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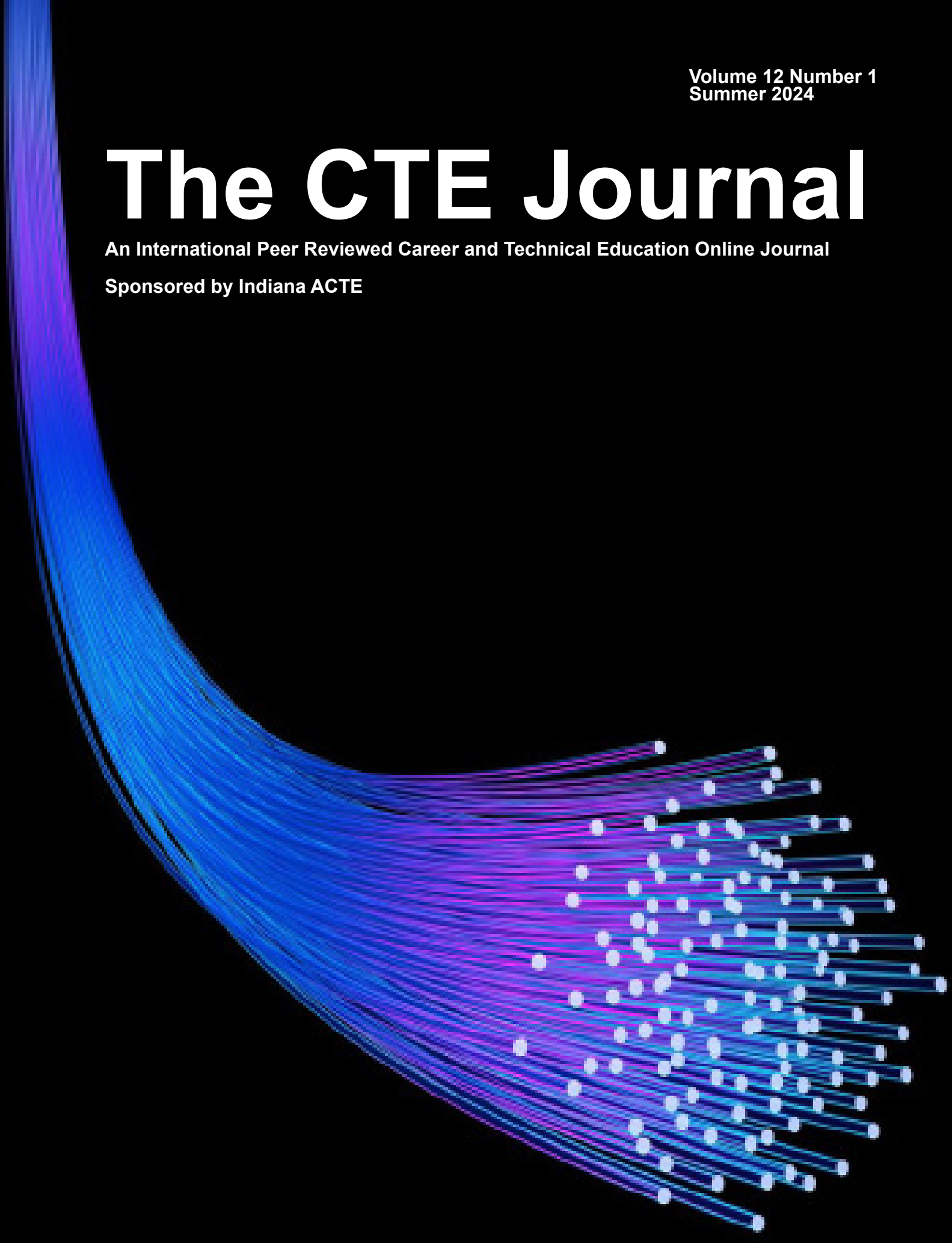

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In Pursuit of FAA *Part 107* Commercial Remote Drone Pilot Certification for Students

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Abstract
Career and technical educators are often looking for new embedded industry certification opportunities to offer their high school and college students. Of the thousands of opportunities available, schools are often limited by which equipment they have on hand on which students can learn or limited by the specific knowledge and skills of their CTE teachers. Commercial drone piloting certification—often known as FAA *Part 107* Remote Pilot's license—represents a unique opportunity for students to earn a government-sponsored industry certification without many of the barriers other industry certifications require. Students as young as 14-years of age can take the pilot's knowledge test (although it isn't valid for commercial operations until the pilot reaches 16-years of age) to earn the certification and no drone equipment nor actual drone flying experience is required. The test itself costs about $150+ and all study materials, including sample tests, are freely available online. For-pay learning modules are also available to students from a variety of sources.

Introduction

As a vital part of the nation's workforce development pipeline, modern, high-quality career and technical education programs—hereafter referred to as CTE—provide students with technical craft skills that allow them to rapidly enter the nation's workforce or position them to pursue advanced technical training (Dortch, 2014). One might mistakenly think that vocational, industrial, CTE-style courses are a passé thing of school days long gone by. However, upon inspection, what we find is that CTE courses are incredibly popular among high school and college students. Nearly 85% of U.S. high school students have taken at least one CTE course during their high school experience (Alvarado, 2023). The most popular of these CTE courses are usually a business-oriented or computer-oriented CTE-credited course.

One of the great promises of today's CTE is its unique ability to efficiently position graduating students to quickly move into working careers or into advanced technical training. Of the many ways a CTE student might demonstrate to a future employer that he or she is ready to enter the workforce, one of the most popular pathways for documenting student achievement and readiness is for schools to help students acquire a formal credential—an embedded industry certification (Webb, 2021). There are many, many industry certifications available to students: The U.S. Department of Labor's Certification Finder web site lists more than 5,000 active certifications available. There might actually be more opportunities for certifications for students as it appears that there is no definitive count of how many industry certifications are available. Prebil and McCarthy (2018) report that national surveys conducted by the U.S. Census Bureau, the Department of Education, and the Bureau of Labor Statistics consistently show that a stable 20 percent of U.S. adults hold at least one industry certification or license, with licenses being the most common.

As one of the newest high tech career opportunities needing a license, operating unmanned ariel vehicles systems (UAVs)—drone technology— is quickly becoming popular with CTE students (Lobo, et al., 2021; Slater, 2024). In the U.S., remote control drone flight is carefully regulated by the Federal Aviation Administration (FAA) and all individuals 16 years or older who wish to use drones for revenue generating, commercial activities are required to have a government-led, industry license. This license is acquired by passing a multiple-choice, written test, described in detail below, and is rapidly gaining popularity. Since its introduction in 2016, more than 300,000 FAA *Part 107* licenses have been awarded (Plaza, 2022). As this license is highly desirable among many CTE students, CTE teachers would benefit knowing how to best help their students prepare for and earn a drone operator's industry certification. The goal of this paper is to describe and document teaching strategies available to CTE teachers to help students earn their FAA "drone pilot" license.

Literature Review

The following literature review is intended to establish the importance of helping students acquire industry certifications and to outline the FAA *Part 107* Remote Pilot drone license requirements.

1. Industry Certifications

The inclusion of embedded industry certifications—external markers of student skill and knowledge acquisition—are a highly popular aspect of modern CTE programs. This is often because CTE programs with embedded industry certifications allow CTE students to earn two distinct types of credentials simultaneously: one issued by an educational entity and another issued by industry, government, or professional organization. Prebil and McCarthy (2018) attribute the industry certification as guaranteeing to employers a set of discrete craft skills and knowledge whereas the educational entity is essentially attesting to the completion of a broad program of study that includes both general and specialized course experiences. They emphasize that embedding industry certifications into CTE courses helps educators make sure their programs are aligned with current industry standards. Taken together, it seems that CTE educators would be abundantly enthusiastic to offer as many embedded industry certification opportunities as they can manage.

At the same time, CTE programs cannot simply offer just any industry certification opportunity to its students. Of the many barriers to implementation facing CTE programs, a CTE teachers' own limited professional knowledge can be a barrier to offering embedded industry certifications. As such, the industry certifications most often embedded in a particular school's CTE program often depend on the specific interests of its own teachers. More broadly, some industry certifications are expensive to offer (Joseph & Canney, 2019). Many certifications require specialized equipment (e.g., expensive industry-current manufacturing machines) on which to train students.

However, the most widely cited challenge identified by Zanville, Porter, and Ganzglass (2017) was attributed to the high cost of certification exams themselves. Certainly, schools would like to increase equity and diversity opportunities by covering the costs of certification exam fees for a wide diversity of interested students. However, these researchers report that most certification exam fees are born by the students and the students' families themselves. This is typically done

either by charging students an extra "course fee" or by requiring students to pay for these exams themselves (Castellano, Stone, & Stringfield, 2005). The situation parallels how College-Board Advanced Placement test fees are sometimes covered by schools, but most often by college bound students themselves (Rodriguez, et al., 2022).

Taken together, the consensus agreement among CTE educators is that embedded industry certifications are most often worth the investment as they ensure that what students are learning represents the most current knowledge and skill requirements of an identified CTE domain (Hendricks, et al., 2021). The biggest challenges to consistently offering one particular embedded industry certification program as compared to another has much to do with the existence of needed infrastructures at the school, and, perhaps more importantly, the ability to cover the certification fee costs. In such a scenario, CTE teachers would benefit greatly from having some self-contained, plug-and-play certification packages that they could offer students that would not take considerable time, resources, investment, and infrastructure that would otherwise detract from other certifications they offer AND one that is not overly expensive. One potential embedded industry certification available to CTE teachers where students can work largely independently and do not need any expensive specialized equipment to earn is that of a professional drone pilot certification offering.

2. Situating Drone Technology within CTE Career Clusters

Where do drone technology programs fit within CTE? The great breadth of possible CTE foci, and their associated embedded industry certifications, are so numerous that it is often easier for CTE educators to talk about "clusters" of CTE program domains rather than specific careers. Most commonly, CTE is subdivided into 16 major cluster areas, listed in Figure 1. Precisely which cluster area drones fit within is largely subjective, and based largely on the specific drone application CTE educators are talking about.

Figure 1. Advance CTE 2022 Career Cluster List.

1. Agriculture, Food & Natural Resources
2. Architecture & Construction
3. Arts, A/V Technology & Communications
4. Business Management & Administration
5. Education & Training
6. Finance
7. Government & Public Administration
8. Health Science
9. Hospitality & Tourism
10. Human Services
11. Information Technology
12. Law, Public Safety, Corrections & Security
13. Manufacturing
14. Marketing
15. Science, Technology, Engineering & Mathematics
16. Transportation, Distribution & Logistics

https://careertech.org/what-we-do/career-clusters/

On one hand, when thinking about drones in terms of being used as part of the aviation industry, drone technology can easily fit in the broad career cluster category of *Transportation, Distribution & Logistics*, but cluster categorization of drones can be more nuanced than this. One the other hand, *SkillsUSA*, for example, squarely places its commercial drone competitions in the *STEM* cluster instead of the *Transportation* cluster (Slater, Biggs, & Sanchez, 2021; Slater & Biggs, 2022).

In the end, which specific cluster drones go in depends specifically on how the drone is being

used. When using drones to distribute commercial materials, drones would be clustered in *Transportation*. Alternatively, if a drone is being used to distribute fertilizers or pesticides to fields, then this is clearly part of the *Agriculture, Food, & Natural Resources* cluster. Or, if a drone is distributing medicine, then it is part of *Health Science*. At the same time, drones making videos to support journalism would be part of the *Arts, A/V Technology & Communications* cluster, but a drone making videos documenting community festivals would be part of the *Hospitality & Tourism* cluster. Whereas a drone used by a building construction firm to monitor materials usage would be part of the *Architecture & Construction* cluster, a drone used specifically for film making sits in the *Arts, A/V Technology & Communications* cluster. Law enforcement entities (*Law, Public Safety, Corrections & Security* cluster) and real estate agents (*Marketing* cluster) also make use of drones. In this sense, drones nearly defy career cluster classification, which is judged to be a good thing because it becomes easier for the CTE teacher to justify the inclusion of drones in their CTE programs and drone licensure as part of a schools embedded industry certification offerings.

3. Nature of the FAA Part 107 Remote Pilot License Test

Anyone flying a drone outdoors over the age of 16 for any revenue generating commercial purpose is required to hold a valid FAA *Part 107* Remote Pilot commercial drone license. This government-sponsored certification is named after the specific FAA rules and regulations document that established it—*Part 107*. (National Archives, 2023). This is a knowledge only exam. In other words, to earn this *Part 107* commercial drone license, one does not need to own a drone, or even have any actual experience flying a drone. Because there is no requirement for purchasing equipment or need for special practice or manufacturing facilities, this becomes a relatively low-cost option for an additional CTE program's embedded industry certification offering. Students who have earned a *Part 107* certification do have operational limits they must adhere to, which are listed in Figure 2.

Figure2. Operational Limitations for Pilots Flying with a *Part 107* Certification

Part 107 Pilots:

- must operate within 400' above ground level or above a structure
- must operate an aircraft less than 55 lbs (take-off weight)
- may not fly a UAV from a moving land or "water-borne" vehicle, unless it is being flown over a sparsely populated area
- may not operate a UAV at night
- may not fly during periods of civil twilight—within 30-minutes of sunrise or sunset—unless the UAV has lighted anti-collision lighting visible for at least 3 statute miles
- must only fly a drone within a visual line of sight without binoculars
- may not operate in restricted or prohibited areas without first obtaining permission from the using or controlling agency, and
- may not carry hazardous materials

To be eligible to take the *Part 107* Remote Pilot exam, students must: be at least 14 years old, be able to read, speak, write, and understand English, and state that they are in a physical and mental condition to safely fly a drone (FAA, 2023). For CTE educators, it is is important to note

that a 14-year old student can take the test, but the *Part 107* certification isn't valid for commercial, revenue generating flying until the pilot reaches the age of 16 years of age. Figure 3, reproduced from the FAA UAS website (FAA, 2023), lists the categories of questions covered by the examination.

Figure 3. Part 107 Unmanned Aircraft General–Small (UAG) Knowledge Test Topic Areas

- Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation
- Aviation weather sources and effects of weather on small unmanned aircraft performance
- Small unmanned aircraft loading and performance
- Emergency procedures
- Crew resource management
- Radio communication procedures
- Determining the performance of small unmanned aircraft
- Physiological effects of drugs and alcohol
- Aeronautical decision-making and judgment
- Airport operations
- Maintenance and preflight inspection procedures
- Operation at night

The *Part 107* exam itself is a rigorous exam, but well within the reach of teenagers who have committed to studying and learning the material (Slater, 2024). The test is 60 multiple choice-style questions, with three possible answers each. Example items from the FAA are provided in the Appendix. The test must be completed within 120 minutes and is done by appointment at specific testing centers, often associated with larger airports. Test takers are provided a "booklet" of maps and sectional charts needed to complete the exam. A simple calculator is allowed; but cell phones are not allowed. The passing score is 70% correct. If a student does not pass the test, one must wait 14 days to attempt the exam again. Each time a student takes the exam, there is a $150+ fee.

A *Part 107* remote drone pilot license is valid for 24-months. After two years, the certification can be renewed online by taking a shorter, review test online. For anyone involved in flying drones with revenue-generating applications, this *Part 107* certification is not optional. It is worth noting that hobbyists who wish only to fly for personal entertainment or educators who are flying for purposes of teaching, earning an online FAA *T.R.U.S.T.* Safety Certificate is now required (Slater & Sanchez, 2021).

4. Teaching Strategies

In the United States, for example, numerous education programs are available to help students pass the FAA *Part 107* Remote Pilot drone licensure test. Costing around $300 USD each and lasting 16-36 hours, the reportedly most popular of these include: (*i.*) University of Delaware: Ground School and Part 107 Test Prep; (*ii.*) Pilot Institute: Part 107; (*iii.*) Drone Pilot Ground

School; (*iv.*). DARTDrones Flight School; and (*v.*) Drone U (Slater, 2023). It is certainly not required that students pay for, enroll in, and take a formal class, although it likely makes studying more organized and efficient. Indeed, there are many online videos and websites available at not cost for students to use for studying.

Experienced suggests that the minimum amount of studying time needed to pass the test is about 20 hours; but, 40 hours is probably a more reasonable goal for high school students. There are numerous aviation terms that students are unlikely to have encountered before that need to be learned. The rules and regulations sections are mostly based on numbers to be memorized: For example: how high (400'), how far from clouds (3,000' horizontally), how long (8 hours after alcohol), and how much (report filed if over $500 in damages). Similarly, the weather questions are based on things to be memorized: For example, questions like, what happens to performance when humidity increases, temperature increases, air density increases, or wind increases?

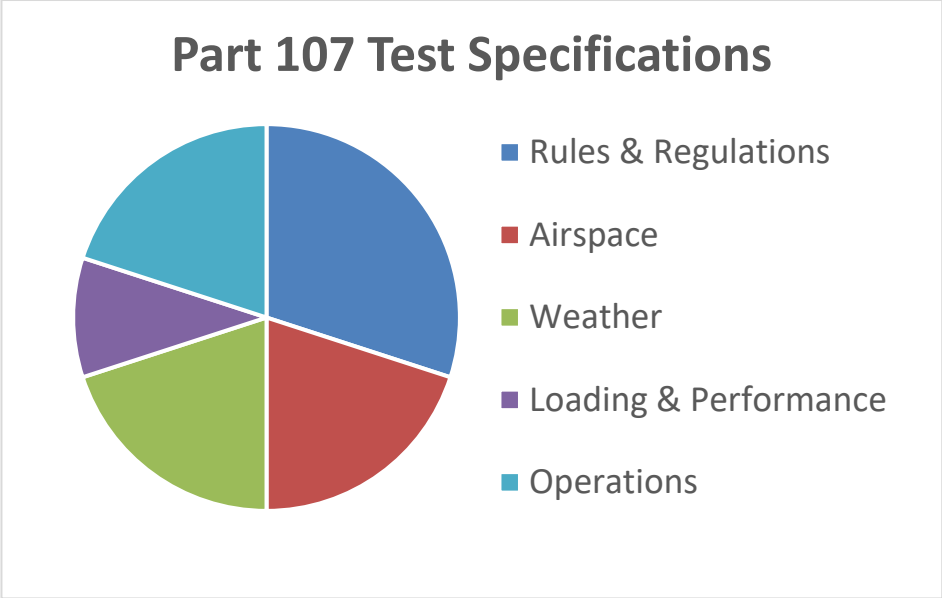

Figure 4. Distribution of Test Questions for the *Part 107* Remote Pilot Exam

Unquestionably, students struggle the most with map reading and answering questions about the aviation sectional charts about airspace and operations. This is most likely because students unnecessarily get in a hurry and make silly mistakes. There is more than enough time to complete the exam even for traditionally slow test takers. For questions involving the operations and airspace maps, and there are quite a few, amounting to nearly one half of the test, students have all the information they need to correctly answer the question directly on the map and, most importantly, using the legend that defines all of the symbols. Nevertheless, this is where students have the most difficulty, and it is in the domains of airspace and operations where they should get the most practice before taking the actual test.

After determining which study resources are to be used—the free ones findable by searching "*Part 107* test preparation" on YouTube are highly recommended—a proposed preparation

schedule sequence motivated by a student-kept learning journal that seems to work well for many students is as follows:

- Module 1-First Steps (*three hours*): Watch 180-minutes worth of "Part 107 test preparation" YouTube videos
- Module 2-First Practice Tests (*four hours*): Search and use several "Part 107 Practice Test" looking for ones with answers & explanations
- Module 3-Reading (*five hours*): Read the "FAA the Remote Pilot Study Guide (PDF)"
- Module 4-Second Practice Tests (*four hours*): Search and use several "Part 107 Practice Test"
- Module 5-Final Test Preparation (*two hours*): Search and watch/read several "most missed Part 107 drone questions"
- Module 6-Find a testing site and sign up/register for Part 107 exam (*two hours*): Search for "Part 107 Testing Center Locations"

Although the teaching strategy of collaborative learning teams and community of practice groups theoretically should work well for helping students prepare to take the *Part 107 Remote Pilot* exam, experience repeatedly suggests that students working individually at their own pace seems to yield the best results. In the end, this is likely because we are talking about obtaining rote and procedural knowledge via repetition rather than developing any deep conceptual understanding that depends on cognitive flexibility. Where students might be able to work together best is perhaps by competing with one another on comparing practice test scores.

