitudes of Illinois high school guidance counselors. Paper presented at the Central Region Agricultural Education Research Conference, St. Louis, MO.

Dyer, J., & Osborne, E. (1999). The influence of Science applications in Agriculture courses on attitudes of Illinois high school guidance counselors at model student-teacher centers. *Journal of Agricultural Education, 40*(4), 57-66. https://doi.org/10.5032/jae.1999.04057

Fishbein, M., & Ajzen, I. (1975). *Beilief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley.

Greenwald, A. G. (1989). *Attitude structure and function*. Hillsdale, NJ: Erlbaum Associates.

Hallinen, J. (2015, October 21). *STEM Education Curriculum*. Britannica. https://www.britannica.com/topic/STEM-education

Johnson, D. & Newman, M. (1993). Perceptions of administrators, guidance counselors and science teachers concerning pilot courses *Journal of Agricultural Education, 31*(2), 46-54. https://doi.org/10.5032/jae.1993.02046

Lindner, J. R., Murphy, T. H., & Briers, G E. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education*, *42*(4), 43-54. https://doi.org/10.5032/jae.2001.04043

Martin, R., Nwozuzu, E., & Gleason, A. (1986). Perceived communications and support linkages of high school principals and vocational Agriculture teachers. *The Journal of the American Association of Teacher Educators in Agriculture, 27*(1), 18-26. https://doi.org/10.5032/jaatea.1986.01018

McNall, S., & Rice, A. (2020). Arizona Agriculture Teachers' Mathematical Content Knowledge. *Journal of Agricultural Education*, *61*(4), 109- 126. http://doi.org/10.5032/jae.2020.04109

Myers, B., & Thompson, G. (2009). Integrating academics into agriculture programs: A Delphi study to determine perceptions of the national agriscience teacher ambassador academy participants. *Journal of Agricultural Education*, *50*(2). 77-88. https://doi.org/10.5032/jae.2009.02075

Myers, B., & Washburn, S. (2008). Integrating Science into the Agriculture Curriculum: Agriculture Teacher Perceptions of the Opportunities, Barriers and Impact on Student Enrollment. *Journal of Agricultural Education, 49(*2), 27-37. https://doi.org/10.5032/jae.2008.02027

National Center for Educational Statistics (2010). *Digest of Education Statistics*. Washington, DC. http://nces.ed.gov/programs/digest/d09/tables/dt09_138.asp

National Center for Educational Statistics (2010). National Assessment of Educational Progress (2008). *Trends in Academic Progress*. Washington, DC. http://nces.ed.gov/whatsnew/commissioner/remarks2009/4_28_2009.asp .

No Child Left Behind Act of 2001 (2009). *The no child left behind act of 2001*. http://www.ed.gov/nclb/overview/intro/execsumm.html

Smith, S., Lawrence, L., Gartin, S., & Odell, K. (1990). Major problems encountered in administrating vocational Agriculture as perceived by state vocational Agriculture supervisors in the United States. *Journal of Agricultural Education*, Vol. 31(2), 45-48. https://doi.org/10.5032/jae.1990.02045

Thompson, G. (2001). Perceptions of Oregon secondary principals regarding integrating science into Agricultural science and technology programs. *Journal of Agricultural Education, 42*(1). 50-60. https://doi.org/10.5032/jae.2001.01050

Thoron, A. & Myers, B. (2011). Effects of inquiry-based agriscience instruction on student achievement. *Journal of Agricultural Education, 55*(4), 175-187. https://doi.org/10.5032/jae.2011.04175

United States Department of Education, (2009). *The no child left behind act of 2001*. http://www.ed.gov/nclb/overview/intro/execsumm.html

Young, R., Edwards, C., & Leising, J. (2009). Effects of a math-enhanced curriculum and instructional approach on student's need for post-secondary remediation in mathematics: A yearlong experimental study in agriculture power and technology. *Journal of Agricultural Education, 50*(1).116-126. https://doi.org/10.5032/jae.2009.01116

Perceptions of Administrators in STATE Secondary Schools Regarding Agriculture and Mathematics, Teaching Integrated Mathematics, and Meeting State Standards

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Abstract
This study was conducted to provide an assessment of the attitudes and perceptions of the administrators of Kentucky secondary schools on the use of mathematics integration in agricultural education curricula. The study researched the perceived relationships between agriculture and mathematics, administrator's perceptions on teaching integrated mathematics, and meeting state standards. An accurate assessment of the administrators' perceptions was vital to the research in order to improve their collaboration with educators. The study population included Kentucky secondary school administrators (N=875). The findings indicate a majority of administrators believe agriculture includes applied mathematics yet were neutral regarding whether or not agriculture teachers could teach a mathematics course.

Introduction/Theoretical Framework

The purpose of the study was to gain a greater understanding of the perceptions of secondary school administrators on the integration of core curriculum, specifically mathematics, into the agricultural education curriculum. Kentucky secondary school administrators have played an important role in facilitating change in agricultural education classrooms by mandating curriculum improvement and/or replacement. According to Dietel et al. (1991), Kentucky secondary school administrators use assessments to plan and improve programs, while teachers utilize them to observe student progress. Policy makers use assessment as a way to set standards and monitor education quality. Therefore, it is important to understand the administrators' relationships with these educators and the level of involvement in the classroom they might have experienced.

Administrators' relationships with agricultural educators has often been an overlooked subject. Agricultural education has been the focus of several studies regarding curriculum and the classroom (Doss & Rayfield, 2021). A study conducted by researchers at the National

Commission on Excellence in Education (1984) suggested American students are falling behind students in other nations. Subjects including agribusiness, plant science, animal science and agriculture mechanics have provided students with an adequate understanding of basic agricultural principles used to build a foundation for a proper agricultural education. Mandates created in the 1980's threaten administrators by holding them responsible for results based on the work of others. This caused the administrators to be cautious and display a low-risk attitude toward reform (Klein, 1991). Great care has to be taken to improve curriculum regarding each specific subject matter and increase passing rates among agriculture students without decreasing the amount and quality of the curriculum. A study conducted by Foster et al. (1995) stated the development of curriculum must take a middle ground with teachers, principals, and superintendents working in partnership. Administrators and teachers can adjust curriculum mandates to local conditions, and package them to increase credibility with other teachers and the community.

Data regarding agricultural educators' perceptions and theories concerning curriculum integration of core principles had been discussed for their relationship to this study, and had been deemed relevant to understanding how one group views agricultural education (Stubbs & Myers, 2016). However, administrators represent another vital segment of the educational equation. The author intended to focus on administrator's attitudes and opinions regarding mathematics integration into the agricultural education curriculum in order to fully understand how improvements to curriculum and teacher relations can further benefit agriculture programs and ultimately benefit the students.

A study conducted through the Kentucky Department of Education (2010) examined 11th grade student's scores on the ACT, which is curriculum-based measure of college readiness. This examination tested students' academic achievement in English, mathematics, science, reading and as an option, writing. The ACT was the only college readiness examination that could be directly tied to academic standards. Administrators could use this data to accurately assess secondary schools for effectiveness of curriculum in each subject administered on the ACT. The study averaged the scores from Kentucky 11th grade students during the years 2008 and 2009 to understand the statistics regarding the students meeting state benchmark scores. The benchmark scores for Kentucky were described as "the minimum score needed on an ACT subject-area test to indicate a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in the corresponding credit-bearing college courses" (Kentucky Department of Education, 2010). This study indicated that 42,929 students' scores from ACT testing revealed only 20% of Kentucky students met the benchmark score for Mathematics in 2008. In 2009, 43,511 students' scores were reported from the ACT, denoting 21% of 11th grade students met the benchmark scores for Mathematics. These findings indicate a deficiency in Mathematics education in Kentucky secondary schools.

However, simply identifying a deficiency in an academic content area is only one piece of the puzzle. Public schools, and by association agricultural education, have the goal of preparing students for work and college (Rice & Kitchel, 2017). As technology advances, workplace readiness continues to evolve with specific technical skills and job-specific knowledge giving way to creative problem-solving, effective communication, team work, and self-regulation (Robinson et al., 2018). Mathematics education plays a significant role in developing these 21st century skills in students' as employees must be able to employ quantitative reasoning skills (Steen, 2002) to address complex problems that involve complex calculations and require problem-solving skills (Robinson et al., 2018).