Discussion & Conclusions

Given the pressure on CTE educators to provide as many opportunities as possible for students to earn industry certifications, the low cost and no equipment needed remote drone pilot certification seems to be ideal. In this scenario, a teacher does not need to have any specific knowledge about drones nor provide students with any authentic flight experiences. Moreover, the nature of the knowledge needed to pass the exam lends itself well for self-motivated students who work well in an independent learning environment. Taken together, this drone pilot program readily adds an actual government-sponsored industry certification with minimal investments from already overworked and overburdened supervising classroom teacher.

Once students have obtained their *Part 107* Remote Pilot drone certification, they are now ready to enter work-based learning programs—such as working alongside local real estate agents—or create their own entrepreneurial businesses (Slater & Sanchez, 2023). In terms of needed future research, although one casually hears about schools where most of all students in a particular CTE or robotics class have completed their *Part 107*, there is no indication in the scholarly literature base of how prevalent this is, due in part to the *Part 107* certificate only being very recently established, in 2016. Moreover, there is no published data on the number or the nature of students who have earned their *Part 107* certificate who might be using it for commercial purposes in any way. In much the same way, education researchers have no idea what skills acquired during the pursuit of a drone piloting certificate have transferability to any specific CTE career cluster at all. In other words, at this point, the drone education research agenda is still largely uncharted and ripe for education researchers to pursue.

References

Alvarado, V. (2023). Research roundup: CTE equity and special populations. *CTE Policy Watch ACTE Blog*. April 21, 2023. https://ctepolicywatch.acteonline.org/2023/04/research-roundup-cte-equity-and-special-populations.html

Castellano, M., Stone III, J. R., & Stringfield, S. (2005). Earning industry-recognized credentials in high school: Exploring research and policy issues. *Journal of Career and Technical Education*, *21*(2), 7-34. https://files.eric.ed.gov/fulltext/EJ1069518.pdf

Dortch, C. (2014). Career and technical education (CTE): A primer. *Congressional Research Service Report for Congress, CRS Report Number R42748*, https://ecommons.cornell.edu/bitstream/handle/1813/79159/CRS_Career_and_Technical_Education2.pdf?sequence=1

FAA (2023, July 27). Become a drone pilot. *FAA.gov Website*. https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot

FAA (2021). Where can I find study materials for the Part 107 aeronautical knowledge test? *FAA.gov Website*. https://www.faa.gov/faq/where-can-i-find-study-materials-part-107-aeronautical-knowledge-test

Hendricks, A., Myran, S., Katsioloudis, P. J., Owings, W., & Kaplan, L. (2021). Career and technical education industry credentials and its potential impact on a state's economy. *The Journal of Applied Business and Economics*, *23*(8), 1-10. https://www.researchgate.net/profile/Anjanette-Hendricks/publication/364188197_Career_and_Technical_Education_Industry_Credentials_and_Its_Potential_Impact_on_a_State's_Economy/links/633e2453ff870c55ce0293cc/Career-and-Technical-Education-Industry-Credentials-and-Its-Potential-Impact-on-a-States-Economy.pdf

Joseph, M., & Canney, M. (2019). Funding for value: Maximizing the impact of career and technical education funding. *A Playbook for State Policymakers: Foundation for Excellence in Education (ExcelinEd)*. https://files.eric.ed.gov/fulltext/ED609961.pdf

Lobo, D., Patel, D., Morainvile, J., , P., & Abichandani, P. (2021). Preparing students for drone careers using active learning instruction. *IEEE Access*, *9*, 126216-126230. https://ieeexplore.ieee.org/iel7/6287639/6514899/09530413.pdf

National Archives (2023, November 29). Title 14-Aeronatucs & Space, Chapter I, Subchapter F, Part 107, PART 107—Small Unmanned Aircraft Systems. *Code of Federal Regulations*. https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-107

Plaza, J. (2022). The growing number of drone pilots. *Commercial UAV News*, August 8, 2022. https://www.commercialuavnews.com/international/the-growing-number-of-drone-pilots

Prebil, M., & McCarthy, M. A. (2018). Building Better Degrees Using Industry Certifications: Lessons from the Field. *New America*. https://www.newamerica.org/education-policy/reports/building-better-degrees-using-industry-certifications/

Rodriguez, A., Rodriguez-Wilhelm, D., Lebioda, K., Kapp, R., & Wilson, N. (2022). Skin in the game: A policy implementation study of how school-level bureaucrats set and rationalize Advanced Placement exam fees for low-income students. *Research in Higher Education*, *63*, 369–399. https://link.springer.com/article/10.1007/s11162-021-09652-w

Slater, T. F. & Biggs, C. N. (2022). Using drones to teach modern earth science. *The Earth Scientist, 39*(1), 19-23. https://www.researchgate.net/publication/372366152_Using_drones_to_teach_modern_earth_science

Slater, T. F., Biggs, C. N., & Sanchez, R. L. (2021). Positive influence of education partnerships for teaching integrated STEM through drone competition. *Journal of Astronomy & Earth Sciences Education*, 8(2), 113-124. https://clutejournals.com/index.php/JAESE/article/download/10409/10456

Slater, T. F., & Sanchez, R. L. (2023). Work-based Learning Infrastructure for Using Drones in Real Estate. *The CTE Journal*, *11*(2). 9-pages. https://www.thectejournal.com/uploads/1/0/6/8/10686931/slater_fall_2023.pdf

Slater, T. F. & Sanchez, R. L. (2021). *Teaching Integrated STEM with Drones: Classroom-ready Lesson Plans for an Integrated STEM+Arts Curriculum*. Pono Publishing, ISBN: 979-8769835230, https://amzn.to/3urVaBm

Slater, T. F. (2024). Identifying an implementation framework for integrating drones into STEM and Career Technology Education CTE programs. *Drones*, *8*(1), 33-39. https://www.preprints.org/manuscript/202311.0505/download/final_file

Webb, M. S. (2021). *Educational Practices that Prepare Career and Technical Education Students with Industry-Ready Skills* (Doctoral dissertation, Walden University). https://search.proquest.com/openview/1e3c74062db95d4015410ba6c7e69db0/1?pq-origsite=gscholar&cbl=18750&diss=y&casa_token=NxXOeqS_J_0AAAAA:PcA_LPe5Q1gty0vn6SYOnJK5C8YdBERfTFfveLJu50I8Ta7lc2HvGloNG_OJK_DhPy02Gf7rLCc

Zanville, H., Porter, K., & Ganzglass, E. (2017, January). Report on phase I study: Embedding industry and professional certifications within higher education. Indianapolis, IN: Lumina Foundation. https://www.luminafoundation.org/files/resources/report-on-phase-i-study-embedding-industry-professional-certifications-within-higher-education-january-2017.pdf

Appendix. Sample *14 CFR Part 107* Exam Questions Provided by FAA

Note: All references to Refer to FAA-CT-8080-2H is a provided document *Airman Knowledge Testing Supplement for Sport Pilot, Recreational Pilot, Remote Pilot, and Private Pilot* (FAA-CT-8080-2H) available online at: https://www.faa.gov/training_testing/testing/supplements

1. What are characteristics of a moist, unstable air mass?

A. Turbulence and showery precipitation.
B. Poor visibility and smooth air.
C. Haze and smoke.

2. According to 14 CFR Part 107, how may a remote pilot operate an unmanned aircraft in Class C airspace?

A. The remote pilot must have prior authorization from the Air Traffic Control (ATC) facility having jurisdiction over that airspace.
B. The remote pilot must monitor the Air Traffic Control (ATC) frequency from launch to recovery.
C. The remote pilot must contact the Air Traffic Control (ATC) facility after launching the unmanned aircraft.

3. According to 14 CFR Part 107 the remote pilot in command (PIC) of a small unmanned aircraft planning to operate within Class C airspace

A. must use a visual observer.
B. is required to file a flight plan.
C. is required to receive ATC authorization.

4. What effect does high density altitude have on the efficiency of a UA propeller?

A. Propeller efficiency is increased.
B. Propeller efficiency is decreased.
C. Density altitude does not affect propeller efficiency.

5. (Refer to FAA-CT-8080-2H, Figure 22, area 2.) At Coeur D`Alene which frequency should be used as a Common Traffic Advisory Frequency (CTAF) to monitor airport traffic?

A. 122.05 MHz.
B. 135.075 MHz.
C. 122.8 MHz.

6. Which technique should a remote pilot use to scan for traffic? A remote pilot should

A. systematically focus on different segments of the sky for short intervals.
B. concentrate on relative movement detected in the peripheral vision area.
C. continuously scan the sky from right to left.

7. (Refer to FAA-CT-8080-2H, Figure 2.) If an unmanned airplane weighs 33 pounds, what approximate weight would the airplane structure be required to support during a 30° banked turn while maintaining altitude?

A. 34 pounds.
B. 47 pounds.
C. 38 pounds.

8. (Refer to FAA-CT-8080-2H, Figure 23, area 3.) What is the floor of the Savannah Class C airspace at the shelf area (outer circle)?

A. 1,300 feet AGL.
B. 1,300 feet MSL.
C. 1,700 feet MSL.

9. (Refer to FAA-CT-8080-2H, Figure 20, area 3.) With ATC authorization, you are operating your small unmanned aircraft approximately 4 SM southeast of Elizabeth City Regional Airport (ECG). What hazard is indicated to be in that area?

A. High density military operations in the vicinity.

B. Unmarked balloon on a cable up to 3,008 feet AGL.
C. Unmarked balloon on a cable up to 3,008 feet MSL.

10. (Refer to FAA-CT-8080-2H, Figure 21.) You have been hired by a farmer to use your small UA to inspect his crops. The area that you are to survey is in the Devil`s Lake West MOA, east of area 2. How would you find out if the MOA is active?

A. Refer to the chart legend.
B. This information is available in the Small UAS database.
C. Refer to the Military Operations Directory.

11. The most comprehensive information on a given airport is provided by

A. the Chart Supplements U.S. (formerly Airport Facility Directory).
B. Notices to Airmen (NOTAMS).
C. Terminal Area Chart (TAC).

12. Identify the hazardous attitude or characteristic a remote pilot displays while taking risks in order to impress others?

A. Impulsivity.
B. Invulnerability.
C. Macho.

13. (Refer to FAA-CT-8080-2H, Figure 26, area 4.) You have been hired to inspect the tower under construction at 46.9N and 98.6W, near Jamestown Regional (JMS). What must you receive prior to flying your unmanned aircraft in this area?

A. Authorization from the military.
B. Authorization from ATC.
C. Authorization from the National Park Service.

14. (Refer to FAA-CT-8080-2H, Figure 20, area 5.) How would a remote PIC "CHECK NOTAMS" as noted in the CAUTION box regarding the unmarked balloon?

A. By utilizing the B4UFLY mobile application.
B. By contacting the FAA district office.
C. By obtaining a briefing via an online source such as: 1800WXBrief.com.

15. When adapting crew resource management (CRM) concepts to the operation of a small UA, CRM must be integrated into

A. the flight portion only.
B. all phases of the operation.
C. the communications only.

16. You have been hired as a remote pilot by a local TV news station to film breaking news with a small UA. You expressed a safety concern and the station manager has instructed you to `fly first, ask questions later.` What type of hazardous attitude does this attitude represent?

A. Machismo.
B. Invulnerability.
C. Impulsivity.

17. A local TV station has hired a remote pilot to operate their small UA to cover news stories. The remote pilot has had multiple near misses with obstacles on the ground and two small UAS accidents. What would be a solution for the news station to improve their operating safety culture?

A. The news station should implement a policy of no more than five crashes/incidents within 6 months.
B. The news station does not need to make any changes; there are times that an accident is unavoidable.
C. The news station should recognize hazardous attitudes and situations and develop standard operating procedures that emphasize safety.

18. (Refer to FAA-CT-8080-2H, Figure 26, area 2.) While monitoring the Cooperstown CTAF you hear an aircraft announce that they are midfield left downwind to RWY 13. Where would the aircraft be relative to the runway?

A. The aircraft is East.
B. The aircraft is South.
C. The aircraft is West.

19. To avoid a possible collision with a manned airplane, you estimate that your small UA climbed to an altitude greater than 600 feet AGL. To whom must you report the deviation?

A. Air Traffic Control.
B. The National Transportation Safety Board.
C. Upon request of the Federal Aviation Administration.

20. When operating an unmanned airplane, the remote pilot should consider that the load factor on the wings may be increased any time

A. the CG is shifted rearward to the aft CG limit.
B. the airplane is subjected to maneuvers other than straight-and-level flight.
C. the gross weight is reduced.

21. A stall occurs when the smooth airflow over the unmanned airplane`s wing is disrupted and the lift degenerates rapidly. This is caused when the wing

A. exceeds the maximum speed.
B. exceeds maximum allowable operating weight.
C. exceeds its critical angle of attack.

22. Safety is an important element for a remote pilot to consider prior to operating an unmanned aircraft system. To prevent the final "link" in the accident chain, a remote pilot must consider which methodology?

A. Crew Resource Management.
B. Safety Management System.
C. Risk Management.

23. You are a remote pilot for a co-op energy service provider. You are to use your UA to inspect power lines in a remote area 15 hours away from your home office. After the drive, fatigue impacts your abilities to complete your assignment on time. Fatigue can be recognized

A. easily by an experienced pilot.
B. as being in an impaired state.
C. by an ability to overcome sleep deprivation.

24. (Refer to FAA-CT-8080-2H, Figure 21.) What airport is located approximately 47 (degrees) 40 (minutes) N latitude and 101 (degrees) 26 (minutes) W longitude?

A. Mercer County Regional Airport.
B. Semshenko Airport.
C. Garrison Airport.

25. (Refer to FAA-CT-8080-2H, Figure 12.) What are the current conditions for Chicago Midway Airport (KMDW)?

A. Sky 700 feet overcast, visibility 1-1/2SM, rain.
B. Sky 7,000 feet overcast, visibility 1-1/2SM, heavy rain.
C. Sky 700 feet overcast, visibility 11, occasionally 2SM, with rain.

26. (Refer to FAA-CT-8080-2H, Figure 12.) The wind direction and velocity at KJFK is from

A. 180° true at 4 knots.
B. 180° magnetic at 4 knots.
C. 040° true at 18 knots.

27. According to 14 CFR Part 107, what is required to operate a small UA within 30 minutes after official sunset?

A. Use of anti-collision lights.
B. Must be operated in a rural area.

C. Use of a transponder.

28. To ensure that the unmanned aircraft center of gravity (CG) limits are not exceeded, follow the aircraft loading instructions specified in the

A. Pilot`s Operating Handbook or UAS Flight Manual.
B. Aeronautical Information Manual (AIM).
C. Aircraft Weight and Balance Handbook.

29. According to 14 CFR Part 107, who is responsible for determining the performance of a small unmanned aircraft?

A. Remote pilot-in-command.
B. Manufacturer.
C. Owner or operator.

30. (Refer to FAA-CT-8080-2H, Figure 59, area 2.) The chart shows a gray line with "VR1667, VR1617, VR1638, and VR1668." Could this area present a hazard to the operations of a small UA?

A. No, all operations will be above 400 feet.
B. Yes, this is a Military Training Route from the surface to 1,500 feet AGL.
C. Yes, the defined route provides traffic separation to manned aircraft.

31. (Refer to FAA-CT-8080-2H, Figure 26.) What does the line of latitude at area 4 measure?

A. The degrees of latitude east and west of the Prime Meridian.
B. The degrees of latitude north and south of the equator.
C. The degrees of latitude east and west of the line that passes through Greenwich, England.

32. Under what condition should the operator of a small UA establish scheduled maintenance protocol?

A. When the manufacturer does not provide a maintenance schedule.
B. UAS does not need a required maintenance schedule.
C. When the FAA requires you to, following an accident.

33. According to 14 CFR Part 107, the responsibility to inspect the small UAS to ensure it is in a safe operating condition rests with the

A. remote pilot-in-command.
B. visual observer.
C. owner of the small UAS.

34. According to 14 CFR part 48, when would a small UA owner not be permitted to register it?

A. If the owner is less than 13 years of age.
B. All persons must register their small UA.
C. If the owner does not have a valid United States driver`s license.

35. According to 14 CFR part 48, when must a person register a small UA with the Federal Aviation Administration?

A. All civilian small UAs weighing greater than .55 pounds must be registered regardless of its intended use.
B. When the small UA is used for any purpose other than as a model aircraft.
C. Only when the operator will be paid for commercial services.

36. Which is true regarding the presence of alcohol within the human body?

A. A small amount of alcohol increases vision acuity.
B. Consuming an equal amount of water will increase the destruction of alcohol and alleviate a hangover.
C. Judgment and decision-making abilities can be adversely affected by even small amounts of alcohol.

37. When using a small UA in a commercial operation, who is responsible for briefing the participants about emergency procedures?

A. The FAA inspector-in-charge.
B. The lead visual observer.
C. The remote PIC.

38. What are the characteristics of stable air?

A. Good visibility and steady precipitation.
B. Poor visibility and steady precipitation.
C. Poor visibility and intermittent precipitation.

39. You have received an outlook briefing from flight service through 1800wxbrief.com. The briefing indicates you can expect a low-level temperature inversion with high relative humidity. What weather conditions would you expect?

A. Smooth air, poor visibility, fog, haze, or low clouds.
B. Light wind shear, poor visibility, haze, and light rain.
C. Turbulent air, poor visibility, fog, low stratus type clouds, and showery precipitation.

40. When may a remote pilot reduce the intensity of an aircraft’s lights during a night flight?

A. At no time may the lights of an sUAS be reduced in intensity at night.
B. When a manned aircraft is in the vicinity of the sUAS.
C. When it is in the interest of safety to dim the aircraft's lights.

41. What must a person, who is manipulating the controls of a small unmanned aircraft, do if the standard remote identification fails during a flight?

A. Land the aircraft as soon as practicable.
B. Notify the nearest FAA Air Traffic facility.
C. Activate the aircraft's navigation lights.

42. Where must a small unmanned aircraft's serial number be listed when using either standard remote identification or a broadcast module?

A. The aircraft's Document of Compliance.
B. The manufacturer's Method of Compliance.
C. The Certificate of Aircraft Registration.

43. When preparing for a night flight, what should an sUAS pilot be aware of after assembling and conducting a preflight of an aircraft while using a bright flashlight or work light?
A. Once adapted to darkness, a persons eyes are relatively immune to bright lights.
B. It takes approximately 30 minutes for a persons eyes to fully adapt to darkness.
C. The person should use a flash light equipped with LED lights to facilitate their night vision.

44. To conduct Category 1 operations, a remote pilot in command must use a small unmanned aircraft that weighs
A. 0.55 pounds or less.
B. 0.65 pounds or less.
C. 0.75 pounds or less.

45. Which Category of small unmanned aircraft must have an airworthiness certificate issued by the FAA?
A. 4.
B. 3.
C. 2.

46. Your surveying company is a title sponsor for a race team at the Indianapolis 500. To promote your new aerial surveying department, you decide to video part of the race using a small UA. The FAA has issued a Temporary Flight Restriction (TFR) for the race in the area you plan to fly. In this situation

A. you may fly your drone in the TFR since your company is sponsoring a team at the race.
B. the TFR applies to all aircraft; you may not fly in the area without a Certificate of Waiver or Authorization.
C. flying your drone is allowed if you notify all non-participating people of the closed course UA operation.

Determining the Teaching Resources Needed for an Ideal Post-Secondary Applied STEM (Agricultural Mechanics) Learning Laboratory: A Delphi Approach

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Abstract
Agricultural Education provides an avenue to integrate and emphasize STEM-based concepts through a contextualized approach, which has been seen as a possible solution to increase student competence in STEM-based areas. The contextualized teaching and learning theory and the Curriculum for Agricultural Science Education (CASE) curriculum-learning model undergirds this research. Contextualized teaching and learning can be defined as applying received information to real-life situations and experiences in various contextual learning environments. With a new curriculum, adequate tools and equipment are vital in preparing students for the workforce. However, the issue of inadequate teaching materials has been prevalent within the entire educational system, and such inadequacies are detrimental to the ability of the students to become proficient in agricultural mechanics. The purpose of this Delphi study is to identify the perceptions of an "expert group" of educators on a list of equipment and supplies that would be included in an ideal Post-Secondary Applied STEM Learning Laboratory targeted at helping better prepare pre-service agriculture educators in content integration prior to entering the secondary education classroom. The data collected in the first round from the thirty-four participants who responded resulted in a 68% response rate. A total of 443 individual tools were identified within the 23 content areas listed in the CASE Agricultural Power and Technology (APT) curriculum. The overwhelming majority of tools the panel of experts identified would be what you would find in a standard agricultural mechanics laboratory. Therefore, the costs associated with transitioning from a traditional agricultural mechanics laboratory to a Post-Secondary Applied STEM Learning Laboratory should be minimal.