The development of 21st century skills including quantitative skills, which falls under the umbrella of mathematics, requires an effective context that provides the foundation for critical thinking and problem-solving (Agustin et al., 2012). According to contextual learning theory, learners process new information in such a way that it makes sense to them in their own frames of reference (Center for Occupational Research and Development, 2010). Furthermore, students gain deeper understandings of the curriculum when they are provided opportunities to construct their own knowledge in contexts they find meaningful (Brown et al., 1989). Agricultural education has been found to provide an effective context to integrate mathematics education (Swafford, 2018). Through the use of projects, students in the agricultural education classroom have the opportunity to practice and sharpen their mathematics skills thus, improving necessary 21st century skills required by contemporary employers (Robinson et al., 2018).

Studies have been conducted regarding the primary educators' perceptions and attitudes concerning the integration of core curriculum in Agricultural Education courses (Anderson et al., 2008; Brister & Swortzel, 2009). A principle concern for educators is that in order for students to successfully complete high school, they must have a positive educational experience. One theory is to achieve success through an integrated curriculum. Integrative instruction aims to teach concepts from two or more subject areas during the same instructional unit (Wells, 2015). A key aspect of integrative instruction is the intention of demonstrating connections between the subjects (Wells, 2015). This is particularly important as students often miss the connections on their own, thus the need for integration (Agustin et al., 2012). Agricultural educators have an increasingly daunting task, which includes balancing lecture and contextual learning, Career Development Events, Supervised Agricultural Experiences, and FFA activities. Young et al. (2007) concluded a math-enhanced Agricultural power and technology curriculum showed a positive effect on math achievement. Attitudes concerning the application of content, allows for students to create an understanding of how concepts are beneficial and meaningful (Moore & Carlson, 2012). Mathematics teachers have articulated a need to greatly reform Mathematics education, listing contextual learning as a possible solution (Briner, 1999).

Agricultural Educators have become aware that they will be called upon to convey a broader knowledge of Educational tools to increase student understanding of basic agricultural concepts.

One study shows "Fitting new practices and techniques to unique, on-the-job conditions is an uneven process that requires time and extra effort, especially when beginning" (Berman, & McLaughlin, 1978, p.60). Secondary Career and Technical Education (CTE) students might only have a cursory understanding of core principles in regards to general secondary education. In order for these students to properly grasp the concepts of agricultural education, some remedial teaching has to be completed to bring these students up to speed. A study by Buriak (1992) defined agricultural science as, "instruction in agriculture emphasizing the principles, concepts, and laws of Science and their mathematical relationships supporting, describing, and explaining agriculture with a foundation in biological and physical science" (p.4). Career and technical educators and critics of both viewed integration of academics as a curricular reform that has improved the academic content of CTE and has helped prepare students for employment in our current workforce (Thompson, 2000). Agricultural educators must be willing and able to adopt these principles to allow their students the opportunity to gain these fundamental concepts in an applied method. The Carl D. Perkins Vocational and Applied Technology Act Amendments of 1990 include mandates that require states to develop systems of performance measures and standards. These systems are designed to aid the states in program evaluation and improvement. "The Center for Law and Education (1990) indicated that a measure is a description of an outcome and a standard is the level or rate of that outcome" (Belcher et al., 1996, p.1). Furthermore, "once a state decided the types of academic and other performance to measure (measures), it was necessary to select the level of acceptable performance (standards)" (p.1).

Graduation rates have become a gauge for curriculum effectiveness due to the No Child Left Behind Act of 2001 (NCLB) and public concerns. NCLB requires states to develop and implement a statewide yearly assessment measuring students' progress and understanding of the state curriculum (United States Department of Education, 2009). Schools have shifted the main focus from improving overall academic achievement to increasing testing scores. NCLB legislation has placed a greater importance on preventing students from failing than on challenging students to become higher order thinkers. Kentucky secondary school funding has been directly related to the scores from these tests as compared to other schools in Kentucky, as well as throughout the Nation.

Secondary school systems have recently been focusing on integrating core curriculum into agriculture and other career clusters in an attempt to increase testing scores on standardized tests, such as Kentucky's Accountability Testing System (CATS). In the past decade, federal legislation authorizing funding for Career and Technical Education began to mandate improved academic achievement. The 1998 Carl D. Perkins Vocational Education and Applied Technology Act continued to commit federal funding to integrating academics into CTE (Myers & Thompson, 2009).