Introduction
Numerous reports over the last two decades have identified that progress in science education in the United States has waned (National Center for Education Statistics, 2005). As a result of this decline, attempts at reformative measures in science student achievement have been insignificant (Johnson, 2012). Recently, in response to the lackluster academic performance of United States

students and the significant decline behind other nations in science, technology, engineering, and mathematics (STEM) disciplines, and the systematic failure of the educational system in preparing future innovative workers, resulted in political intervention by the Obama administration (Barack Obama and Joe Biden's Plan for Lifetime Success Through Education, 2009). According to the National Science Board (2010) report, ". . . the quality of K-12 STEM education has been identified as a key factor in the performance of U.S. students, decline in STEM pipeline, and position of the United States globally" (Johnson, 2012, p. 46).

Agricultural Education has been identified as a potential solution to the lack of student science and mathematics competency (National Research Council [NRC], 1996), as the integration and emphasis of STEM-based concepts through a contextualized approach (Roberts & Ball, 2009) is ideally suited to the instruction of science, mathematics, and other STEM-related areas (Anderson & Swafford, 2021; Balschweid, 2002; Thompson & Balschweid, 2000). Dewey (1938) stated that the blending of academic content in a contextually heavy-based curriculum has vast potential for the transfer of knowledge and life skills, thereby increasing the potential for academic success. As a contextual framework, agriculture has been acknowledged as ideally suited for the integration, retention, and transference of academic knowledge (Roberts & Ball, 2009).

Teachers need assistance in the transformation of teacher educator programs to one that would align future educators with the pedagogical tools they need to effectively integrate "content" and STEM education (Johnson, 2013; Stohlmann et al., 2012) through applied practice and project-based learning. Recently, project-based learning has been seen as a real-world way to foster scientific inquiry through self-directed student activity (Barak & Dori, 2005). Preservice teachers who are provided opportunities for content-specific pedagogical instruction experience an increased balance of teacher efficacy and confidence (Robinson et al., 2010; Tschannen-Moran & Woolfolk Hoy, 2002), increasing the probability of meeting national content standards (McCubbins et al., 2016).

The contextualized teaching and learning theory and the Curriculum for Agricultural Science Education (CASE) curriculum-learning model undergirds this research. Contextualized teaching and learning can be defined as applying received information to real-life situations and experiences in various contextual learning environments (ERIC Clearinghouse on Adult, Career, and Vocational Education & ERIC Clearinghouse on Teaching and Teacher Education, 1998). Curry et al. (2012) maintained that the contextualized teaching and learning process be characterized as one that ". . . is problem-based; occurs in multiple contexts (schools, homes, worksites, communities); fosters self-regulated learning; anchors teaching and learning in students' diverse life contexts; employs authentic assessment; and uses interdependent learning groups" (p. 59).

The Curriculum for Agricultural Science Education (CASE) is designed to enhance the rigor and relevance of agriculture, food, and natural resources subject matter. The CASE curriculum uses scientific inquiry as the foundation to enhance science and mathematics understanding by utilizing activities, projects, and problem-based instructional strategies (CASE, 2014). The Agricultural Power and Technology (APT) course outline has been developed for the CASE curriculum. According to McCubbins, et al. (2016), adequate tools and equipment are vital in

preparing students for the workforce. However, the issue of inadequate teaching materials has been prevalent within the entire educational system, and such inadequacies are detrimental to the ability of the students to become proficient in agricultural mechanics (Anderson & Anderson, 2018; McCubbins et al., 2017).

Insufficient teaching materials and supplies create impediments for both teachers and students that can lead to failure to meet teaching standards, competency exams, and being less competitive in getting into the workforce (McCubbins et al., 2016; Oakes & Saunders, 2002). McCubbins et al. (2017) found that teachers felt more competent to teach agricultural mechanics topics if they felt they had adequate materials and tools in their laboratory. Since agricultural mechanics is a sought-after class by secondary students because of the hands-on nature of the class, teachers must have the necessary tools and equipment to be successful in preparing laboratory exercises that replicate real-life situations (Agnew & Shinn, 1987; Blackburn & Kelsey, 2012; Byrd et al., 2015; Sutphin, 1984).

Theoretical and Conceptual Framework

Human capital theory was the guiding theoretical framework for this study. Haynes et al. (2014) state that humans are like other commodities and are capable of being developed so that they can be more beneficial economically and socially. One important method utilized to develop one's human capital is through the use of education (Olaniyan & Okemakinde, 2008; Psacharopoulos & Woodhall, 1997; Sakamota & Powers, 1995; Schultz, 1971). Previous researchers have stated that one area that is emphasized by human capital theory is how education increases the cognitive stock of humans to make them more economically beneficial (Haynes et al., 2014; Olaniyan & Okemakinde, 2008; Schultz 1971). The increase of cognitive stock is the primary goal of all post-secondary teacher preparation programs, so that the human capital that goes into teaching is competent in their subject area but can also impact their students, school, and community (Beaulieu & Mulkey, 1995; Haynes et al., 2014).

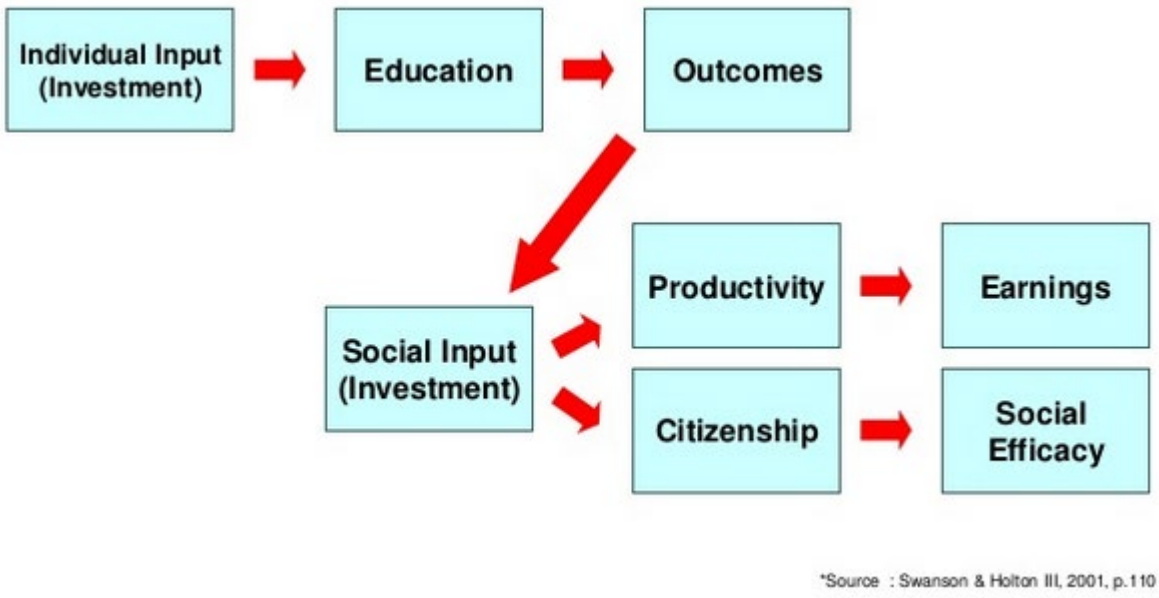

Figure 1. Model of Human Capital Theory. Adapted from "Foundations of Human Resource Development" by R. A. Swanson, and E. F. Holton, 2009. San Francisco, Calif: Berrett-Koehler Publishers.

In agricultural education, the functioning and sustainability of the profession are dependent on the human capital stock that is developed within post-secondary agricultural education teacher preparation programs. Investment in human capital is based on three beliefs, according to Babalola (2003), which states that previously gained knowledge of past generations must be given to the new generation. The second belief focuses on how to create new ideas and products using the existing knowledge given to them. Lastly, creative approaches are encouraged to develop entirely new ideas and products. One area that has become prominent in education is the incorporation of STEM concepts in agricultural education curricula (Doerfort, 2011). In the past decade, through the creative approaches of human capital, the CASE curriculum was created to help advance the efforts of integrating STEM into agricultural education (CASE, 2014).

Purpose and Objectives

The purpose of this Delphi study is to identify the perceptions of an "expert group" of educators on a list of equipment and supplies that would be included in an ideal Post-Secondary Applied STEM Learning Laboratory targeted at helping better prepare pre-service agriculture educators in content integration prior to entering the secondary education classroom. The following objectives guided this study:

1. Determine the demographics of the panel of experts serving as the population for this study.
2. Determine by consensus a list of equipment and supplies that would be included in an ideal Post-Secondary Applied STEM Learning Laboratory

Methodology

The purpose of this Delphi study is to identify the perceptions of an "expert group" of educators on a list of equipment and supplies that would be included in an ideal Post-Secondary Applied STEM Learning Laboratory targeted at helping better prepare pre-service agriculture educators in content integration prior to entering the secondary education classroom. A three-round Delphi method was designed to serve as a research tool to gain insight from an "expert" group on an open-ended question(s), where responses are distilled, achieving a reliable consensus to confirm or contradict the study (Delp et al., 1977). Hasson et al. (2000) indicated that the Delphi approach is a "group facilitation technique, which is an iterative multistage process, designed to transform opinion into group consensus" (p. 1008). The Delphi method is a valuable tool to investigate problems where a lack of information is available regarding a given issue (Skulmoski et al., 2007).

Delp et al. (1977) described the Delphi method as a group process by which a panel of experts is assembled to provide informed judgment toward consensus on a specific topic. A three-member advisory panel consisting of faculty from two land grant university systems and one state university from each region (North Central, Southern, & Western) of the American Association for Agricultural Education (AAAE) nominated members of the panel of experts. The advisory panel was provided with a set of criteria to guide the establishment of the panel of experts. The

list of criteria included: (1) post-secondary faculty and staff that teach a diverse set of agricultural mechanics courses and have secondary agricultural education experience; (2) post-secondary agricultural education department chairs that have experience teaching agricultural mechanics and worked closely with the agricultural mechanics curriculum offered at their institution; (3) doctoral students in agricultural education that have a graduate teaching and/or research assistantship related to agricultural mechanics and had prior secondary agricultural education experience; and (4) current school-based agricultural education teachers who are considered experts in agricultural mechanics within their respective states.

The advisory panel identified a panel of experts (N=50) that were comprised of university faculty and staff (n=15) that teach agricultural mechanics, agricultural education department chairs (n=5), agricultural education Ph.D. graduate students (n=7), and current secondary agricultural education teachers (n=23) who teach agricultural mechanics/power systems, as recommended by association leadership in the National Association for Agricultural Education (NAAE) and had served as reviewers for a recent agricultural mechanics textbook. At least one member from each of the four groups above represented all three regions (North Central, Southern, & Western) of the American Association for Agricultural Education (AAAE). The demographics of the 13 experts who have completed all three rounds of the Delphi methods are included in the appendix.

The three-round Delphi technique used in this research study contributed to establishing content and concurrent validity (Sharkey & Sharples, 2001). Habibi et al., (2014) suggested that content validity can be established in a Delphi study by carefully selecting participants who have an interest and a depth of knowledge in the topic. Using the selection criteria for our panel of experts, we were able to identify participants who had a strong interest in agricultural mechanics and, more specifically, the equipment and supplies necessary to teach in an applied STEM learning laboratory. Furthermore, Hasson and Keeney (2011) indicated that successive rounds of the Delphi process allow the experts to reach a level of agreement on the responses put forth by the group, leading to establishing concurrent validity. In a Delphi study, when a group of selected experts exceeds 13, the reliability of the study is greater than .80 (Dalkey, 1969). However, it should be noted that establishing reliability in Delphi studies is suspect and serves as a limitation (Hainline & Wells, 2019). Therefore, caution should be exercised when generalizing the findings of this study.

Upon the agreement of the panelists to participate, this study employed three separate rounds of questionnaires and was initiated through an email detailing the process and anticipated timeline. The study was conducted electronically via Qualtrics, an online data collection instrument. Each round was closed after 21 days, and data collection was closed after 63 days. Following the initial distribution of questionnaires in each round, two follow-up reminder emails were sent to the participants in seven-day increments, following the recommendations from Yun and Trumbo (2000). The first round of the study used an open-ended questionnaire that included eight questions focusing on equipment and supplies needed for the varying topics derived from the CASE APT curriculum. The CASE curriculum is aligned with the Agricultural, Food, and Natural Resources Career Cluster Content Standards (The Council, 2024), and the National Science Education Standards (NRC, 1996). At the conclusion of this round, a total of 443 individual items were identified as equipment and supplies needed within the eight content areas listed in the CASE APT curriculum.

The second-round questionnaire was sent electronically to only those who had participated in the first round. In the second questionnaire, panelists were asked to review each item and indicate their level of agreement on the importance of each item that would be included in an ideal Post-Secondary Applied STEM Learning Laboratory. The panelists were asked to rate the 443 items identified in round one using a five-point Likert-type scale (1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly Agree). The second-round instrument also included an open-ended question that asked the panel members to include any other tools or equipment that should be considered. Items that received a score of four (Agree) or five (Strongly Agree) from at least 80% of the experts were considered to have reached consensus. No additional recommendations from the panel of experts were included in the open-ended question.

The third questionnaire sought to further determine consensus. The third questionnaire was sent to only those who had participated in the second round. Panel members were asked to provide a dichotomous indication as to whether they agreed or disagreed with each of the 413 tools and equipment that were critical in incorporating the CASE APT curriculum. The participants were also asked to provide comments if they could not agree with the summary findings. Consensus was reached on 437 items, with no suggested revisions, and thus, data collection ceased.

The Statistical Package for Social Sciences (SPSS©) Version 29 software was used to analyze the data collected in this study. The data gathered from the eight open-ended questions were aligned by the content areas listed in the CASE APT curriculum and were analyzed by organizing the expert's responses to each area. Descriptive statistics were computed for Likert-type items contained in the two subsequent rounds of the Delphi process.

Results

The objective of this study sought to identify a list of equipment and supplies that would be included in an ideal Post-Secondary Applied STEM Learning Laboratory. The Delphi technique of obtaining group consensus was used to accomplish this objective. The first round of the study used a questionnaire with an open-ended question to facilitate the generation of a wide array of response categories. The questions that were used coincided with the CASE APT curriculum content specific area list and are detailed in Table 1.

Table 1

CASE Ag Power and Technology Curriculum Content Areas

Resources needed in an Applied STEM Lab to teach concepts in the content area of:
1. Components of Agricultural Power and Technology, including two topics: The first being Mechanical World.
2. Components of Agricultural Power and Technology, including two topics: The second being Mechanical Basics.
3. Safety and Tool Use, including three topics: The first being Safety in the shop setting.
4. Safety and Tool Use, including three topics: The second being Machine and tool operations safety.
5. Safety and Tool Use, including three topics: The third being Measurement in agriculture.
6. Building and Design Materials used in Agriculture, including four topics: The first being Structural materials in Agriculture
7. Building and Design Materials used in Agriculture, including four topics: The second being Fluids in Agriculture

8. Building and Design Materials used in Agriculture, including four topics: The third being Earthen materials in agriculture
9. Building and Design Materials used in Agriculture, including four topics: The fourth being Fabricating materials
10. Agricultural Energy and Power, including four topics: The first being Heat
11. Agricultural Energy and Power, including four topics: The second being Electrical
12. Agricultural Energy and Power, including four topics: The third being Fluid
13. Agricultural Energy and Power, including four topics: The fourth being Renewable Energy
14. Machines, including three topics: The first being Simple Machines
15. Machines, including three topics: The second being Machine Systems
16. Machines, including three topics: The third being Transmission of Power
17. Machinery Management, including three topics: The first being Machine Performance and Efficiency
18. Machinery Management, including three topics: The second being Calibration and Monitoring of Power
19. Machinery Management, including three topics: The third being Technical Reading and Problem Solving
20. Engineering, including three topics: The first being Design Process
21. Engineering, including three topics: The second being Construction Processes
22. Engineering, including three topics: The third being Testing Processes
23. Technologies that enhance tools and equipment

Note: A list of all tools is listed in the appendix

Round One

Data collection in round one consisted of responses generated through the open-ended questions seeking to determine what resources are needed in an applied STEM laboratory to teach contextually specific concepts in the different content areas of agricultural power and technology systems. The data collected in the first round from the thirty-four participants who responded resulted in a 68% response rate. A total of 443 individual tools were identified within the 23 content areas listed in the CASE APT curriculum. Table 2 contains the 25 tools and equipment most frequently identified in round one.

Table 2

Delphi Round 1: Tools and Equipment Needed for an Ideal STEM laboratory (n = 34)

	Tools and Equipment Identified
1.	Safety Data Sheets, Adequate square footage of laboratory space per student . . .
2.	Ag Power (small gas engines, tools), C2H2 - O2 applications, CNC plasma cam . . .
3.	Safety materials (goggles, hearing protection, fire extinguishers, fire blanket.) . . .
4.	Clean-up/maintenance guidelines, Computers, Consumables, Gloves, Hand tools . . .
5.	Modern machinery problems, Combination square, Dial calipers, Dial gauges . . .
6.	Auto level, Band saw, building materials, CAD for design, Compound miter saw . . .
7.	Cylinders, Fluid, Fluid trainers, Fuels, Hoses, Hydraulic systems, Hydraulic trainers . . .
8.	Auto and laser level, EDM (Electronic Distance Measuring), Flags, Levels . . .
9.	Arc Welders, Band saw, Concrete tools, Metal tools, Wood tools, CAD equipment . . .
10.	Electric welders, IR cameras to detect heat loss, Oxy-fuel setups, Propane torch . . .
11.	Electrical tools and fixtures, teaching aids, Circuit breakers, Electric motor controls . . .
12.	Fluid power equipment, Hydraulic power equipment, Hydraulic trainer . . .
13.	Electrical motor (12v), Generation and storage of chemical electricity . . .
14.	Items displaying mechanical advantage, Gears to attach to small motors . . .
15.	Activities that illustrate how electrical and hydraulic energy is harnessed to do work . . .

16. Wiring principles, Hydraulics lab, Teaching aids covering bearings, belts, and gears . . .
17. Engine performance testing equipment . . .
18. Aids to monitor power and how conditions affect power, Tools for calibration . . .
19. Activities requiring reading and problem solving, Problems using real-world items . . .
20. Basic plan reading, Computer-aided design programs . . .
21. Real projects requiring management and oversight, Plans, Reference material . . .
22. Performance testing equipment, Reference material . . .
23. Activities illustrating use of tools to perform functions, bring concepts to reality, and to address needs . . .

Round Two

Thirteen of the 34 individuals responded in round two, for a 38% response rate. In this round, respondents were asked to rate the 423 tools and equipment identified in round one on a Likert-type scale (1 = Strongly disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly Agree), and to add any critical tools and equipment not included on the list. Results of responses for round two include 107 tools and equipment that the panel strongly agreed with, 306 tools and equipment that the panelists agreed with, ten tools that the panelists were uncertain about, and the panelists did not identify any tools or equipment that they disagreed or strongly disagreed with. Displayed in Table 3 are the top-ranked tools and equipment for *Components of Agricultural Power and Technology* that the panelists strongly agreed (M = 4.50 – 5.00) and agreed (M = 3.50 – 4.49) with over and above seven of the tools and equipment that they were uncertain (M = 2.50 – 3.49) about (Table 3).

Table 3

Delphi Round Two: Level of Agreement with Ranked Tools and Equipment (n = 13)

	Tools and Equipment	*M*	*SD*
Q1	**Components of Agricultural Power and Technology, which includes two topics: The first being Mechanical World**		
	Safety Training	4.54	1.20
	PPE; apparel, glasses, face-shield, washbasin, etc.	4.69	1.11
Q2	**Components of Agricultural Power and Technology, which includes two topics: The second being mechanical basics**		
	Digital Multi-Meter	3.17	0.94
	Basic content specific hand and power Tools	3.33	1.44
	Laser cutter; Wood lathe	3.42	1.08

1.00 – 1.49 = Strongly Disagree, 1.50 – 2.49 = Disagree, 2.50 – 3.49 = Uncertain, 3.50 – 4.49 = Agree, 4.50 – 5.00 = Strongly Agree.

Ranked tools and equipment that reached a level of strong agreement by those surveyed included Personal Protective Equipment (PPE) to include apparel, glasses, face-shields, washbasins, etc. (M = 4.69) and safety training (M = 4.54). Those ranked tools and equipment the panel of experts were uncertain about included the use of a digital multi-meter (M = 3.17) in the Ideal STEM enhanced laboratory.

Regarding *Safety and Tool Use* (Table 4), it was determined that PPE was considered essential

for inclusion in the laboratory setting (M = 5.00) for two of the topic areas, *Safety in the Shop Setting*, and *Machine and Tool Operations Safety,* along with the use of properly maintained equipment with all safety features (M = 4.91) as strongly agreed upon in the second content area of *Machine and Tool Operations Safety.* However, the panel of experts could not reach agreement with the use of instructional DVDs to support STEM laboratory safety in the topics of *Safety in the Shop Setting* (M = 3.27) or *Measurement in Agriculture* (M = 3.18) (Table 4).

Table 4

Delphi Round Two: Level of Agreement with Ranked Tools and Equipment (n = 13)

	Tools and Equipment	*M*	*SD*
Q3	**Safety and Tool Use, which includes three topics: The first being Safety in the shop setting**		
	Teaching aids (computers, video, etc.) Tool specific safety rules	4.55	0.52
	Lab management guidelines	4.55	0.69
	Safety protocol	4.55	1.21
	Power tools; Safety colors and zones; State/National shop safety guidelines	4.64	0.50
	Current industry safety curriculum; Permanent safety features, (ventilation, etc.); Wash Basins	4.73	0.47
	Safety exams; shields; ventilation systems	4.82	0.40
	Safety Equipment (PPE, fire extinguishers, blanket, fire alarm); Safety rules/tests; Welding helmets	4.91	0.30
	PPE; Safety glasses	5.00	0.00
	Instructional DVD	3.27	1.42
Q4	**Safety and Tool Use, which includes three topics: The second being Machine and tool operations safety**		
	Larger stationary equipment (drill press, metal breaks, etc.)	4.55	0.82
	Curriculum; Inclusion of modern and current machine and power tools used in industry; Teaching aids (computers, video abilities, etc.)	4.55	0.52
	Safety Contracts	4.55	0.69
	Clean-up/maintenance guidelines; Instruction in hand tools; machine and power tools; Specific application safety items	4.64	0.50
	Hand and power tools to demonstrate safe operating procedures; Safety exams; Tool guards, specific safety, and area markers	4.73	0.47
	Safety rules/test	4.82	0.40
	Properly maintained equipment with all safety features; Welding helmets	4.91	0.30
	PPE (Personal Protective Equipment)	5.00	0.00
Q5	**Safety and Tool Use, which includes three topics: The third being measurement in agriculture**		
	Dial calipers and gauges; Rulers, yardsticks, steel tape, squares, torque wrenches, and traditional measuring tools	4.55	0.52
	Basic tools of measurement including dimensions, weight, volume, etc.; Curriculum; Feeler gauges; Framing square; Hand and power tools; Inside/outside calipers; Micrometers; Tape measures (log tape, fiberglass tape, standard lumber tape, survey instruments)	4.64	0.50
	Levels; Precision measuring equipment (surveying equipment, micrometers, calipers, etc.)	4.73	0.47
	Instructional DVD	3.18	1.08

1.00 – 1.49 = Strongly Disagree, 1.50 – 2.49 = Disagree, 2.50 – 3.49 = Uncertain, 3.50 – 4.49 = Agree, 4.50 – 5.00 = Strongly Agree.

It was determined by the panel of experts that Personal Protective Equipment (PPE) (M = 5.00) was again strongly agreed upon as a necessary component of a STEM enhanced laboratory learning environment in the content area, *Building and Designing Materials Used in Agriculture* under the heading of fabricating materials. However, those surveyed found difficulty coming to an agreement with regards to the use of a smartboard (M = 3.45) in the topic area *Earthen Materials in Agriculture* (Table 5).

Table 5

Delphi Round Two: Level of Agreement with Ranked Tools and Equipment (n = 13)

	Tools and Equipment	*M*	*SD*
Q6	**Building and Design Materials used in Agriculture, which includes four topics: The first being Structural materials in Agriculture**		
	Cross/rip saw; Fasteners; Framing squares; Portable circular saw; Squares (rafter, tri, tri-miter, combination); Table saw; Tables with clamps	4.55	0.52
Q8	**Building and Design Materials used in Agriculture, which includes four topics: The third being Earthen materials in agriculture**		
	Smartboard	3.45	1.29
Q9	**Building and Design Materials used in Agriculture, which includes four topics: The fourth being Fabricating materials**		
	Band saw; Metal construction materials; Wood storage racks	4.55	0.69
	Basic metal tools; Basic wood tools; Compound miter saw; Metal cutting band saw; MIG Welders; Oxy-fuel cutting equipment; Plasma cutting equipment; Portable circular saw; Table saw; Welding rods	4.64	0.50
	Arc Welders; Pedestal grinder; Portable grinder	4.73	0.47
	Personal Protective Equipment	5.00	0.00

1.00 – 1.49 = Strongly Disagree, 1.50 – 2.49 = Disagree, 2.50 – 3.49 = Uncertain, 3.50 – 4.49 = Agree, 4.50 – 5.00 = Strongly Agree.

In table 6, four topic areas exist under *Agricultural Energy and Power,* with those surveyed finding the highest level of agreement in the use of Multimeters (M = 4.82), followed by the use of Wiring Boards (M = 4.73) under the *Electrical* topic. There was not a level of agreement reached with regards to the inclusion of student learning in small engines (M = 3.36).

Table 6

Delphi Round Two: Level of Agreement with Ranked Tools and Equipment (n = 13)

	Tools and Equipment	*M*	*SD*
Q10	**Agricultural Energy and Power, which includes four topics: The first being Heat**		
	Fuel and energy storage cabinet,	4.55	0.69
	Oxy-fuel setups	4.55	0.52
	Electric welders	4.64	0.50
Q11	**Agricultural Energy and Power, which includes four topics: The second being Electrical**		

Electrical meters; Power transfer safety device; Principles of AC electrical power; Principles of DC electrical power; Screwdrivers; Wire nuts	4.55	0.52
All electrical tools and fixtures; Basic electrical teaching aids; Circuit breakers; Junction boxes; Light fixtures; Outlets; Switches; Wire	4.64	0.50
Wiring boards	4.73	0.47
Multimeters	4.82	0.40
Small engines	3.36	1.29

1.00 – 1.49 = Strongly Disagree, 1.50 – 2.49 = Disagree, 2.50 – 3.49 = Uncertain, 3.50 – 4.49 = Agree, 4.50 – 5.00 = Strongly Agree.

Round Three

In round three, respondents were provided with both their own individual ratings and those of the group from round two. Panel members were asked to provide a dichotomous indication of whether they agreed or disagreed with each of the 413 tools and equipment as critical for including in the CASE APT curriculum. The participants were also asked to provide comments if they could not agree with the summary findings. All thirteen of the panel members who responded in round two participated in this round, for a 100% response rate. Table 7 contains summary data for this round and includes those tools and equipment that reached a consensus level of 80% or higher by the panel of experts.

Table 7

Delphi Round Three: Tools & Equipment Needed that Reached Consensus for the CASE Agricultural Power and Technology Curriculum (n = 13)

	Tools & Equipment
Q2	Adequate lab space per student/worker; Appropriate lighting; Building supplies . . .
Q4	Building supplies; CNC Plasma cam; Computer-driven technology machines (Plasma, laser cutter, CO2 engraver, Wood shaper); Concrete Tools . . .
Q6	Safety tests; Gloves; Handouts; Hazard Identification and reduction . . .
Q8	Consumables; Hand tools; Tool area guards and markers; Safe operation videos . . .
Q10	Basic measurement tools (Dimensions, weight, volume, etc.); Combination square; Curriculum; Hand/Power tools; Survey equipment . . .
Q12	Wood clamps for safety purposes; Woodworking (Building floors, wall, roofs, etc.) . . .
Q14	Fluid trainers; Syringes, tubing, small lumber; associated tools; Pneumatics
Q16	Auto and laser level; Computer; EDM (Electronic distance measuring)
Q18	Composite construction materials; Fasteners; Jointer; Planer; Pneumatic nail gun; Vises
Q20	Learning activities (Concepts and measurements of energy); Ovens; Small gas engines
Q22	Electrical tools, fixtures; Electric motor controls; Electrical pliers; Motion controls; . . .
Q25	Tanks; Windmills; Alternative energy items
Q27	Items that display mechanical advantage; Hand tools; Small 12V Machine Motors Fasteners; Handouts
Q29	Hydraulics Lab; Activities to illustrate how electrical/hydraulic energy is harnessed to do work; Teaching aids
Q31	Basic wiring principles; Handouts; Hydraulics lab; Teaching aids covering belts, gears
Q35	Basic tools; Reading, problem-solving learning activities; Problems involving Realia
Q37	Basic plan reading
Q38	Management and oversight projects; videos

***** Tools and equipment reached consensus with 80.00% or higher level of agreement

The panel of experts failed to reach a consensus on tools and equipment for eight areas in the

CASE Agricultural Power and Technology curriculum.

Table 8

Delphi Round Three: Tools & Equipment Needed that Did Not Reach Consensus for the CASE Agricultural Power and Technology Curriculum (n = 13)

	Tools & Equipment	Yes (%)	No (%)
Q4	Diesel engines	75.00	25.00
	Surveying equipment	66.67	33.33
Q6	Aprons; Accident handling; Safety color and zones	75.00	25.00
	Computers; Textbooks	66.67	33.33
Q8	Lab coats	72.73	27.27
	DVD's	54.55	45.45
Q10	Modern machinery with modern problems	72.73	27.27
Q12	Wood lathe	72.73	27.27
	Auto level; laser cutter	63.64	36.36
Q20	Electric welders	72.73	27.27
Q25	PVC Connections and fittings	72.73	27.27
Q29	Clear Briggs carburetor	72.73	27.27

Discussion, Conclusions, Implications, and Recommendations

The researchers believe that Post-Secondary Applied STEM Learning Laboratories will need to be updated to support pre-service teacher STEM content integration in agricultural mechanics, meeting the needs of a changing world based upon the results of this study. Out of the 413 tools that were identified by the panel of experts, 409 tools were identified as agree or strongly agree. The experts were uncertain of only four tools and did not disagree with a single tool included in the list. With the considerable number of tools identified by the panel of experts (*413*), it is understandable that McCubbins et al., (2016) identified a shortage of tools needed to teach agricultural mechanics courses. If you look closer at the tools identified by the panel of experts, an overwhelming majority of the tools identified would be what you would find in a standard agricultural mechanics laboratory. Therefore, the costs associated with the transition from a traditional agricultural mechanics laboratory to a Post-Secondary Applied STEM Learning Laboratory should be minimal, assuming the number of tools and equipment currently available is adequate.

The panel of experts identified in the initial round a need for STEM enhanced technology (i.e., microscopes, digital multimeters, calibration equipment, laser cutters, etc.) but only one; Precision Measuring Equipment (Micrometers & Calipers)-achieved a dichotomous consensus in round three of 100%. The panel of experts was uncertain as to the value of other STEM enhanced technology as worthy of inclusion in a Post-Secondary Applied STEM Learning Lab facility. Is it possible that the panel of experts' views current best practices in agricultural mechanics as being STEM enhanced? Is it possible that the growing trend of students possessing basic agricultural mechanics skills is limiting the potential of educators to institute a STEM enhanced curriculum? Furthermore, with the current skills gap and the need for skilled laborers, is there a need for a STEM enhanced curriculum? With this concern, future research should attempt to identify the basic skills needed in an introductory agricultural mechanics course.

Implications of this research exist regarding future teacher preparation. Since exposure to a STEM-enhanced curriculum could potentially reinforce student learning and competency in STEM areas (Haynes, et al., 2012; Myers & Dyer, 2006; Parr, et al., 2006; Thompson & Balschweid, 2000), it stands to reason that teacher education programs need to provide future teachers with the tools and facilities necessary to effectively integrate and emphasize STEM principles into agriculture content (Johnson, 2012; Stohlmann, et al., 2012). As such, could increased exposure to a Post-Secondary Applied STEM Learning Laboratory influence the abilities of teachers to effectively integrate STEM content? Future research should investigate this possibility.

References

Agnew, D. M., & Shinn, G. (1987). Importance of mechanical activities performed by outstanding young farmers In Mississippi. *Journal of Agricultural Education*, *28*(3), 29–36. https://doi.org/10.5032/jaatea.1987.03029

Anderson, R. G. & Anderson, K. (2018). Career and technical education teachers' tool and equipment availability related to the teaching and learning of two-stroke engines content: A preliminary study. *Career and Technical Education Research Journal, 43*(3) 213-226. https://doi.org/10.5328/cter43.3.213

Anderson, R. & Swafford, M. (2021). Perceptions of administrators in Kentucky secondary schools regarding agriculture and mathematics, teaching integrated mathematics and meeting state standards. *The CTE Journal, 9*(1). 1-12.

Babalola, J. B. (2003). Budget preparation and expenditure control in education. In J. B. Babalola (Ed.) *Basic text in educational planning* (pps). Ibadan: Awemark Industrial Printers.

Balschweid, M. A. (2002). Teaching biology using agriculture as the context: Perceptions of high school students. *Journal of Agricultural Education*, 43(2), 56–67. doi: 10.5032/jae.2002.02056

Barack Obama and Joe Biden's Plan for Lifetime Success Through Education. (2009). https://googlegroups.com/group/macareers11/attach/2ca924ca2391ef2a/PreK-12EducationFactSheet%5B1%5D.pdf?part=0.1&view=1 Barak, M., and Dori, Y. J. (2005). Enhancing undergraduate students' chemistry understanding through project-based learning in an IT environment. *Science Education, 89*(1) 117–39.

Barak, M. & Dori, Y. (2005). Enhancing undergraduate students' chemistry understanding through project-based learning in an IT environment. *Science Education 89*(1): 117-139.

Beaulieu, L. J., & Mulkey, D. (1995). *Investing in people: The human capital needs of rural America.* Westview Press, Inc.

Blackburn, J. J., & Kelsey, K. D. (2012). *A case study of authentic assessment in a secondary agricultural mechanics laboratory*. Proceedings from the 2012 Southern Region of the American Association for Agricultural Education Research Conference. Birmingham, AL: 32-46.

Byrd, A. P., Anderson, R. G., & Paulsen, T. H. (2015). Does agricultural mechanics laboratory size affect agricultural education teachers' job satisfaction. *Journal of Agricultural Education*, *56*(1), 6–19. https://doi.org/10.5032/jae.2015.01006

Curriculum for Agricultural Science Education. (February 2014) *CASE vision*. http://www.case4learning.org

Curry, K. W., Jr., Wilson, E., Flowers, J. L., & Farin, C. E. (2012). Scientific basis vs. contextualized teaching and learning: The effect on the achievement of postsecondary students. *Journal of Agricultural Education*, *53*(1), 57–66. doi: 10.5032/jae.2012.01057

Dalkey, N. C. (1969). *The Delphi method: An experimental study of group opinion.* The Rand Corporation.

Delp, P., Thesen, A., Motiwalla, J., & Seshadri, N. (1977). *Delphi: System tools for project planning.* National Center for Research in Vocational Education, The Ohio State University.

Dewey, J. (1938). Experience and education. Collier Books.

Doerfert, D. (2011). *National Research Agenda: American Association for Agricultural Education's research priority areas for 2011-2015*. Lubbock, TX: Texas Tech University, Dept. of Agricultural Education and Communications.

ERIC Clearinghouse on Adult, Career, and Vocational Education & ERIC Clearinghouse on Teaching and Teacher Education. (1998). *Contextual teaching and learning: Preparing teachers to enhance student success in the workplace and beyond.* Information series no. 376. Center on Education and Training for Employment.

Habibi, A., Sarafrazi, A., & Izadyar, S. (2014). Delphi technique theoretical framework in qualitative research. *The International Journal of Engineering and Science* 3(4), 8-13.

Hainline, M. S., & Wells, T. (2019). Identifying the agricultural mechanics knowledge and skills needed by Iowa school-based agricultural education teachers. *Journal of Agricultural Education, 60*(1), 59-79. https://doi.org/10.5032/jae.2019.01059

Hasson, F., & Keeney, S. (2011). Enhancing rigour in the Delphi technique research. *Technological Forecasting and Social Change*, 78(9), 1695-1704. doi:10.1016/j.techfore .2011.04.005

Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing*, 32(4), 1008-1015. doi:10.1046/j.1365-2648.2000.t01-1-01567.x

Haynes, J. C., Gill, B. E., Chumbley, S. B., & Slater, T. F. (2014). A cross-case comparison of the academic integration human capital pre-service agricultural educators retain prior to their teaching internship. *Journal of Agricultural Education, 55*(5), 191-206. doi: 10.5032/jae.2014.05191

Haynes, J. C., Robinson, J. S., Edwards, M. C., & Key, J. P. (2012). Assesing the effect of using a science-enhanced curriculum to improve agriculture students' science scores: A causal comparative study. *Journal of Agricultural Education, 53*(2), 15–27. doi: 10.5032/jae.2012.02015

Johnson, C. C. (2012). Implementation of STEM education policy: Challenges, progress, and lessons learned. *School Science and Mathematics, 112*(1), 45–55. doi: 10.1111/j.1949-8594.2011.00110.x

Johnson, C. C. (2013). Conceptualizing integrated STEM education. *School Science and Mathematics, 113*(8), 367–368. doi: 10.1111/ssm.12043

McCubbins, O., Anderson, R., Paulsen, T. & Wells, T. (2016). Teacher-perceived adequacy of tools and equipment available to teach agricultural mechanics. *Journal of Agricultural Education, 57(3), 223-236. doi: 10.5032/jae.2016.03223*

McCubbins, O., Wells, T., Anderson, R. & Paulsen, T. (2017). Examining the relationship

between the perceived adequacy of tools and equipment and the perceived competency to teach agricultural mechanics. *Journal of Agricultural Education, 58*(2), 268-283. *https://doi.org/10.5032/jae.2017.02268*

Myers, B. E., & Dyer, J. E. (2006). Effects of investigative laboratory instruction on content knowledge and science process skill achievement across learning styles. *Journal of Agricultural Education, 47*(4), 52–63. doi: 10.5032/jae.2006.04052

National Center for Education Statistics. (2005). *NAEP state comparisons – data table*. http://nces.ed.gov/nationsreportcard/statecomparisons/withinyear.aspx?usrSelections=1%2cSCI%2c0%2c2%2cwithin%2c0%2c0.

National Research Council. (1996). *National science education standards*. National Academy Press.

National Science Board (NSB) (2010). Science and engineering indicators 2010, NSB 10-01, National Science Foundation.

Oakes, J., & Saunders, M. (2002, October). Access to textbooks, instructional materials, equipment, and technology: Inadequacy and inequality in California's public schools. http://escholarship.org/uc/item/4ht4z71v

Olaniyan, D. A., & Okemakinde, T. (2008). Human capital theory: Implications for educational development. *European Journal of Scientific Research, 24*(2), 157-162.

Parr, B. A., Edwards, M. C., & Leising, J. G. (2006). Effects of a math–enhanced curriculum and instructional approach on the mathematics achievement of agricultural power and technology students: An experimental study. *Journal of Agricultural Education, 47*(3), 81–93. doi: 10.5032/jae.2006.03081

Psacharopoulos, G., & Woodhall, M. (1997). *Education for development: An analysis of Investment Choice.* Oxford University Press.

Roberts, T. G., & Ball, A. L. (2009). Secondary agricultural science as content and context for teaching. *Journal of Agricultural Education, 50*(1), 81–91. doi: 10.5032/jae.2009.01081

Robinson, J. S., Krysher, S., Haynes, J. C., & Edwards, M. C. (2010). How Oklahoma state university students spent their time student teaching in agricultural education: A fall versus spring semester comparison with implications for teacher education. *Journal of Agricultural Education 51*(4), 142–153. doi: 10.5032/jae.2010.04142

Sakamota, A., & Powers, P. A. (1995). Education and the dual labour market for Japanaese men. *American Sociological Review, 60*(2), 222-246. doi: 10.2307/2096385

Schultz, T. W. (1971). *Investment in human capital: The role of education and research.* The Free Press.