Kentucky's Accountability Testing System (CATS) has been used to not only compare general education students, but also CTE students across the state. Standardized testing can be used to

compare scores from Agricultural Education students to general education students at both the school and state levels. These figures are also useful in assessing the effectiveness of programs, viability of the curriculum, and the need for reform. Woglom et al. (2005) describe this CATS testing system as a "very useful form of assessment, in that it is designed for both state and national comparison" (p.36). The researchers discussed the creation of the CATS standardized test through a broad collaborative process that included teachers, administrators and members of the community. This test is given over a multi-day period, and includes single answer questions used to test students' specific knowledge in certain core subjects. These subjects include mathematics, science, reading and writing, social studies, arts, and humanities. "In addition to a conglomeration of student academic scores, schools also receive scores regarding non-academic issues including student retention rate, dropout rate, and the percentage of graduates that continue their education in college" (Woglom et al., 2005, p. 36). One of the criticisms of administering standardized testing is that lengthy tests discourage students prior to taking the test. It is also the belief that these standardized tests encourage memorization due to the fact that standardized tests narrow curriculum by focusing on recall (Sloan & Kelly, 2003). Another criticism is that teachers will teach for the test, missing out on important curricula normally taught in non-testing semesters.

Research has indicated that math and science concepts integrated in agricultural education curriculum has a positive impact on student achievement (Stubbs & Myers, 2016). Young et al. (2007) concluded that a positive effect on Mathematics achievement could be realized through a Mathematics-enhanced Agricultural Power and Technology curriculum. Agricultural Education programs have begun aligning curriculum to state standards to improve both Science and Mathematics scores. Region 8 of the Texas Education Agency has implemented a new course called Agricultural Algebraic Extensive Exploration (A^2E^2). The A^2E^2 course was designed for ninth grade students who were unsuccessful in mastering the eighth grade Texas Assessment of Knowledge and Skill (TAKS) test and are enrolled in Algebra I (Burris et al., 2008). This course was designed to assist students who were struggling in understanding Mathematics concepts by applying to the context of real world settings. The research concluded that the A^2E^2 course provided the students with similar improvement in testing scores when compared to current forms of remediation.

Theoretical Framework

"A description of attitude is explained as a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object" (Fishbein & Ajzen, 1975). Fishbein and Ajzen describe four classifications which categorize predispositions:

- Affect (feelings, evaluations): A favorable or unfavorable evaluation of an object. (attitude)
- Cognition (opinions, beliefs): Information a subject has of an object, thus linking a belief of the object to an attribute.

- Conation (behavioral intentions): A subjects intention to perform various behaviors, based on strength of intention.
- Behavior (observed overt acts): Observable act, reaction, or response.

Any response to a questionnaire or verbal survey is considered a behavioral instance. The responses can be used to aid in creating inferences regarding beliefs, intentions or attitudes. The fourth category, however, is used to measure a particular overt behavior in order to understand the details relating to it (Fishbein & Ajzen, 1975). This theory suggests prior exposure to a subject would have an effect on the perceptions of respondents. Positive experiences would tend to lead researchers to infer positive attitudes, and negative experiences would lead to negative attitudes. Knowledge of a subject, the respondent's own belief system, and personal opinions all serve to guide the respondent behaviors in regards to completing the survey instrument.

Greenwald (1989) supported this theory by concluding that individuals, who showed a positive favor towards a situation or an issue, also tend to evaluate the situation in a positive manner. This concept suggested that if an administrator had a positive attitude in relation to the integration of mathematics in the agricultural education curriculum, administrators would tend to be more supportive of agricultural educators efforts to integrate mathematics into the curriculum. In theory, changing a person's attitude regarding a subject could change the level of support that would be offered for that subject.

The Purpose of the Study

The purpose of this study was to provide an assessment of the attitudes and perceptions of administrators of Kentucky secondary schools regarding mathematics integration in the agricultural education curriculum. The research objectives of the study were:

1. Determine the demographics of schools offering agricultural education in Kentucky.
2. Determine and compare the perceived level of mathematics integration in the Kentucky secondary school agricultural education curriculum by administrators (superintendent, assistant superintendent, principal, guidance counselor, and professional development personnel).
3. Determine and compare attitudes of administrators regarding the agricultural education curriculum as a viable source of mathematics in Kentucky secondary schools.
4. Determine and compare the perceived level of mathematics integration in the Kentucky secondary school agricultural education curriculum by administrators for any correlations to specific demographic data.