Sharkey, S. B., & Sharples, A. Y. (2001). An approach to consensus building using the Delphi technique: Developing a learning resource in mental health. *Nurse Education Today*, 21(5), 398-408. doi:10.1054/nedt.2001.0573

Skulmoski, G. J., Hartman, F. T., & Krahn, J. (2007). The Delphi method for graduate research. *Journal of Information Technology Education: Research*, 6(1), 1-21.https://www.learntechlib.org/p/111405/

Stohlmann, M., Moore, T. J., & Roehrig, G. H. (2012). Considerations for teaching integrated STEM education. *Journal of Pre-College Engineering Education Research (J-PEER), 2*(1), 23–34. doi: 10.5703/1288284314653

Sutphin, H. D. (1984). SOE: Laboratories. *The Agricultural Education Magazine*, 56(10), 4. http://www.naae.org/links/agedmagazine/archive/Volume56/v56i10.pd

Swanson, R. A., & Holton, E. F. (2009). *Foundations of human resource development*. Berrett-Koehler Publishers.

The Council. (2024). CASE *Curriculum standards alignment*. https://www.case4learning.org/curriculum/standards-alignment/

Thompson, G. W., & Balschweid, M. A. (1999). Attitudes of Oregon agricultural science and technology teachers toward integrating science. *Journal of Agricultural Education, 40*(3), 21–29. doi: 10.5032/jae.1999.03021

Thompson, G. W., & Balschweid, M. A. (2000). Integrating science into agriculture programs: Implications for addressing state standards and teacher preparation programs. *Journal of Agricultural Education, 41*(2), 73–80. doi: 10.5032/jae.2000.02073

Tschannen-Moran, M., & Woolfolk Hoy, A. (2002, April). *The influence of resources and support on teachers' efficacy beliefs.* Paper session presented at the annual meeting the American Educational Research Association, Louisiana.

Yun, G. W., & Trumbo, C. W. (2000). Comparative response to a survey executed by post, e-mail, & web form. *Journal of Computer‐Mediated Communication*, 6(1). doi:10.1111/j.1083-6101.2000.tb00112.x

Appendix 1
Delphi STEM Data Round 1

Q1.	A/V capacity, Accompanying SDSs (Safety Data Sheets), Adequate square footage of laboratory space per student/worker, Alternative energy source equipment for demonstrations, Appropriate lighting, Appropriate space, Appropriately designed facility with both open space for students to work independently and in small groups, Bench equipment, Building supplies, CAD software, CNC capabilities, Computers, Concrete tools, Cutting rigs, Dedicated work areas in the facility, Diagnostic tools, Dynameter, Electrical wiring components, Energy converters, Everyday items that display the use of simple machines, Fasteners, Gear pullers, Generic Hand tools, GPS equipment, Hand tools, Jack stands, Jacks, Lab safety materials, Learning activities to illustrate mechanical applications in food, agriculture, and natural resources, Measuring equipment, Microscopes, Plumbing supplies, Pneumatic power, Power equipment, Power generation as in energy and fuel, Power tools, Precision Measurement tools, Safety apparel such as glasses, face shields, wash basin, etc., Safety Training, Simulated events (engine problem diagnostic, hydraulic component failure/diagnosis, equipment repair) provided by industrial counterparts, Shop tables based on enrollment expectations, Small gas engines, Small gas engines tools, Tables, Teaching Aids (video conferencing/recording abilities, projectors, class computers, etc.), Text resources, Ventilation, Vises, Welders, Welding supplies: Arc, MIG, Oxy, White board space, Wood shop tools for construction and woodworking
Q2.	Ag Power (small gas engines, tools), Band saw (wood and metal), Building supplies, C2H2 - O2 setups for cut and weld applications, CNC plasma cam, Compound miter saw, Computer driven technology machines also needed such as plasma, laser cutter, CO2 engraver, wood shaper, Computers, Concrete tools, Construction (woodworking tools, lumber, fasteners, etc.), Crack and leak testing, Cutting rigs, Diagnostic capable computer station, Diesel engines, Digital camera, Dmm, Electrical (electrical tools, wire, electrical hardware), Electrical motors based on specific amperage, watts and rotation, Electrical Systems Equipment (components for wiring), Electrical wiring components, Engines would need engine sets consisting of single L and OHV, twin and other multiples of cylinders in 2 & 4 stroke configurations, Everyday items that display the use of simple machines, Handouts, Hand tools and fasteners to display basic mechanical operations, such as leverage or torque, Hydraulic demo and testing apparatus, Hydraulic gauge, If world lists are satisfied the basic tools and equipment for hand and power based on the specified area, Large power tools - such as table saw, Laser cutter, Learning activities that illustrate basic physics principles, including measurement and mechanical advantage, Mechanical technology such as SMAW, GTAW, and other fusion based processes would be needed, Metal fabrication equipment, Microscopes, Models, Output equipment such as pulleys, gears, etc., Oxy-acetylene rigs, Parts washers, Planer,

	Plumbing supplies, Pneumatic tools, Power testing equipment, Power tools, Precision measuring instruments, Pressure testing (hydraulic, fuel, crank), Reference material, Safety equipment, Small gas engines, Small gas engines tools, Surveying (leveling rods, levels, etc.), Surveying instruments, Teaching aids of modern/current equipment and machinery coupled with basic knowledge of said specific skill...laying out a trailer, Test stand of appropriate size and configuration, Textual information, Welders, Welding Equipment and Machinery (GMAW, SMAW, GTAW), Welding supplies, Wood lathe, Wood shop tools for construction and woodworking
Q3.	All safety materials (coats, goggles, hearing protection, fire extinguishers, fire blanket.), Aprons, Computers, Consequences as seen in an industrial setting, Curriculum, DVD, Examples of safety tests, Exams, Gloves, Hand tools, Handling accidents, Handouts, Identification and reduction of hazards, Industry validated and up to date safety curriculum, Lab coats, Lab layout guidelines, Lab management guidelines, Learning activities that teach the concepts of shop organization, Online resources, Permanent safety features such as ventilation, Posters, Power tools, PPE - safety glasses, Protective safety equipment, Safety colors and zones, Safety contracts, Safety Equipment (fire extinguishers, blanket, fire alarm), Safety exams, Safety glasses, Safety protocol, Safety slides, Shields, Shop safety rules/tests, State/national shop safety guidelines, Teaching aids (computers, video abilities, etc.), Textbooks, The value of cleanliness and organization, Tool specific safety rules, Variety of PPE, Ventilation system(S), Wash basins, Welding helmets
Q4.	Clean-up/maintenance guidelines, Computers, Consumables, Curriculum, DVD, Gloves, Good working equipment that has all their safety features, Hand and power tools, Hand tools, Handouts and exams, Lab coats, Larger stationary equipment (drill press, metal breaks, etc.), Learning activities that emphasize the safe use of hand tools and power tools, Machine and tools being taught to cover areas of welding, metal work, small engines, and woodwork, Modern and current machine tools that will actually be seen not only by those going into the teaching field, but also by those that will be entering the workforce either after secondary graduation, or after they graduate high school, Online resources, Posters, Power tools, PPE (Personal Protective Equipment), Safety contracts, Safety exams, Safety rules/test for each, Safety slides, Specific application safety items, Teaching aids (computers, video abilities, etc.), Textbooks, Tool area use guards and markers, Tool specific safety rules, Tools (hand and power) to demonstrate safe operating procedures, Videos of safe operation, Welding helmets
Q5.	Modern machinery with modern problems, Basic tools of measurement including dimensions, weight, volume, etc., Calculators, Combination square, Curriculum, Dial calipers, Dial gauges, Direct and indirect measuring tools, DVD, Feeler gauges, Framing square, Hand and power tools, Handouts and exams, Inside/outside calipers, Levels, Materials for measuring/mixing liquids, Measurement conversion charts, Micrometers, Online resources, Posters, Precision measuring equipment (surveying equipment, micrometers, calipers, etc.), Rulers, Safety slides, Squares, Steel rule, Surveying equipment, Tape measure (various lengths), Tape measures (log tape, fiberglass tape, standard lumber tape, survey instruments), Teaching aids (computers, video abilities, etc.), Teaching material such as "The Big Inch", Torque wrenches, Traditional measuring tools, i.e., steel tape, yard sticks, ruler, Transits, Tri-square
Q6.	Auto level, Band saw, Building materials, CAD for design, Compound miter saw, Concrete & masonry, Couple the doing with a design that has engineering components so that students understand the "why" of nailing a board in a certain place or what a heat affected zone in metal really translates into, Cross/rip saw, Designing tools, Fasteners, Framing squares, Hammers, Jig/sabre saw, Laser cutter, Laser level, Learning activities that illustrate basic design elements for structures and buildings including pole and balloon construction, Planer, Plumb bob, Portable circular saw, Room to build a structure, Squares (rafter, tri, tri-miter, combination), Structural design guidelines, Surveying equipment, Table saw, Tables with clamps, The ability with tools and space to construct a project that one would see in agriculture. Be it a building or a metal project (trailer, piece of equipment), Wheel barrow, Wood clamps (safety?), Wood lathe, Woodworking (building floors, wall, roofs, etc.)
Q7.	Access to the different mechanical fluids, Cylinders, Fluid, Fluid trainers, Fuels, Hoses, Hydraulic and pneumatic information, Hydraulic components one would see in agriculture, Hydraulic systems,

	Hydraulic trainers, In addition to identification of these fluids, a lot of class time going over the math of flow rates and uses are needed, Learning activities that illustrate the principles of hydraulics, Materials related to creating proper drainage around ag buildings, Oils, Pneumatics, Rain water runoff, Syringes, tubing, small lumber, associated tools, Training stations, Viscometer
Q8.	A land lab, Auto and laser level, Building codes for different soil types and areas, Computer, EDM (Electronic Distance Measuring), Equipment for soil samples, Flags, Hand tools (shovels), Learning activities that involve the selection and use of building materials including soil and concrete, Levels, Natural resources for teaching, Rod, Smart board, Stakes, Surveying and land layout materials (transit, rods), Surveying equipment, Surveyor's tape, Tractor/skid loaders for moving earthen materials, Wheel barrow
Q9.	Arc Welders, Band saw, Basic concrete tools, Basic metal tools, Basic wood tools, CAD equipment, CNC equipment, Composite construction materials, Compound miter saw, Fasteners, Hammers, Jigsaw, Jointer, Metal construction materials, Metal cutting band saw, Metal lathe, MIG Welders, Oxy-fuel cutting equipment, panel saw, Pedestal grinder, Personal Protective Equipment, Planer, Plasma cutting equipment, Pneumatic nail gun, Portable circular saw, Portable drill press, Portable grinder, Reciprocating saw, Sawhorse, Sheet metal break, Table saw, TIG Welders, Vises, Welding rods, Wood clamps, Wood construction materials, Wood storage racks
Q10.	Electric welders, Fuel and energy storage cabinet, Heat source, IR cameras to detect heat loss, Learning activities that include the concepts of energy, Learning activities that includes the measurement of energy, Ovens, Oxy-fuel set ups, Propane torch, Small gasoline engines, Teaching aids on heat energy
Q11.	All electrical tools and fixtures, Basic electrical teaching aids, Circuit breakers, Electric motor controls, Electrical distribution, Electrical generation, Electrical meters, Electrical motors, Electrical pliers, Junction boxes, Light fixtures, Line meter, Measurements, Motion controls, Multi-meters, Needle nose pliers, Outlets, Power transfer safety device, Principles of AC electrical power, Principles of DC electrical power, Screwdrivers, Small engines, Switches, Thermostats, Wire, Wire nuts, Wiring boards
Q12.	Fluid power equipment, Hydraulic power equipment, Hydraulic trainer
Q13.	All alternative energy items, Electrical motor (12v), Generation and storage of chemical electricity, Generation and storage of solar electricity, Generation and storage of wind electricity, PVC connections, PVC fittings, Solar panels, Tanks, Viable renewable energy teaching aids, Windmills
Q14.	Basic shops tools, Everyday items that display mechanical advantage, Fasteners, Gears to attach to small motors used in course, Hand tools, Handouts, Learning activities that illustrate basic principles of physics, Legos, Power points, Pulleys to attach to small motors used in course, Simple aids such as pulleys, and how they work, Small 12V machine motors
Q15.	Briggs new clear carburetor, Handouts, Hydraulics lab, Learning activities to illustrate how electrical energy is harnessed to do work, Learning activities to illustrate how hydraulic energy is harnessed to do work, Learning activities to illustrate how mechanical energy is harnessed to do work, Motors and any associated tools, Power points, Small gas engines, Teaching aids, Videos of the actual movement of engine parts
Q16.	Basic wiring principles, Handouts, Hydraulics lab, Power points, Teaching aids covering bearings, Teaching aids covering belts, Teaching aids covering gears
Q17.	Engine performance testing equipment

Q18.	Aids to monitor power and how conditions affect power, Measurement of electrical and fuel power consumption, Tools for calibration
Q19.	Basic shop tools, Computer, Learning activities that require reading and problem solving, Problems using real world items
Q20.	Basic plan reading, Computer-aided design programs
Q21.	A real project that takes real management and oversight, Plans, Reference material, Software, Videos
Q22.	Performance testing equipment, Reference material
Q23.	Computers, Learning activities that illustrate the uses of tools and equipment to perform functions, bring concepts to reality, and to address needs

Appendix 2

Panel of Experts Demographics (n = 11)

Demographic Variables	***f***	***%***
Gender		
Male	11	100.00
Female	0	0.00
Racial/Ethnic Heritage		
Native American	0	0.00
African American	0	0.00
White, Non-Hispanic	11	100.00
Hispanic	0	0.00
Asian, Pacific-Islander	0	0.00
Years Teaching Experience		
0-10	5	45.45
11-20	2	18.18
21-30	0	0.00
31-40	3	27.27
>40	1	9.09
Educational Level Currently Teaching		
Secondary Education	0	0.00
Post-Secondary Education	11	100.00
Industry Employment	0	0.00
Number of APT Courses Currently Teaching		
0	1	9.09
1 - 2	9	81.8
3 - 4	1	9.09
NAAE Region Affiliation		
Region 1	0	0.00
Region 2	3	37.50
Region 3	4	50.00

Region 4	0	0.00
Region 5	0	0.00
Region 6	1	12.50

Human Resources Career Path Explanation

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Introduction

The purpose of this article is to provide information for individuals interested in pursuing a career in Human Resources (HR). This article contains information on how to pursue a career in human resources, the types of human resource jobs, the responsibilities of this position, along with the average yearly salary. Included in this article is an interview with Human Resources Business Partner Maggie Orlando who shares her journey and experience with this profession.

Responsibility of a Human Resource positions

HR professionals are essential to an organization's success, overseeing a range of responsibilities that ensure a well-functioning workforce. HR contains many different titles and positions that include specialists, managers, business partners, and directors. These positions vary based on the organizations but contain similar tasks and share the same overall goals. According to the U.S Bureau of Labor Statistics (2022), "human resources specialists recruit, screen, and interview job applicants and place newly hired workers in jobs." HR professionals are tasked with developing training programs, conducting performance evaluations, and strategizing for long-term workforce planning. Additionally, Human Resource Managers "lead and direct the routine functions of the Human Resources (HR) department including hiring and interviewing staff, administering pay, benefits, and leave, and enforcing company policies and practices" (Human Resource Manager). This position is essential in nurturing a productive, diverse, and inclusive workforce aligned with the organization's goals.

How to get a job in HR

The path to pursing a job in HR typically starts with pursuing a college education and obtaining a bachelor's degree. According to the U.S. Bureau of Labor Statistics (2022), to enter the

occupation, human resources specialists typically need a bachelor's degree in human resources, business, or a related field." Although a human resources degree is often the route some individuals take it is not mandatory. "While there are a number of undergraduate HR programs available at U.S. colleges and universities, a bachelor's degree in a related subject – such as communications, business, industrial/organizational psychology, sociology and the social sciences – could also be applied to a career in human resources (UCPath Center). Additionally, throughout your professional journey it's important to develop strong interpersonal, communication, and problem-solving skills, these skills are needed to be effective in your future HR role. It is common for current college students to gain practical experience through internships in the summer and be as involved with networking with HR professionals as much as possible. Ultimately, becoming an HR specialist requires a combination of education, skills, practical experience, and a commitment to ongoing learning in the dynamic field of human resources.

Pay

"The median annual wage for human resources specialists was $64,240 in May 2022. The median wage is the wage at which half the workers in an occupation earned more than that amount and half earned less. The lowest 10 percent earned less than $39,340, and the highest 10 percent earned more than $116,060" (U.S. Bureau of Labor Statistics, 2021). It's also important to note that there are many different types of human resource positions and each offer various different salaries. Additionally, the average starting salary will increase if an individual contains a graduate degree.

Job Outlook

The job outlook for careers in Human resources are looking promising. The U.S. The Bureau of Labor Statistics states that the "employment of human resources specialists is projected to grow 6 percent from 2022 to 2032, faster than the average for all occupations." As organizations recognize the importance of talent management, diversity and inclusion, and compliance with evolving labor laws, the need for HR specialists will keep rising. This is a very positive sign for anyone looking into a future career in Human resources.

Interview with Human Resources Business Partner at International Paper Maggie Orlando

1. What previous experience prepared you for this position?

I've had two major HR internships during undergrad and grad school. My education has played a major role in my preparation for this job. I have a bachelor's in Psychology paired with a minor in Law, Justice, and Public Policy and a Master's in Human Resources and Labor Relations. When looking for my first full-time role out of grad school, I wanted a company and position that had an HR development program for employees hired directly from Grad school. Development programs provide you access to network top company leadership and provide consistent industry training, resources, and support that normal role does not.

2. What does a typical workday look like for you?

As a business partner, my role is to directly support salaried and hourly employees at our union-free facility. Every day is different. I'm involved in strategic workforce planning, recruiting, hiring, training, and retaining. I ensure consistent policy enforcement across managers. If there is an employee issue – I will help lead the investigation. I run engagement initiatives and events for all employees. I work on a team of 3 to support a workforce of about 250 employees.

I also travel about 20% of the year to conferences, meetings, or trainings.

3. What is your favorite part about working in Human Resources?

I enjoy helping people and developing positive working relationships with all employees. How people feel in an organization matters. Do they feel heard, supported, and empowered? It's up to HR to lead leaders and set the standard for the workforce. I enjoy having that impact and being able to see how impacts culture.

4. What are the main challenges you encounter in Human Resources?

People can be challenging to work with. There is a lot of gray area in HR. You have to balance compassion with consistent policy enforcement. Additionally, as a business partner, there are a lot of moving pieces and you have to be able to organize priorities effectively.

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

For a high school student who is thinking about this as a career, job shadowing would be a good idea. Learn more about the career by job shadowing someone who is currently in HR. This will help you decide if this is what you are looking for. Pursuing an internship and getting on-the-job learning may also be helpful. Companies look for people with job-related experience. You learn so much through on-the-job learning. I would recommend everyone start in a generalist or business partner role because you have your hands in every HR actively – talent accusation & recruitment, management, training, pay and benefits, and so on. It can help you decide what direction in HR you want to move to next.

A graduate degree is not necessary but does provide you with more career opportunities and a higher starting wage.

6. What qualifications and experience do you bring to your role in HR?

My masters in Human Resources and Labor Relations has been vital – it has set me up for success. My education and HR internships have enhanced my ability to deal with ambiguity, think on my feet, and handle leading tough conversations. I have worked hard to gain the trust and respect of our employees. Without that, you cannot be an effective business partner.
I also was a career advisor in Grad School for other grad students. I have been able to use that experience to develop new college recruitment incentives and strategies that we use on campuses across the country.

7. How much impact do you feel like you can have on the company or organization?

People are a company's competitive advantage – attracting and retaining top talent is vital for a company to develop a path-dependent and strategic industry advantage. I know I have a large responsibility for the success of our facility and I take great pride in that.

Conclusion

A career in human resources is a very valuable profession that plays a critical role in every organization. Overall it involves a fast area of

References

Getting into human resources without an HR degree. (2018, Jan, 24). *UCPath Center.* https://ucpathjobs.org/human-resources/getting-human-resources-without-hr-degree/

Human Resources (HR) Manager Job Description. Resources for employers. https://resources.workable.com/hr-manager-job-description

Human Resource Manager. (2022, December 2). *Society for Human Resource Management (SHRM).* https://www.shrm.org/resourcesandtools/tools-and-samples/job-descriptions/pages/human-resource-manager.aspx

Human Resource Specialists:Occupational Outlook Handbook. (2023, Sep 6). *U.S. Bureau of Labor Statistics.*https://www.bls.gov/ooh/business-and-financial/human-resources-specialists.htm#tab-1

Youth Leadership Development: A Synthesis of Literature

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Abstract
Youth leadership development is one-way strong adult leaders are created by preparing the leaders of tomorrow. This study aims to assess the studies published in Journals of Leadership Education about youth leadership development from 2000 to 2021. A total of 33 articles were collected, assessed, and sorted into four themes and one emerging theme. The four themes included: impact of youth leadership programs, role of adults, youth leadership skill acquisition and community-based leadership. The emerging theme encompassed a growing interest in modeling youth leadership development. Studies collected highlight the importance of youth leadership development and in what settings it can occur. Understanding these studies provides insight into the current knowledge about youth leadership development. Recommendations for future research include further assessment of the youth perspective on their leadership development and adult leader interactions. Future research should also focus on modeling youth leadership with quantifiable data. Implications for future practice focuses on adult leaders understanding the impact they have on youth leadership development and should use the results from these studies to decide what are the best programs and activities to incorporate. This can aid in encouraging youth to be engaged with their community.

Introduction

Youth leadership education is the foundation of resiliency and confidence in the youth that will become the leaders of tomorrow (Kress, 2006). The agricultural sector requires youth leader involvement to maintain pace with a constantly evolving global market economy (Som et al., 2018). Strong adult leaders were once young adults and children, taught by other adult leaders how to bring change and influence in positive, reinforcing ways. Leadership training during the formative years of youth education has been considered in many journals including The *Journal of Psychology* (Cassel & Shafer, 1961), Journal of Applied Psychology (Hynes et al., 1978), Journal of Agricultural Education (Seevers et al., 1995; Ricketts & Rudd, 2005), Journal of Extension (Boyd, 2001), Journal of Career and Technical Education (Ricketts & Rudd, 2002), Institute for Educational Leadership (Edelman et al., 2004), Teaching Exceptional Children

(Grenwelge et al., 2010), International Journal of Adolescence and Youth (Ngai et al., 2012), and Journal of Community Psychology (Mortensen et al., 2014).

To explore the state of youth leadership in agriculture today and draw insights about the future leaders of American and global agriculture, we investigate the literature on this topic in journals of leadership education from the year 2000 to present-day. Literature published in in journals of leadership education is evidence-based and rooted in leadership theory. Various aspects of leadership education that correlate with youth involvement in the agriculture industry include the non-exhaustive list of youth leader self-efficacy, desirable characteristics of leaders and followers in agriculture, responsible youth leadership, and application of leadership skills to experiential learning (Rehm et al., 2019; Cavagnaro & van der Zande 2021; Cline 2021; Coleman et al., 2021). Youth education of applicable skills in general is integral to lesson plans and curricula, specifically with agricultural educators, one of the "primary goals is to foster student interest in agricultural content" (Wells et al., 2015, p. 175). Leadership theory at its core focuses on methods of integrating leaders and followers with common goals and missions to encourage and enact positive change. When we put all these concepts together, we are assessing the last 21 years of youth leadership literature in agriculture to determine common themes across a plethora of leadership theories and applications.

A great deal of research has investigated adult and young adult leadership development, unintentionally leaving leadership development of youth somewhat out of the conversation (Murphy & Johnson, 2011). While some research has taken a deeper dive into the enumeration of tasks and skills of youth leadership development and the mechanisms within, the overall amount of research into specifically youth leadership development does not match the amount of similar research into adult and young adult leadership development (Murphy & Johnson, 2011). Throughout this paper we aim to illustrate the current state of youth leadership research and identify areas of existing research that are lacking.

An important consideration from the research performed by Murphy and Johnson (2011) is their proposed model of leader development across one's lifespan, where early development factors are listed, and their importance explained. Murphy and Johnson's (2011) early development factors are broken down into three categories of: 1) early influences (genetics, temperament, and gender), 2) parenting styles (Authoritarian vs. Authoritative vs. Laissez Faire vs. Neglectful and Attachment Focus) and 3) early learning experiences (education, sports, practice). Considering factors from such an early age is bound to change the paradigm of leadership theories through further study and research, as was shown in this article. Their model then proceeds to consider adult-level and contextual-level factors that meld together with early developmental factors to affect adult leaders in their effectiveness and future development. This emphasizes the importance of all developmental levels of leadership learning and experience along with the leader's context and expectations from their time as a youth.

Van Velsor and Wright (2012) point out that when leaders ask where future leaders will be sourced from, the typical method is to seek out individuals in high school and college who are naturally inclined to leadership roles or who have already sought out leadership positions in their educational experience. Current leaders have been inclined to ignore the potential benefits that focus on youth leadership could have on lifelong leadership development. Several identifying

research questions were put forth by Van Velsor and Wright (2012) such as "1) the age a young person should commence his or her leadership journey, 2) whether leadership development should be part of the regular educational curriculum, 3) how widely it should be offered, 4) leadership qualities that managers want to see in young people entering the workforce, and 5) what excited managers and what concerns them about the young people they employ today" (Van Velsor and Wright, 2012, p. 2). Their findings show that an overwhelming majority (95%) of their respondents believed that leadership education should begin by age 21, with a further breakdown showing 21% think leadership development should begin by five years of age, 29% think leadership development should begin between ages 6 and 10, and 40% of respondents think leadership development should being between ages 11 and 17 (Van Velsor & Wright, 2012). Other important data from this same study includes 84% of respondents believing opportunities for leadership development should be offered and available to all youth and 90% believed leadership development should be part of the educational experience of every student.

Conceptual Framework

The framework that guided this study stems from the National Leadership Education Research Agenda (NLERA) (Andenoro, 2013). The NLERA was designed to establish a foundation to guide Leadership Education research and development, and to form it as a discipline. The research priorities provide a framework for scholarship that will form future practices and developments of future leaders (Andenoro, 2013). The NLERA adopted seven priorities that defined the field of Leadership Education, broken into two defining areas (Andenoro, 2013). This study aligned with Priority 1 and Priority 2 in the first area: *Pedagogical Priorities*; dealing with leadership learning and usage of learning through innovative leadership education. Priority 1, *Teaching, Learning, & Curriculum Development* reflects the research and understanding of how to teach and learn leadership skills and attributes. Priority 2, *Program Assessment & Evaluation*, reflects that leadership educators understand the differences between leadership programs and the mechanisms of how these programs work in respect to leadership education (Andenoro, 2013). The application and usage of Priority 1 and Priority 2 from the NLERA as a framework for this study allows for the extensive assessment of current research regarding youth leadership development.

Purpose and Objectives

Literature syntheses provide a means to sift through and analyze the immense volume of data on a given subject and are considered the strongest measure of evidence (Biondi-Zoccai, 2016; Hennessy et al., 2019). The purpose of this study is to create a synthesis of literature that focuses on the examination of youth leadership development research within journals of leadership education from 2000 to 2021. Conducting a synthesis of the existing literature will help create a framework for the general process of conducting and analyzing results of youth leadership development research, as well as provide insight into the future of youth leadership development. This study aligns with the National Research Agenda of the American Association for Agricultural Education Research Priority 5: *Efficient and Effective Agricultural Education Programs* (Roberts et al., 2016). This research priority emphasizes the need for efficient agricultural communication, extension education, leadership education, and agricultural awareness in order to create efficient professional development programs that aid in career competency. By providing a thorough overview of youth leadership development by means of a

literature synthesis, we can bolster support for the research needs established by the AAAE. The objectives of this study are to:

1. Determine the quantity of youth leadership development studies published in journals of leadership education from 2000 to present.
2. Identify major themes associated with youth leadership development research within in journals of leadership education
3. Summarize overarching trends throughout the results of youth leadership development research.

Methods

The design used for this study intends to quantify and interpret the existing research related to youth leadership development published in journals of leadership education (JOLE). The journals were selected for investigation due to their high regard as journals that engages scholars and teachers while advancing leadership education and development in numerous fields. Though there exists research regarding the topic our study aims to include publications from the year 2000 to 2021 as to identify any shifts in research styles and findings over the period. Our study design was partially developed from Kovar and Ball (2013), who established an efficient method for collecting and classifying literature. Three fundamental strategies for our precise, comprehensive research synthesis include: 1) search strategies, 2) inclusion criteria, and 3) source analysis and categorization.

Data Collection and Analysis

Strategies for collection involved an exhaustive search through journals of leadership education database for articles including key phrases. Inclusion criteria were key words and phrases such as: “youth leadership development”, “youth leadership”, “youth development”, and “leadership development”. Articles containing our criteria for youth leadership development were flagged and saved for further analysis by the researchers. Coding of the articles involved identification of article titles, research populations, study purposes, objectives, and overall research findings. Coding the articles allowed for further clarification and identification of themes across sources, as well as common research conclusions. One author was assigned the role of lead coder, responsible for categorizing all youth leadership development research. As suggested by Kovar and Ball (2013), peer debriefings served to externally review our research process. The purpose of this was to ensure reliable coding a logical order of organization in creating this synthesis of literature. Each the four researchers read and evaluated the literature, posed their suggestion for a theme that represented the main focuses and findings of the literature. Researchers then justified their reasoning for assigning each suggested theme. Following peer debriefings, researchers decided which of the various suggested themes best represented the existing literature. The themes were narrowed down to four main themes, with one emerging theme. Considering most literature touches on multiple themes, researchers conducted additional peer debriefings to determine, for each research article, which theme was Primarily associated, and if there are additional themes associated, they identified secondarily associated, and in one article’s case, tertiarily associated themes. From the results of existing literature, researchers created conclusions regarding youth leadership development. Implications and recommendations for future youth leadership development practice and research are likewise provided.

Results

Literature findings for this study resulted in a total of 33 articles collected from the JOLE. Four main themes were identified by researchers to accurately represent existing literature regarding youth leadership development. Those four themes are: 1) Youth leadership development programs, 2) Role of adults in youth leadership, 3) Youth leadership skill acquisition, and 4) Community-based leadership. One theme was broken into two sub-themes to enhance literature analysis and discussion. In this study, an emerging theme was identified by researchers. Due to the lack of peer-reviewed information on research modeling youth leadership development, there exists an immense gap in the research area. However, research published within the past few years has begun conceptualizing models of youth leadership development. The identified emerging theme, intended to represent cutting-edge research that addresses shortcomings in existing JOLE literature, is Modeling youth leadership development. Below, Table 1 displays the five themes and two sub-themes, corresponding example articles, article justification, and the number of articles associated with that theme specifically. This table intends to give a better understanding of how researchers coded and categorized the content of existing JOLE literature.

Table 1

Example Articles and Corresponding Theme Justifications

Theme	Sub-theme	Example article	Justification	Article #
#1. Impact of youth leadership development programs	N/A	Youth Leadership Development: A National Analysis of FFA Member Role and Activity Context (Horstmeier & Nall, 2007)	Found that FFA (a youth leadership program) helped youth gain life skills, such as leadership skills, and youth can recognize the skills they have gained	8
#2. Role of adults in youth leadership development	#2A. Adult Leader Viewpoint in Youth Leadership	The Perceived Importance of Youth Educator's Confidence in Delivering Leadership Development Programming (Brumbaugh & Cater, 2016)	The "results of this study indicate that perceived importance of youth leadership development training is predictive of youth educator's confidence level in teaching youth leadership."	8
	#2B. Youth Leader Viewpoint in Youth Leadership	Out-of-School Programming: Assessing Impact on Asset Development in Young People (Walahoski & Lodl, 2004)	Found that "4-H offers opportunities for [youth] having meaningful contact with adults that may not be as prevalent in other out-of-school offerings".	4
#3. Youth leadership skill acquisition	N/A	Assessing the Possibility of Leadership Education as Psychosocial-Based Problem Behavior Prevention for Adolescents: A Review of the Literature (Theodore L. Caputi, 2017)	Examined how engaging youth in leadership behaviors is related to preventing problem behavior. Additional results show leadership skill acquisition in youth.	7

#4. Community based leadership	N/A	Influences of Youth Leadership within a Community-Based Context (Jones, 2008)	Found that a leadership development program, that included civic engagement, exposed youth to practical skills and provided a sense of community connectedness.	5
#5. Modeling youth leadership development	N/A	Modeling Youth Leadership: An Integration of Personality Development Theories and Ethics (Sherif, 2019)	Found that by creating a model of youth leadership using existing youth leadership research and theories, which can help plan and implement effective leadership education, curriculum, and interventions.	5

*Some articles were included in multiple themes, see Appendix A for clarification.

Upon a comprehensive evaluation of the current literature regarding youth leadership development, researchers determined key findings and conclusions of those research studies. Each of the four main themes and one emerging theme are discussed independently to provide a thorough understanding of the current literature.

Impact of Youth Leadership Development Programs

In our review, we found that several studies researched the impact of youth leadership programs on youth development. Eight articles were primarily associated with this theme, and four articles were secondarily associated. Youth leadership development programs that were studied included: FFA (Future Farmers of America), 4-H, Boys & Girls Club, and leadership programs created by high schools and the community. The studies assessed the short- or long-term impacts they had on youth leadership skills and development. The short-term impacts were observed with students currently involved in leadership-based programs, finding that students gained confidence and the skills needed to be strong leaders (Horstmeier & Nall, 2007a; Horstmeier & Nall, 2007b; Rosser et al., 2009; Bush et al., 2019). Walahoski and Lodl (2004), comparing leadership skill differences between students in 4-H and students not in 4-H, found that 4-H students had stronger leadership skills. The long-term impacts were assessed through interviews with alumni, finding that the leadership skills gained were still utilized and the alumni believed these types of programs were beneficial to youth (Bruce et al., 2005; Hoover & Bruce, 2006; Anderson et al., 2010; Swigert & Boyd, 2010; Buschlen et al., 2018; Rosch & Nelson, 2018). Nestor et al. (2006) assessed the skills and current knowledge of 4-H adult leaders, concluding that the adult leaders directly impact the youth development in 4-H. These studies have continuously appeared in the past two decades, showing that research on the impacts of youth leadership development programs continues to be a research interest in youth development.

Role of Adults in Youth Leadership

Youth leadership development generally has some level of adult aspect in the form of program leaders, community leaders, teachers, and parents, to name a few. In our review, we found research which directly quantifies the role of adults in youth leadership focuses on one of two viewpoints: 1) from the view of the adult, and 2) from the view of the youth leader. Therefore, we developed these two viewpoints into the two sub-themes for this theme.

Adult Leader Viewpoint in Youth Leadership

Youth leadership from the viewpoint of adult leaders was examined in eight of our 11 sources directly relating to the role of adults in youth leadership. Nearly all of the articles in this sub-theme focused on 4-H or FFA leaders with Voelker et al. (2019) specifically focusing on coaches in high school environments. Transformational leadership was used as a conceptual framework or as part of the research questionnaires in multiple sources (Bruce et al., 2006; Greiman & Addington, 2008; Nowak et al., 2019) where adult leaders generally self-reported transformational leadership behaviors and skills more often than transactional or laissez-faire leadership. They did, however, note that contingent reward behavior was adopted more frequently than the other least-utilized behaviors of transactional leadership. Comparing demographics to self-reported leadership outcomes found that gender and age did not affect leadership outcomes generally while leader training and education were found to have significant effects on perceived youth outcomes (Nestor et al., 2006; Greiman & Addington, 2008; Nowak et al., 2019). An overarching theme of the research in this subtheme was well stated by Brumbaugh and Cater (2016, p.1): the "perceived importance of youth leadership development training is predictive of youth educators' confidence level in teaching youth leadership."

Youth Leader View of Adults in Youth Leadership

Four articles in this literature synthesis focused on the youth view of the adult leaders in their leadership journey. Walahoski and Lodl (2004) surveyed fifth, seventh, and ninth graders for character-building aspects of various levels and types of out-of-school leadership opportunities and involvement with adult leadership educators. The authors found that the asset-index relationship to level of out-of-school involvement was highest at the intersection of "contact with adults" and "4-H only" or "no activities" involvement levels. Walahoski and Lodl (2004, p.23) stated that "4-H offers opportunities for having meaningful contact with adults that may not be as prevalent in other out-of-school offerings" where adults are spectators and teachers instead of partners in learning. Horstmeier & Nall (2007a, p. 135) concluded that youth understood the directive roll of adults in their leadership education and "students seemed to see this as a positive, in that, without this form of encouragement they might not have participated." The study assessing the influence of community-based leadership curricula on youth found that youth who completed a *Step Up to Leadership* program "had developed more positive perceptions of their relationships with adults" – from 3.41 pre-survey to 3.68 post-survey (Jones, 2009, p. 257). A study based on high school students in Kentucky "found that males and females who perceived their adult support more positively had more positive perceptions of their [own] leadership skills" (Hancock et al., 2012, p. 84). All four youth-centered studies displayed a positive correlation between quality interactions with adult leaders and perception of their own leadership skills at young people.

Youth Leadership Skill Acquisition

In our study, 11 of the 33 articles displayed research that related to our identified Youth leadership skill acquisition theme. Seven articles were categorized as Primarily associated, and four articles were Secondarily associated to the theme. The articles that aligned with this theme were collected from a wide range of years, and discuss youth leadership skill acquisition, as well as provide outlines for desirable youth leader skills. Although it remains unclear as to which exact leadership traits are most valuable for youth leaders, existing literature in the JOLE exemplify significant frameworks that aid in youth leadership skill acquisition (Bruce et al.,

2006; Real & Harlin, 2006; Rehm et al., 2021; Ricketts et al., 2007). Key leadership skills identified by related articles included personal leadership beliefs, leadership self-efficacy, collaboration, direction-oriented action, independence, and service qualities, among many more (Caputi, 2017; Rehm et al., 2021; Ricketts et al., 2007). Various methods for guiding and enhancing youth leadership skill acquisition were discussed in the articles, with a heavy emphasis on involvement in developmental programs, extracurricular activities, and mentor-mentee relationships (Hoover & Bruce, 2006; Horstmeier & Nall, 2007a; Horstmeier & Nall, 2007b). No clear formula for teaching leadership skills or ensuring skill acquisition is determined, however, existing research attempts to outline successful models.

Community-Based Leadership

In our review of youth leadership literature, we noticed a heavy emphasis on community-based leadership. Five articles (Webster et al., 2006; Jones, 2009; Rosser et al., 2009; Horstmeier & Ricketts, 2009; Harris & Beckert, 2019) were identified to fit within the theme of community-based leadership, which includes studies that involved service learning, civic engagement, training programs, or took place in other community-based contexts. Having community-based experiences provides youth with the opportunity to develop a sense of community connectedness and learn from their peers. Involvement in civic engagement can encourage youth leadership development via community involvement (Horstmeier & Ricketts, 2009; Jones, 2009; Rosser et al., 2009) which can aid in instilling greater confidence in youth and providing a life of continued engagement (Harris & Beckert, 2019). Similarly, service learning has been found to aid in the development of youth leadership skills (Webster et al., 2006).

Emerging Theme: Modeling Youth Leadership Development

While examining the existing literature on youth leadership, we noticed an emergence of studies focused on various ways to model youth leadership. These studies were deemed an emerging theme based on the recency of the existing published literature as well as the novelty of this area of study. Five articles (Ahrens et al., 2015; Seemiller, 2018; Sherif, 2019; Rehm & Selznick, 2019; Hastings & McElravy, 2020) were identified to fall under this emerging theme. Modeling youth leadership is important to the field of leadership education as it provides a more conceptual and thorough understanding of the distinct components within youth leadership development. Seemiller (2018) identified a lack of existing youth leadership development models. Youth leadership development models are an effective tool to assess the effectiveness of youth leadership programs, such as FFA (Ahrens et al., 2015), and can be a resource for measuring youth leader self-efficacy (Rehm & Selznick, 2019). Additionally, by creating models that can predict youth leadership skills based on existing youth development theories and ethics (Sherif, 2019), youth program leaders can alter project outcomes and learning objectives to better support youth leadership development (Hastings & McElravy, 2020). By developing models such as these, we can achieve a better understanding of the needs and demands of youth leadership.