Methods/Procedures

Kentucky secondary administrators were surveyed for their perceptions regarding mathematics integration in the agricultural education curriculum. An email list of administrators was compiled from the Kentucky Department of Education employee listing from the Kentucky Department of Education website. A total of 130 superintendents, 78 assistant superintendents, 170 principals, 369 guidance counselors and 128 professional development coordinators were emailed a copy of

the instrument. Superintendents, assistant superintendents, principals, and professional coordinators comprised between 24% and 27% of email addresses being returned or seemingly invalid, while guidance counselors displayed nearly 38% of email addresses listed through the KDE database to be invalid, unwilling, or missing from the email list. Response rates for individual administrative positions included 31.5% for superintendents, assistant superintendents with 28.2%, principals with 28.8%, professional development coordinators with 28.1%, and guidance counselors indicating a 9.2% response rate yielding an overall response rate of 20.8%.

The instrument consisting of 71 statements and 17 demographic questions was created using a compilation of five of Thompson's (2000) surveys regarding science and mathematics integration, and modified to fit the spirit of this study. The respondents were asked to respond to 71 statements regarding different aspects of mathematics integration and agricultural education curriculum. The instrument was divided into 10 categories. These categories included *Agriculture and Mathematics*, *Teaching Integrated Mathematics, Barriers to Integrating Mathematics, Teacher Preparation Programs, Student Enrollment, Meeting State Standards, Collaboration, Administrator and Agriculture, Agriculture Program Support, and Relationships.* Their responses were measured using a five-point Likert-type scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The participants were also asked a series of 17 demographic questions designed for a greater understanding of background information and school population characteristics.

The reliability and face validity were examined through the field study. The reliability of the instrument was found to be "very good" according to DeVellis (1991) with the Cronbach's alpha coefficient score falling between .80 and .90 from the results of the study yielding an (α=.895). Murray State University pre-service teacher candidates and selected faculty members served as the panel for review of the instrument due to the background in agricultural education. The student and faculty panel was asked to review the instrument for face and content validity.

Data was collected following the guidance of Dillman's (2000) *Tailored Design Method* and included five-points of contact. Non-response error was assessed using Dillman's recommendations with no significant differences identified between those participants considered respondents and non-respondents. Data was analyzed using SPSS with means and standard deviations calculated.

Results and Findings

As indicated in Table 1, the administrators were the most unified in their response to the statement regarding the applied nature of mathematics in agriculture (M=4.68; SD=0.50). Administrators also rated three statements regarding the need for understanding mathematical concepts highly among the statements in this section of the survey (4.48, 4.44, and 4.44). Administrators agreed with the statements regarding student learning and motivation with an agricultural education curriculum integrated with mathematical concepts. However, the

administrators were less positive on the statement, *Students are better prepared in mathematics after they have completed a course in agricultural education that integrates mathematics* (*M*=3.99; *SD*=0.73).

Table 1
Agriculture and Mathematics (n=182)

Statement	M	SD
Agriculture uses applied mathematics.	4.68	0.50
People pursuing a career in agriculture must have a greater understanding of mathematical concepts than they did ten years ago.	4.48	0.66
Agricultural education curriculum requires a greater understanding of mathematical concepts than it did ten years ago.	4.44	0.67
Students are more aware of the connection between mathematical principles and agriculture when mathematical concepts are an integral part of their agricultural education instruction.	4.44	0.54
Mathematical concepts are easier for agriculture students to understand when mathematics has been integrated into the agricultural education curriculum.	4.31	0.62
Students learn more about agriculture when mathematical concepts are an integral part of their instruction.	4.26	0.66
Students are more motivated to learn mathematical concepts when the concepts are integrated into the agricultural education curriculum.	4.24	0.74
Students are better prepared in mathematics after they have completed a course in agricultural education that integrates mathematics.	3.99	0.73