Discussion

The literature regarding the impact of youth leadership programs on youth leadership development shows to be an area of interest in the JOLE. With eight articles having this as the primary theme and four articles having it as the secondary theme, understanding these programs provides an insight into their importance in youth leadership. Earlier studies primarily focused on

4-H and FFA programs by assessing the leadership skills youth gain from these programs. The Walahoski and Lodl (2004) study highlights this with a comparison survey that concludes FFA members have stronger leadership skills than those who were not involved in a FFA program. It also becomes apparent how these specific programs give youth leadership skills that will translate into their adult life and will still be utilized (Hoover & Bruce, 2006). Recent studies continue to assess how 4-H and FFA impact youth leadership development but have started to assess other programs such as the Boys & Girls Clubs and programs created by high schools or the community. Similar conclusions were made about the Boys & Girls Club (Swigert & Boyd, 2010) where alumni were interviewed about their experiences, and it was concluded that this program gave members the chance to grow leaderships skills and seek leadership opportunities as adults. Community leadership programs similarly have positive impacts on youth leadership development by giving opportunities for youth to learn and expand their skills (Buschlen et al., 2018). Overall, these studies show that youth leadership programs have a positive, lasting impact on youth by giving them the opportunity to expand their life skills to grow as leaders.

Adult roles in youth leadership development are inherent as teachers, coaches, counselors, parents, and organization leaders are part of the youth leadership process. The majority of literature in this theme showed a preference for adult self-reported leadership skills and impacts on the youth they work with. The most common conclusions drawn from adult-view of leadership studies included continuous leadership training and education of adults relating to positive outcomes in the youth they teach (Nestor et al., 2006; Brumbaugh & Cater, 2016; Nowak et al., 2019; Voelker et al., 2019) and use of transformational leadership techniques and skills in youth leadership education (Bruce et al., 2006; Greiman & Addington, 2008; Nowak et al., 2019; Windon et al., 2021). These commonalities among the research focused on adult roles in youth leadership leads us to conclude that continuing leadership education for adult leaders along with employment of transformational leadership skills may have the most positive influence on the youth leadership educational process, regardless of type of program. Youth voices in this area were largely in the minority with only four of the twelve articles in this theme utilizing methods which directly gleaned youth impressions of adults' roles in their leadership education. Each of the four youth-centered studies found a positive correlation between adult leader interactions and youth leadership development as well as leadership skill acquisition. Horstmeier and Nall (2007) concluded similarly that students acknowledged the adult's role was as directive, guidance that many youths require during developmental periods. Involvement in community-based leadership activities was also noted as an important part of the youth leadership process where adult involvement was crucial to youth perception of their own skills and abilities (Jones, 2009; Hancock et al., 2012). These conclusions lead us to reiterate the importance of high-quality interactions between youth and adult leaders as well as utilizing continuous leadership education and training for the adult leaders in this process.

As we have discussed much in this review, there exist many ways to promote the acquisition and development of youth leadership skills. However, it is still unclear how to measure our youth's actual level of leadership skill acquisition most effectively. Related literature we collected displayed various ways to measure and model youth leadership skill acquisition such as Leadership Skills Inventory, Multifactor Leadership Questionnaire, and more recently, Leader Self-Efficacy (Bruce et al., 2006; Real & Harlin, 2006; Rehm, 2021). As we continue to provide ways for youth to develop their leadership skills, we must also find ways to measure their

development and ensure skill acquisition. Transformational and transactional leadership frameworks were highlighted as effective among youth by Bruce et al. (2006), but more recent research by Bush et al. (2019), with the Teen Excellence in Leadership Institute, showed that blending the Chickering Model of Identity Development and the 4-H Citizenship framework were impactful and successful at providing youth the leadership skill development opportunities and measuring their status. In the literature reviewed, there are mixed opinions when it comes to modeling and measuring skill acquisition. It seems, though, that leadership development programs and educators are adapting to how the youth learn and how they interact. Research shows that youth's skill development is highly affected by the youth's environment and characteristics of those they interact with (Anderson et al., 2010). Inversely, leadership skill development is not only affected by the environment, but the level of leadership skill development can also affect the leader's environment. Research by Caputi (2017) displayed how a youth's leadership skill acquisition can affect so much including management of bad behavior, academic success, and community involvement. General findings within this theme show that as youth leadership skill acquisition increases, in both quantity and quality, many other aspects benefit.

Community based leadership has been identified as an opportunity for youth to develop skills necessary to be a leader and to foster a sense of connectedness through a common goal, thus its selection as a major theme within this review. Understanding how service learning and community-based endeavors can function in youth populations to foster leadership development can be useful in creating youth leadership program curriculums. Existing literature emphasizes the importance of youth playing a role in decision making in community-based contexts. Webster et al. (2006) found that by allowing youth to take part in the planning, implementation, and evaluation of service-learning projects, a sense of involvement and connectedness within the organization or community can be fostered. Furthermore, adults should encourage youth participation to ensure a reciprocal process (Webster et al., 2006). It is important to provide youth with adequate time and accountability for their leadership experience for community development to be effective (Rosser et al., 2008). A similar study conducted by Jones (2008) concluded that when youth are directly engaged in leadership development opportunities, they have more positive perceptions towards decision making in their communities. A study by Horstmeier and Ricketts (2009) identified that through school-based civic engagement activities, the link between leadership skill acquisition and leadership skill application is created. Harris and Beckert (2019) expand upon this idea by emphasizing that youth can not only emerge as leaders through volunteerism, but also positively impact society by fostering social change. The literature within the theme of community-based leadership demonstrates that providing youth with strong leadership experiences can result in the development of strong communities.

Recent research has identified the need for models of youth leadership to quantify existing research, establishing a common baseline for future researchers. This is an important area as recent literature has indicated a lack of quantifiable results in the realm of youth leadership development. There have been five studies published in this area of interest since 2015. Modeling youth leadership can be very helpful in interpreting research results. For example, Ahrens et al. (2015) used a three-part instrument, which included the Youth Leadership Skills Development Scale (YLLSDS), to evaluate the effectiveness of youth leadership development at the 2012 Arkansas Leadership Conference. Seemiller (2018) created a theoretically grounded

framework for youth leadership competency that was developed by using a meta-analysis of leadership competencies included in a professional preparation framework. Creating frameworks such as these can be helpful in developing youth leadership programs. Similarly, Sherif (2019) created a theoretically grounded conceptual model of youth leadership that involved five major youth leadership domains: cognitive, motivational, affective, behavioral, and ethical. This model can be applied to youth leadership programs targeted at encouraging the learning and practice of leadership. Measuring youth leader self-efficacy is also an important component to youth leadership development. Rehm and Selznick (2019) used an original survey instrument to measure youth leader self-efficacy to create a common youth leadership language and positive leadership experiences for all. Hastings and McElravy (2020) conducted a comparable study to Rehm and Selznick that examined youth leadership skills predictors which can help to make youth leadership development programs more effective. Modeling youth leadership development can help to make consistent methodologies within the field of youth leadership as well as aim to create a common language that ensures continuity amongst all youth leadership research.

Conclusions and Recommendations

It is critical for future research to investigate how youth can be supported through effective leadership education via youth leadership programs, as well as guidance from adults in their communities, to acquire skills necessary to become competent leaders. This literature review included 33 articles on youth leadership development in in journals of leadership education from 2000 to 2021 and found four major themes along with one emerging theme. Articles within these themes emphasized the role of adults in youth leadership, the impact of youth leadership development programs, the acquisition of youth leadership skills, the value of community-based endeavors in developing leaders, and the need for developing succinct youth leadership models. With these themes in mind, youth program developers can provide youth with the necessary opportunities to acquire leadership skills as well as the autonomy to initiate leadership engagement within their community and one another. Additionally, the emerging theme, Modeling youth leadership, can provide an opportunity for researchers to recognize the gap in existing models to quantify youth leadership development and strive to fill this lack of knowledge.

These themes achieve the goals of Priority 1 and 2 of the NLERA by providing recommendations on how leadership development can be presented to youth and providing suggestions on how to create effective youth leadership programs. Specifically, the theme of Youth leadership skill acquisition meets the needs of Priority 1 by providing an understanding of the skills and attributes youth need in order to be effective leaders. The themes Role of adults in youth leadership, Impact of youth leadership development programs, and Community based leadership achieved the goals of Priority 2 by highlighting how youth leadership programs can be effective in providing leadership education to youth as well guiding adults in their role as a youth educator. With these themes and areas of interest in mind, implications were presented for future research and practice within the realm of youth leadership development.

Through this literature review, we determined that future research in this topic may benefit from a more thorough investigation of longevity of leadership skills in alumni of youth leadership programs, as well as an increased focus on the youth perspective of their own leadership development and their perceptions of adult leader interactions. Six of the eight articles in the

theme Impact of youth leadership development programs covered long-term impacts of youth leadership development programs by interviewing alumni of these programs as adults (Bruce et al., 2005; Hoover & Bruce, 2006; Anderson et al., 2010; Swigert & Boyd, 2010; Buschlen et al., 2018; Rosch & Nelson, 2018). While these long-term studies included most of the articles in the theme, the quantification of long-term effects of leadership development of youth as they become adults have yet to be standardized. Further research may be necessary to identify the best fit for the quantification of youth leadership skills translating to adult leadership abilities, as three of the studies utilized semi-structured interviews (Bruce et al., 2005; Hoover & Bruce, 2006; Anderson et al., 2010), one conducted structured interviews (Swigert & Boyd, 2010), one employed transcendental phenomenology and a corresponding interview (Buschlen et al., 2018), and one using a quantitative questionnaire (Rosch & Nelson, 2018). Five of these studies had a sample size of 25 participants or less (Bruce et al., 2005; Hoover & Bruce, 2006; Anderson et al., 2010; Swigert & Boyd, 2010; Buschlen et al., 2018) while the other study had a sample size of 757 (Rosch & Nelson, 2018). The trend among these articles seems to be interview-based inquiry amongst a small number of participants, though questions used in each study were not included in the methodologies and may vary. Further research can help standardize interviews for these long-term studies on leadership skills or may show that the more quantitative approach conducted by Rosch and Nelson (2018) provided clearer conclusions.

Of the twelve articles in the role of adults in youth leadership theme, eight articles (Bruce et al., 2006; Nestor et al., 2006; Greiman & Addington, 2008; Rehm, 2014; Brumbaugh & Cater, 2016; Voelker et al., 2019; Nowak et al., 2019; Windon et al., 2021) utilized the adult view of youth leadership while only four articles (Walahoski & Lodl, 2004; Horstmeier & Nall, 2007; Jones, 2009; Hancock et al., 2012) considered the youth view of their own leadership development. This uneven view of youth leadership which currently focuses on the adult's view of their own abilities to develop youth in their leadership skills may not provide a complete picture of the effectiveness of the programs examined. Future research should include data from both viewpoints, aiming to find correlations between the adult and youth perspective. Our emerging theme of modeling youth leadership development also highlights an area of potential research as identifying quantifiable data with regards to conceptual models of youth leadership is not well covered in existing research.

Moving forward in the practice of developing youth leaders, ample amounts of research discuss the importance and value of youth leadership development programs. These resources should be utilized when deciding which programs and activities are best suited for the targeted youth. Furthermore, research has shown that adults play a vital role in youth leadership development, thus mentors and teachers incorporating leadership development lessons should be aware of their severe impact (Voelker et al., 2019). Leadership mentors should also implore youths to acquire leadership skills at younger ages as it is proven to provide benefits in aspects of success and behavior management (Caputi, 2017). Lastly, much research has shown that involvement in community and extracurricular activities is a great tool in developing leadership skills among youths (Hancock et al., 2012; Harris & Beckert, 2019). Youth should be encouraged to engage in their community via volunteerism, programs, workshops, or other pathways, to fully immerse themselves into situations that help them to develop leadership skills and abilities.

References

Ahrens, C. A., Cox, C. K., Burris, S., & Dykes, M. (2015). Perceived leadership life skills developed through participation at the Arkansas FFA leadership conference: A program evaluation. *Journal of Leadership, 14(*1*)*, 124-141. https://doi.org/10.12806/v14/i1/r8

Andenoro, A. (2013). The National Leadership Education Research Agenda: Strategic priorities and deepened perspectives. *Journal of Leadership Education*, *12(*3*)*, 1-9. https://doi.org/10.12806/v12/i3/c1

Anderson, J., Bruce, J., & Mouton, L. (2010). 4-H made me a leader. *Journal of Leadership Education*, *9(*2*)*, 35–49. https://doi.org/10.12806/v9/i2/rf3

Biondi-Zoccai, G. (2016). *Umbrella reviews: Evidence synthesis with meta-reviews of reviews and meta-epidemiologic studies* (1st ed.). Basel, Switzerland: Springer International Publishing.

Boyd, B. L. (2001). Bringing leadership experiences to inner-city youth. *Journal of Extension*, *39(*4*),* n4.

Bruce, J. A., Boyd, B. L., & Dooley, K. E. (2005). Evaluation of transfer of training and skills learned as state 4-H council members. *Journal of Leadership Education*, *4(*1*),* 51-61. https://doi.org/10.12806/V4/I1/RF1

Bruce, J. A., Webster, N. S., & Sinasky, M. E. (2006). Leadership practices employed by 4-H youth development educators in a northeast State. *Journal of Leadership Education*, *5(*3*)*, 79–92. https://doi.org/10.12806/v5/i3/rf4

Brumbaugh, L. & Cater, M. (2016). The perceived importance of youth educator's confidence in delivering leadership development programming. *Journal of Leadership Education, 15(*1*)*, 1-14. https://doi.org/10.12806/v15/I1/r1

Buschlen, E., Chang, T., & Kniess, D. R. (2018). My brother's keeper: Transcendent leadership lessons learned from an inner-city program for fatherless, adolescent boys. *Journal of Leadership Education*, *17(*3*)*, 1-25. https://doi.org/10.12806/v17/i3/r1

Bush, S., Grove, B., Johnson, J., Seibel, M., & Price, T. (2019). Cultivating innovative teen-leadership programming: Building evidence of impact. *Journal of Leadership Education*, *18(*2*)*, 1-17. https://doi.org/10.12806/v18/i2/r1

Caputi, T. L. (2017). Assessing the possibility of leadership education as psychosocial-based problem behavior prevention for adolescents: A review of the literature. *Journal of Leadership Education*, *16(*1*),* 115–132. https://doi.org/10.12806/v16/i1/t2

Cassel, R. N., & Shafer, A. E. (1961). An experiment in leadership training. *The Journal of Psychology*, *51(*2*)*, 299-305.

Cavagnaro, E., & van der Zande, I. S. (2021). Reflecting on responsible leadership in the context of higher education. *Journal of Leadership Education*, *20*(3*)*.

Cline, L. L. (2021). What does industry really want? Understanding the desirable follower characteristics for entry level positions in agriculture. *Journal of Leadership Education*, *20(*3*).*

Coleman, B. M., Orsini, J., Bunch, J. C., & Greenhaw, L. L. (2021). Student's application of team leadership in an undergraduate agricultural leadership course when learning experientially. *Journal of Leadership Education*, *20(*2*).*

Edelman, A., Gill, P., Comerford, K., Larson, M., & Hare, R. (2004). Youth development & youth leadership. A background paper. *Institute for Educational Leadership*.

Greiman, B. & Addington, L. (2008). Youth leadership development self-efficacy: An exploratory study involving a new construct. *Journal of Leadership Education*, 7*(1)*, 1-23. https://doi.org/10.12806/V7/I1/RF1

Grenwelge, C., Zhang, D., & Landmark, L. (2010). Comprehensive leadership training for youth with disabilities: A new and improved youth leadership forum model. *Teaching Exceptional Children*, *42(*4*),* 62-68.

Hancock, D., Dyk, P. H., & Jones, K. (2012). Adolescent involvement in extracurricular activities. *Journal of Leadership Education*, *11(*1*),* 84–101. https://doi.org/10.12806/v11/i1/rf5

Harris, A. & Beckert, T. E. (2019). Leadership emergence through volunteerism: A case study of late adolescent exemplars. *Journal of Leadership Education*, *18(*2*),* 110-125. https://doi.org/10.12806/v18/i2/r9

Hastings, L. J. & McElravy, L. J. (2020). Further examination of youth leadership skills predicators. *Journal of Leadership Education*, *19*(1), 99-118. https://doi.org/10.12806/V19/I1/R4

Hennessy, E.A., Johnson, B.T., & Keenan, C. (2019). Best practice guidelines and essential methodological steps to conduct rigorous and systematic meta-reviews. *Appl Psychol Health Well-Being*, *11*(1), 353-381. https://doi.org/10.1111/aphw.12169

Horstmeier, R. P. & Nall, M. A. (2007a). Rural FFA leadership: Understanding members' role and the context of chapter activities. *Journal of Leadership Education*, *6*(1), 127–140. https://doi.org/10.12806/v6/i1/rf6

Horstmeier, R. P. & Nall, M. A. (2007b). Youth leadership development. *Journal of Leadership Education*, *6*(1), 141–157. https://doi.org/10.12806/v6/i1/rf7

Horstmeier, R. P. & Ricketts, K. G. (2009). Youth leadership development through school-Based civic engagement activities: A case study. *Journal of Leadership Education*, *8*(2), 238-253. https://doi.org/10.12806/V8/I2/RF8

Hoover, T. S. & Bruce, J. A. (2006). Contributions to the development of state FFA officers. *Journal of Leadership Education*, *5*(3), 111–127. https://doi.org/10.12806/v5/i3/rf6

Hynes, K., Feldhusen, J. F., & Richardson, W. B. (1978). Application of a three-stage model of instruction to youth leadership training. *Journal of Applied Psychology*, *63*(5), 623.

Jones, K. R. (2009). Influences of youth leadership within a community-based context. *Journal of Leadership Education*, *7*(3), 246-264. https://doi.org/10.12806/v7/i3/rf9

Journal of Leadership Education Theory, Research & Application. (2021). *Journal of Leadership Education*.

Kovar, K. A., & Ball, A. L. (2013). Two decades of agricultural literacy research: A synthesis of the literature. *Journal of Agricultural Education*, *54*(1), 167-178.Kress, C. A. (2006). Youth leadership and youth development: Connections and questions. *New Directions for Youth Development*, *2006*(109), 45-56.

Mortensen, J., Lichty, L., Foster-Fishman, P., Harfst, S., Hockin, S., Warsinske, K., & Abdullah, K. (2014). Leadership through a youth lens: Understanding youth conceptualizations of leadership. *Journal of Community Psychology*, *42*(4), 447-462.

Murphy, S. E., & Johnson, S. K. (2011). The benefits of a long-lens approach to leader development: Understanding the seeds of leadership. *The Leadership Quarterly*, *22*(3), 459-470.

Nestor, P., McKee, R. K., & Culp III, K. (2006). Core competencies for 4-H volunteer leaders differentiated by occupation, level of education, and college major: Implications for

leadership education. *Journal of Leadership Education*, *5*(1), 26-38. https://doi.org/10.12806/v5/i1/ab2

Ngai, N. P., Cheung, C. K., Ngai, S. S. Y., & To, S. M. (2012). Youth leadership training in Hong Kong: current developments and the way ahead. *International Journal of Adolescence and Youth*, *17*(2-3), 165-179.

Nowak, Z., Pavelock, D., Ullrich, D. R., & Wolfskill, L. A. (2019). Leadership styles of successful FFA advisors and FFA programs. *Journal of Leadership Education*, *18*(1), 45-67. https://doi.org/10.12806/v18/i1/r4

Real, L. A. & Harlin, J. F. (2006). Development of youth leadership life skills of Texas youth as San Antonio Livestock Exposition school tour guides. *Journal of Leadership Education*, *5*(1), 39–53. https://doi.org/10.12806/v5/i1/rf3

Rehm, C. (2014). An evidence-based practitioner's model for adolescent leadership development. Journal of Leadership Education, *13*(3), 83-97. https://doi.org/10.12806/v13/13/t1

Rehm, C. & Selznick, B. (2019). Measuring leader self-efficacy among youth. *Journal of Leadership Education*, *18*(2), 52-64. https://doi.org/10.12806/v18/i2/r4

Rehm, C., Selznick, B., & Divona, K. (2021). Impacting youth leader self-efficacy. *Journal of Leadership Education*, *20*(3), 89-103. https://doi.org/10.12806/V20/I3/R5

Ricketts, J. C., & Rudd, R. D. (2002). A comprehensive leadership education model to train, teach, and develop leadership in youth. *Journal of Career and Technical Education*, *19*(1), 7-17.