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

Table 2 contained statements on the topic of teaching integrated mathematics. Respondents agreed that integrating mathematics into agricultural education curriculum would take more preparation time than currently required of non-integrated curriculum (3.78). Administrators agreed integrating mathematics into the agricultural education curriculum had increased the schools ability to solve problems (3.53). Statements regarding agricultural education teachers teaching integrated concepts (3.51), and agricultural education teachers being prepared to teach integrated concepts (3.36) were also placed high among the statements ranked in this section. The two statements ranking lowest in this section were regarding their agriculture teacher integrating more mathematics into advanced agricultural education courses versus introductory courses (3.32), and their agricultural education teacher's ability to teach a general mathematics course (3.21).

Table 2
Teaching Integrated Mathematics (n=182)

Statement	M	SD
Integrating mathematical concepts into the agricultural education curriculum requires more preparation time for my agriculture teacher than before integrated concepts were emphasized.	3.78	0.76
Integrating mathematics into agricultural education courses has increased our schools ability to teach students to solve problems.	3.53	0.73
My agriculture teacher teaches integrated mathematical concepts in agricultural education.	3.51	0.83
My agriculture teacher is adequately prepared to teach integrated mathematical concepts.	3.36	0.91
My agriculture teacher has integrated more mathematics into advanced agricultural education courses than he/she has into introductory agricultural education courses.	3.32	0.75
My agriculture teacher is prepared to teach a general mathematics course.	3.21	1.03

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

Table 3 consisted of statements about meeting state standards for Kentucky secondary school administrators through an integrated curriculum. Administrators agreed strongly that integrated mathematics would align agricultural education programs with Kentucky Department of Education standards (4.06). Respondents agreed an integrated program would help students meet Commonwealth Accountability Testing System (CATS) standards (4.03). Respondents indicated, almost identically, that students would be better prepared for standardized testing through contextualized agriculture courses (3.99), and mathematics teachers with an agricultural background should examine agricultural education curriculum for integration opportunities (3.99).

The first section of the instrument delved into the administrators' perceptions on the subject of agricultural education and mathematics. Administrators indicated this section contained the most agreeable statements of the study. The statement, *Agriculture uses applied mathematics* was the highest rated statement of the entire study with a mean score of 4.67 (SD 0.50). Administrators strongly agreed with this statement. The lowest ranked statement in this section was the statement, *Students are better prepared in mathematics after they have completed a course in agricultural education that integrates mathematics*, with a mean score of 3.98 (SD 0.72). This score indicated that even though this was the lowest score, administrators still agreed with the

statement. This was the only statement in this section that administrators did not indicate a strong agreement. The author concluded this section was highly rated due to the value placed upon the integration of core curriculum into career and technical education by administrators.

Section two focused on the administrators' perceptions regarding teaching integrated mathematics. The statement regarding integrating mathematical concepts into the agricultural education curriculum would require more preparation time for administrators' agriculture teacher than before integrated concepts were emphasized ranked the highest with a mean score of 3.77 (SD 0.76). Administrators agreed with this statement, but did not feel as strongly about statements from the previous section. Administrators indicated, with a mean score of 3.21 (SD 1.03), the statement, *My agriculture teacher is prepared to teach a general mathematics course* was the lowest rated in this section. The rating of statements in this section suggests administrators have more faith in their agricultural education teacher's ability to teach an integrated course than in the ability to teach a general mathematics course.

Table 3
Meeting State Standards (n=182)

Statement	M	SD
Integrating mathematics will help align agricultural education programs with emerging KDE educational standards.	4.06	0.60
Integrating mathematics will support agricultural education programs by helping our students meet C.A.T.S. standard requirements.	4.03	0.68
Students will be better prepared for standardized testing if they learn the application of mathematical concepts in agriculture.	3.99	0.65
Mathematics teachers with knowledge of agriculture should examine curricula and instructional materials to identify opportunities to incorporate agricultural education subject matter into mathematics instruction.	3.99	0.63
State standards (C.A.T.S.) are seen as an asset to what we are trying to achieve in our agricultural education program.	3.53	0.79
Agricultural education courses that integrate mathematics should be credited toward satisfying college admission mathematics requirements.	3.22	0.92

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

The sixth section of the instrument included statements on the subject of meeting state standards. Administrators' perception of the statement regarding integration would help align agricultural programs with Kentucky Department of Education standards showed a strong agreement with the statement, with a mean score of 4.06 (SD 0.60). The statement, *Agricultural education courses*

that integrate mathematics should be credited toward satisfying college admission mathematics requirements rated lowest among secondary administrators, indicating a mean score of 3.22 (SD 0.92). Examination of this section of research revealed secondary administrators advocate the use of Mathematics integration to improve the current curriculum in order to meet Kentucky Department of Education testing standards but did not believe integrated agricultural education courses should replace general mathematics for college admission credit.

Conclusions and Recommendations/Implications

Support for the integration of mathematics into the agricultural education is vital if this integrative instructional practice is to be successful. This study provided baseline data to ascertain the perceptions of secondary school administrators toward integrating mathematics. Data from this study can be used to assist agricultural education teachers, state departments of education, and teacher preparation programs. As administrator support is a key aspect of agricultural education program development and growth. Due to the positive perceptions of the administrators toward agriculture and mathematics there exists data that can be useful in making curriculum enhancements in agricultural education curriculum.

While the perceptions of the administrators were generally positive, areas of concern in this study exist. The administrators' perceptions of teaching integrated mathematics were mostly neutral, warranting further examination. Of primary concern relates to the administrators' concerns with their agriculture teacher's preparation to teach integrated mathematics. Using this as a call, this study can assist teacher preparation in planning curricular changes. Furthermore, the findings can be used as a foundation to develop and delivery professional development opportunities for in-service teachers.

While not concerning, the administrators' perceptions toward the requirement that mathematics teachers incorporate agriculture topics into mathematics instruction were interesting. Could these perceptions be the result of the administrator taking for granted that agriculture teachers must able to teach math to teach agriculture but mathematics teachers do not need to teach agriculture to teach mathematics? This provides an opportunity to provide professional development to secondary school administrators regarding the symbiotic relationship which exists between agriculture and mathematics. Additionally, this supports integrative instructional design. If integrating mathematics in agriculture education is viewed as positive and providing an effective context to facilitate mathematics instruction could not integrating agriculture in mathematics still provide that context? This question should be further investigated and expand to include mathematics instructors' perceptions of integrating agriculture and mathematics. Developing rapport between the agriculture and mathematics teachers will create a positive professional relationship which will support collaboration between the disciplines, resulting in enhanced agriculture and mathematics curricula.

References

Agustin, M., Agustin, M, Brunkow, P., & Thomas, S. (2012). Developing quantitative reasoning: Will taking traditional math courses suffice? An empirical study. *Journal of General Education, 61*(4), 305-313.

Anderson, R., Williams, R., & Hillson, J. (2008). Self-reported level of Mathematics integration of outstanding Virginia Agricultural educators. *Journal of Southern Agricultural Education Research, 58*(1), 81-93.

Belcher, G., McCaslin, N., & Headley, W. (1996). Implications of Performance Measures and Standards for Evaluation and Assessment in Agricultural Education. *Journal of Agricultural Education*, *37*(4), 1-7. https://doi.10.5032/jae.1996.04001

Berman, P., & McLaughlin, M. (1978). *Federal programs supporting educational change, Vol. 8. Implementing and sustaining innovations.* The Rand Corporation.

Brister, M., & Swortzel, K. (2009*). A comparison of attitudes of Agriscience teachers, counselors, administrators toward science integration with students' attitudes toward Agriscience programs* [Paper Presentation]. American Association for Agricultural Education Research Conference Proceedings, Louisville, KY.

Brown, J., Collins, A., & Dauguid, P., (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Buriak, P. (1992). *Filling the gap in Agriculture*. *The Agricultural Education Magazine, 64*(9), 4, 23.

Burris, S., Bednarz, A., & Fraze, S. (2008). *Investigating student achievement in mathematics: The effect of an integrated agriculture and mathematics curriculum* [Paper Presentation]. 2008 Western Region AAAE Research Conference

Center for Law and Education (1990). *Guide to designing systems of standards and measures for evaluating the performance of vocational education programs*.

Center for Occupational Research and Development (2010). *What is contextual learning?* Waco, TX. http://www.cord.org/contextual-learning-definition/

DeVallis, R. (1991). *Scale development*. Sage.

Dietel, R.J., Herman, J.L., & Knuth, R.A., (1991). *What does research say about assessment?* North Central Regional Educational Laboratory. Oak Brook.

Dillman, D. (2000). *Mail and Internet Surveys: The tailored design method.* Wiley and Sons.

Doss, W., & Rayfield, J. (2021). Comparing Texas principal and agricultural education teacher perceptions of the importance of teaching activities in agricultural education classrooms. *Journal of Agricultural Education, 62*(1), 1-16. https://doi.org/10.5032/jae.2021.01001

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, Intention, and Behavior: An Introduction to Theory and Research.* Addison-Wesley.

Foster, R., Bell, L., and Erskine, N., (1995). The importance of selected instructional areas in the present and future secondary agricultural education curriculum as perceived by teachers, principals, and superintendents in Nebraska. *Journal of Agricultural Education*, *36*(3), 1-7. https://doi.10.5032/jae.1995.03001

Greenwald, A. (1989). *Attitude, structure, and function.* Erlbaum Associates.

Kentucky Department of Education (2010). ACT Profile Report-State. *Kentucky State Testing 2009, Grade 11 Tested Students*. Commonwealth of Kentucky. Retrieved from http://www.education.ky.gov/NR/rdonlyres/61549509-C22B-4D50-AB8D-AED059EC934B/0/ACT_Kentucky_11_2009.pdf?

Klein, M. (1991). *The politics of curriculum decision-making. Issues in centralizing the curriculum.* State University of New York Press.

Moore, K., & Carlson, M. (2012). Students' images of problem contexts when solving applied problems. *The Journal of Mathematical Behavior, 31*(1), 48-59.

Myers, B., & Thompson, G. (2009). Integrating academics into Agriculture programs: A Delphi study to determine perceptions of the national Agriscience teacher ambassador academy participants. *Journal of Agricultural Education, 50*(2), 75-86. https://doi.10.5032/jae.2009.02075

National Commission on Excellence in Education (1984). *A Nation at Risk*. USA Research.

Rice, A., & Kitchel, T. (2017). Teachers' beliefs about the purpose of agricultural education and its influence on their pedagogical content knowledge. *Journal of Agricultural Education*, *58*(2), 198-213. https://doi.10.5032/jae.2017.02198

Robinson, K., Westfall-Rudd, D., Drape, T., & Scherer, H. (2018). Conceptualizing integrative agricultural education: Introductory framework for integrating mathematics in agricultural curriculum. *Journal of Agricultural Education*, *59*(4), 253-269. https://doi.10.5032/jae.2018.04253

Sloan, F., & Kelly, A., (2003). Issues in High-stakes Testing Programs. *Theory into practice*, *42*(1), 12-18.

Steen, L. (2002). Quantitative literacy: Why numeracy matters for schools and colleges. *FOCUS, 22*(2), 8-9.

Stubbs, E., & Myers, B. (2016). Part of what we do: Teacher perceptions of STEM integration. *Journal of Agricultural Education*, *57*(3), 87-100. https://doi.10.5032/jae.2016.03087

Swafford, M. (2018). The state of the profession: STEM in agricultural education. *Journal of Agricultural Education*, *59*(4), 87-100. https://doi.10.5032/jae.2018.04315

Thompson, G. (2000). *Principals' perceptions of integrating science into agricultural programs* [Paper Presentation]. 27th National Agricultural Education Research Conference, San Diego, CA

United States Department of Education, (2009). *The no child left behind act of 2001*. http://www.ed.gov/nclb/overview/intro/execsumm.html

Wells, J. (2015). *A technology perspective on the potential of STEM education*. Virginia Polytechnic Institute and State University.

Woglom, C., Parr, B., & Morgan, J., (2005) A comparison of commonwealth accountability atandardized testing scores between high school agricultural education/career and technical education students and Kentucky state standards. *Journal of Southern Agricultural Education Research*, 55(1).

Young, R., Edwards, M., and Leising, J. (2007). *Effects of a math-enhanced curriculum and instructional approach on student's need for post-secondary remediation in mathematics:*

A yearlong experimental study in agriculture power and technology [Paper Presentation]. 2007 AAAE Research Conference, Minneapolis, MN.