Ricketts, J. C., & Rudd, R. D. (2005). Critical thinking skills of selected youth leaders: The efficacy of critical thinking dispositions, leadership, and academic performance. *Journal of Agricultural Education*, *46*(1), 32-43.

Ricketts, J. C., Priest, K., & Lastly, B. (2007). Student leadership practices of Georgia FFA success conference participants. *Journal of Leadership Education*, *6*(1), 158–173. https://doi.org/10.12806/v6/i1/rf8

Roberts, T. G., Harder, A., & Brashears, M. T. (2016). American Association for Agricultural Education national research agenda: 2016-2020. Gainesville, FL: Department of Agricultural Education and Communication

Rosch, D. M. & Nelson, N. E. (2018). The differential effects of high school and collegiate student organization involvement on adolescent leader development. *Journal of Leadership Education*, *17*(4), 1-16. https://doi.org/10.12806/v17/i4/r1

Rosser, M., Stedman, N., Elbert, C., & Rutherford, T. (2009). Making a difference: Two case studies describing the impact of a capstone leadership education experience provided through a national youth leadership training program. *Journal of Leadership Education*, *7*(3), 83-99. https://doi.org/10.12806/v7/i3/rf1

Seemiller, C. (2018). A competency-based model for youth leadership development. *Journal of Leadership Education*, *17*(1), 56-72. https://doi.org/10.12806/v17/I1/r1

Seevers, B. S., Dormody, T. J., & Clason, D. L. (1995). Developing a scale to research and evaluate youth leadership life skills development. *Journal of Agricultural Education*, *36*(2), 28-34.

Sherif, V. (2019). Modeling youth leadership: An integration of personality development theories and ethics. *Journal of Leadership Education*, *18*(2), 1-15. https://doi.org/10.12806/v18/i2/t2

Som, S., Burman, R. R., Sharma, J. P., Padaria, R. N., Paul, S., & Singh, A. K. (2018). Attracting and retaining youth in agriculture: challenges and prospects. *Journal of Community Mobilization and Sustainable Development*, *13*(3), 385-395.

Swigert, T. & Boyd, B. (2010). The impact of Boys & Girls Club/Keystone Club participation on alumni. J*ournal of Leadership Education*, *9*(1), 69-86. https://doi.org/10.12806/v9/i1/rf5

Van Velsor, E., & Wright, J. (2012). Expanding the leadership equation: Developing next-generation leaders. A White Paper. *Center for Creative Leadership (NJ1)*.

Voelker, D. K., Martin, E. M., Blanton, J. E., & Gould, D. (2019). Views and practices of high school coaches on the education and training of team captains in leadership. *Journal of Leadership Education*, *18*(2), 181-196. https://doi.org/10.12806/v18/i2/r2

Walahoski, J. & Lodl, K. (2004). Out-of-school programming: Assessing the impact on asset development in young people. *Journal of Leadership Education*, *3*(1), 17-26.

Webster, N., Bruce, J. A., & Hoover, T. S. (2006). Understanding the perceptions of service learning with teen leaders. *Journal of Leadership Education*, *5*(1), 26-38. https://doi.org/10.12806/V5/I1/RF2

Wells, T., Matthews, J., Caudle, L., Lunceford, C., Clement, B., & Anderson, R. (2015). The infusion of inquiry-based learning into School-Based Agricultural Education: A review of literature. *Journal of Agricultural Education*, *56*(4), 169-181.

Windon, S., Stollar, M., & Radhakrishna, R. (2021). Assessing leadership development needs of 4-H volunteer leaders. *Journal of Leadership Education*, *20*(2), 127-146. https://doi.org/10.12806/v20/i2

Professional Development Needs of CTE Teachers in Idaho: A Literature Review

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Abstract
Career and Technical Education programs are pipelines for preparing students with skills for higher education and career readiness. With the inception of the Morrill Act of 1862, CTE as we know it today, has existed for more than 160 years. The purpose of this research was to review the existing literature related to CTE and CTE PD found in academic databases, books, dissertations, papers, and government reports. A synthesis of empirical manuscripts was completed. This literary review examined 80 articles and found overarching themes related to CTE and CTE PD. The themes are CTE characteristics, CTE PD, digital world/Generation Z students, college/career readiness, traditional/alternative certification, teacher community, laboratory safety, and administration.

Introduction

Technical training dates to ancient times. Evidence of technical training occurred when Noah was given detailed instructions for building an ark in Genesis 6:15-16 (English Standard Version Bible, 2016). Graduate students nearly 4,500 years later used the Archimedes principle to conclude that the ark would have had sufficient buoyancy to safely support the mass of animals (Youle et al., 2013; Bishop, 2020). As it was in ancient times, technical training continues to be essential and is currently known as Career and Technical Education (CTE).

CTE created a new path for education in the United States. The first American colleges were based on the English university model where the classics were studied (Seevers et al., 2007). However, engineers were needed to deal with practical problems of plant layout, machine design, and machine parts, but the traditional colleges prepared students for law, medicine, teaching, and the ministry (Gordon, 2014). Responding to the deficiency of industrial training Representative Justin Morrill of Vermont introduced what was known as the land-grant bill to Congress in 1857 (Seevers et al., 2007). The Morrill Act established land-grant universities and was passed by Congress and signed by President Abraham Lincoln into U.S. law in 1862 (Seevers et al., 2007). The land-grant bill donated federal land to each state and territory for an endowment to establish one college in each state to teach not only scientific and classical studies, but also agriculture, mechanic arts, and military tactics (Seevers et al., 2007; Gordon, 2014). As a result, CTE evolved to provide open educational systems that addressed employment needs (Gordon, 2014).

CTE has been identified as industrial education, manual education, career education, and was once named vocational education (Malkus, 2019; Hodge et al., 2020). CTE educators are a catalyst for preparing the next generation of high-skilled employees for the workforce. Delivering technical training will continue to be an important responsibility to serve society.

Significance

CTE programs need to update and evolve as technology, industry, and student characteristics evolve to ensure students are equipped to perform the skills needed in a career. The global population is projected to exceed nine billion by 2050 and may peak at more than 11 billion by the end of the century creating significant challenges to produce sufficient food, feed, fiber, and biofuel feedstock (Food and Agriculture Organization of The United Nations, 2017). Historically, CTE has been an evolving and adaptable educational delivery system and will continue to need to evolve with industry. Unprecedented challenges exist to fill open U.S. jobs across the country as there are more job openings than unemployed workers (Ferguson, 2022).

Over the next decade, on average, an expected 17,500 openings for CTE teachers are projected each year (U.S. Bureau of Labor Statistics, 2022). The National FFA Organization (2017) identified the shortage of qualified teachers as being the greatest challenge facing agricultural education. Moreover, Zirkle et al. (2019) determined there has been a national trend for teachers across all disciplines to leave the teaching profession for a variety of different reasons.

Evaluating the current PD needs of CTE professionals is imperative. There is a national focus on teachers leaving the profession, a growing population in need of food and fiber, workforce demands of high-skilled employees, attention to alternative vs. traditional certified teachers, and an evolving digital world. Evaluating current CTE teachers' PD needs is essential to help inform and guide future in-service learning activities to equip teachers for success in the profession.

Purpose and Research Objectives

The purpose of this article was to synthesize the literature related to CTE PD needs. Two objectives guided this study:

1. Examine the literature for CTE PD.
2. Determine common categories and themes across the literature.

Findings will be used to develop the framework to determine current PD needs for CTE educators.

Research Methodology

A synthesis of literature was conducted to accomplish the research objectives. Oosterwyk et al. (2019) determined there are five stages of syntheses: (1) define protocol, (2) search the literature, (3) select the papers, (4) analyze, synthesize, and interpret, and (5) write the review.

The Search Process

To ensure the rigor and reliability of the literature search, an adaptation of the Oosterwyk et al. (2019) guidelines was identified and served as a guide to locate relevant literature for this study.

Table 1

Synthesis of Literature Guidelines (Oosterwyk et al., 2019)

Major Stages	Activities
Define the protocol	• Agree on a detailed procedure • Specify primary goal • Define key concepts • Establish boundaries • Draft the research objectives • Specify type of review • Specify disposition
Search the literature	• Specify where to search • Identify the main sources • Specify terms to use • Specify dimensions to search • Specify timespan • Restrict search within bounds of research question • Minimize publication bias • Perform backward and forward search
Select the papers	• Specify inclusion/exclusion criteria • Review Title, Abstract, Keywords and apply screen (inclusion/exclusion criteria) • Review Introduction and Conclusion and apply screen • Review full papers for relevance, rigor, and credibility
Analyze, synthesize, and interpret	• Select and apply appropriate method
Write the review	• Specify structural elements • Consider presentation

The academic research databases, Educational Resources Information Center (ERIC) and Google Scholar were chosen for the literature search as they provide a broad range of publications. When using the ERIC database, the criteria was set to peer-reviewed only and full text within the last 12 years. The timeline criteria of 12 years was established to target CTE PD changes since a similar study was conducted by Cannon et al. (2010). Data that was published within this timespan was used, except for historical references, and references that included established methodological models found in the literature. Backward literature chaining of references led to 10 articles published before 2010 that provided information important to addressing trends in PD and CTE.

Additional databases searched include the *Journal of Career and Technical Education, Journal of Research in Technical Careers, Journal of Agricultural Education, Journal of Teacher Education, International Journal of Vocational and Technical Education, Journal of Teaching and Learning with Technology,* and *Career and Technical Education Research.* These journals were selected as they were peer-reviewed and frequently cited in CTE PD literature. The following keywords were used in the search: "(state) CTE Teacher PD," "Teacher PD," "Journal

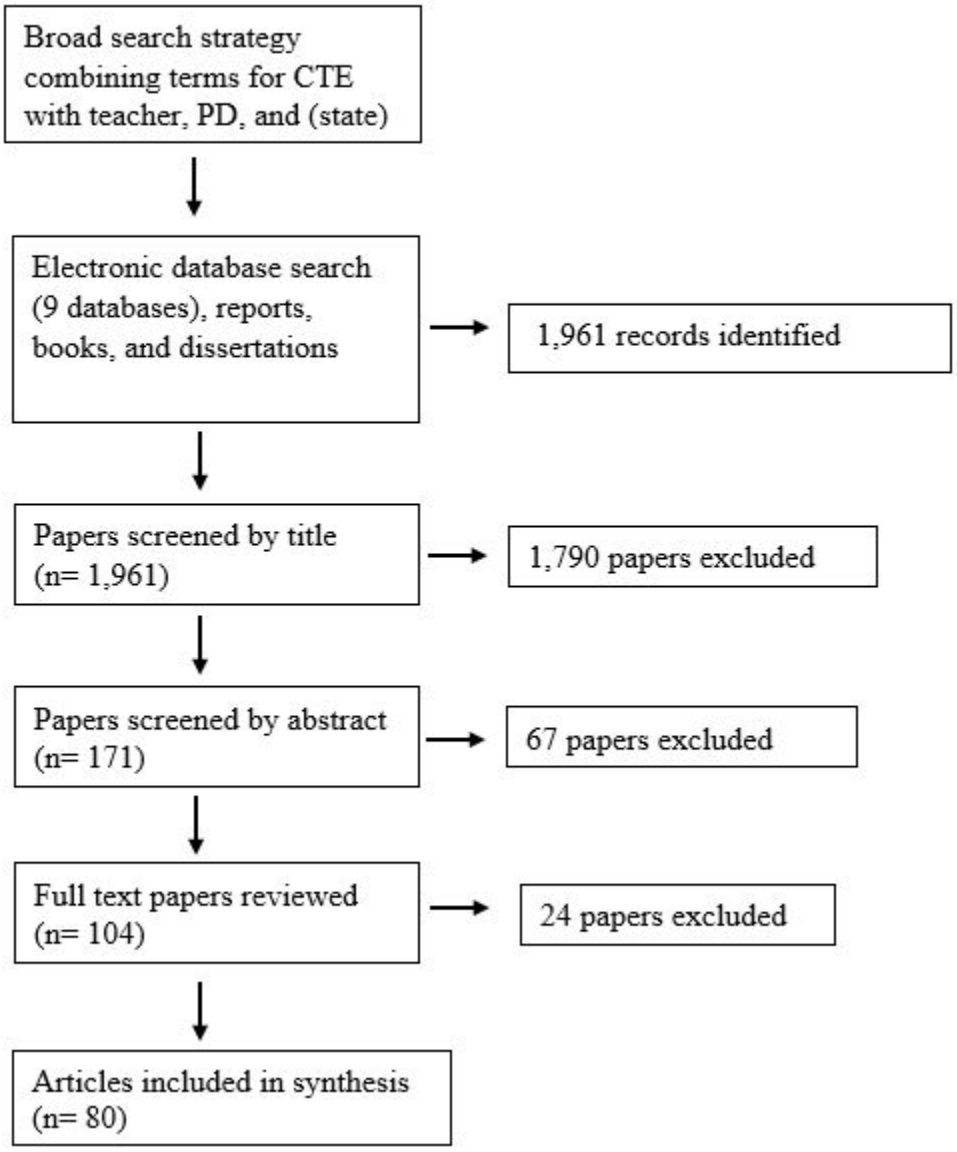
of Teacher Education CTE," "History of Career Technical Education," "CTE PD," and "CTE Teacher PD."

Article titles and abstracts were reviewed and if the articles did not clearly pertain to CTE or CTE PD, they were excluded from the study. Most of the literature focused on agricultural education. Cannon et al. (2010) determined few studies have been conducted to determine teacher in-service needs in CTE content areas other than agricultural education. Experiences and PD needs of agricultural education CTE teachers are unique, they have numerous professional responsibilities that require them to manage the total program, such as developing engaging learning activities in the classroom and laboratory, program budgeting, occupational analysis and curriculum development, supervising career and technical student organizations (CTSOs), developing a recruitment and public relations plan, and other associated CTE activities (Cannon et al., 2013).

The search was conducted from March 2022 to August 2022. In total, 1,961 publications (2010-2022) were identified from academic databases, journals, government databases, dissertations, and books. The researcher included current government and industry reports, papers, dissertations, and books in the synthesis of the literature to provide a broad context regarding CTE and how CTE programs relate to society and industry. All electronic articles identified were exported to the Zotero database manager for screening and reference. There were 1,881 articles excluded during the literature review process based on the eligibility criteria. The screening process resulted in 80 publications for the final analysis.

Figure 1

Process of study selection (adapted from Page et al., 2021)



Eligibility Criteria

First, only manuscripts published in academic journals, textbooks, dissertations, government and scientific reports, and academic papers were included. Second, only publications focusing on CTE and PD in the United States were included. This choice was made because of the urgency to evaluate CTE programs in the region and focus on their unique needs. Third, there was no time restriction, however, if a database search would allow for a time parameter, the time selection was between 2010-2022. Fourth, only empirical manuscripts that included evidence-based data were included. The focus was on current needs in programs versus conceptual ideas and theory-building.

Methodological Quality

First, the abstracts were read as an initial review, allowing the researcher to identify the purpose of the study, the participant characteristics, and the results of the study. Then, if the data applied to CTE and CTE PD, the article went into a general concept matrix. Finally, categories of concepts were identified and provided the themes for the findings (Greiman, 2009). Many of the manuscripts reported similar information providing the researcher with repetitive sources. Some manuscripts could have had overlapping themes that were not applied to multiple themes during the coding process. For example, if an article mentioned PD theories but focused more on administration, the article was counted in the administration category.

Triangulation of the manuscripts established the credibility of the study. By triangulating the findings, it is possible to identify common themes in studies, giving the user more confidence in applying the resulting evidence (Corder & Irlbeck, 2018). Additionally, triangulation of studies using different methods to address the same question gives greater confidence that the results obtained are not simply due to the repetition of biases and limitations in design, methods, or analyses (Johnston et al., 2021). Detailed records of descriptions of the findings, reflective notes, and coding records were archived to provide dependability and confirmability.

Findings

The researcher begins with the history and evolution of CTE, followed by current CTE programs, and then identifies the eight categories or themes that emerged from the literature. Recommendations for future research are outlined based on the findings.

In total, 1,961 publications from 2010-2022 were identified from academic databases, journals, government databases, dissertations, industry reports, and books. There were 1,881 articles excluded during the literature review process. The screening process resulted in 80 publications for the final analysis.

Table 2

Publication outlets (26 Journals, 14 reports, 6 books, 1 dissertation)

Journal Title	Number of articles
Journal of Agricultural Education	19
Journal of Research in Technical Careers	6
Career and Technical Education Research	5
Journal of Career and Technical Education	3
International Journal of Vocational and Technical Education	2
Journal of Research on Technology in Education	2
Teaching and Teacher Education	2
Phi Delta Kappan	2
Journal of Physics Special Topics	1
Journal of Vocational and Technical Careers	1
The Researcher	1
Journal of Research in Science Teaching	1
Journal of Teaching and Learning with Technology	1
Online Journal of Workforce Education and Development	1
Journal of Teacher Education	1
Journal of the Scholarship of Teaching and Learning	1
Peabody Journal of Education	1
Computer & Education	1
Computers in School	1
Journal of Empowering Teacher Excellence	1
Science World: Future Science Leaders	1
Educational Researcher	1
Journal of STEM Teacher Education	1
Scientific Reports	1
LEARNing Landscapes	1
eSTEAMED Journal	1
Report Title	**Numbers of articles**
U.S. Bureau of Labor	1
An investigation of State Educational Twitter Hashtags (SETHs) as affinity spaces	1
National Research Council	1
The Evolution of CTE	1
Secondary career and technical education activity in 2021	1
Idaho Division of Career and Technical Education	1
Essential facts about the video game industry	1
Food and Agriculture Organization (FAO)	1
Understanding America's labor shortage	1
Reauthorization of the Perkins Act in the 115th Congress: The Strengthening Career and Technical Education for the 21st Century Act	1

Landscape of CTE Leaders	1
Tracking and the Future of Career and Technical Education: How Efforts to Connect School and Work Can Avoid the Past Mistakes of Vocational Education	1
National FFA Organization	1
Standard Quality Assessment Criteria for Evaluating Primary Research Papers From a Variety of Fields	1

Book Title	Number of articles
Teaching Your Occupation to Others: A Guide to Surviving the First Year	1
Generation Z Unfiltered: Facing Nine Hidden Challenges of the Most Anxious Population	1
Leadership for Learning: How to Help Teachers Succeed	1
The History and Growth of Career and Technical Education in America	1
Education through cooperative extension	1
Education through cooperative extension (Second edition)	1

Dissertation	Number of articles
Characteristics of high-quality CTE teachers	1

Note. Coder & Irlbec (2018), Page (2021), Greiman (2009), Oosterwyk (2019), Johnston (2021), focus on reference methodologies and were not included in the publication outlet table.

Research Objective One: Examine the literature for CTE PD

Literature was examined in the area of CTE PD. CTE program areas available in (state) are Agriculture, Food and Natural Resources, Business and Marketing Education, Engineering and Technology Education, Family and Consumer Sciences and Human Services, Health Professions and Public Safety, Middle School: First Steps, Individualized Occupational Training, and Trades and Industry (The (state) Division of Career and Technical Education, 2022). Not all states require CTE administrator certification, but the state of (state) does require CTE administrator certification, and formal CTE administrator training is available after certification (Conrad & Watkins, 2021).

The Carl D. Perkins Career and Technical Education Act (Perkins Act) is a federal law and legislative initiative that supports the development and improvement of CTE programs at the secondary and postsecondary educational levels (Fletcher & Tyson, 2017; Granovskiy, 2018). CTE continues to be viewed as necessary and important, the Perkins Act was reauthorized again, through the Strengthening Career and Technical Education for the 21st Century Act (Perkins V; P.L. 115-224) and went into effect July 1, 2019. Under Perkins V, states are allowed to reserve 5% more of their allocation for CTE programs in rural areas or areas with high numbers of CTE students, or for innovative CTE programs (Granovskiy, 2018).

Additionally, Perkins V more clearly defines the purpose of CTE to include academic knowledge, and has added the need for employability skills (Valentine & Kosloski, 2021). After the reauthorization of Perkins in 2006, there was a call to administrators and teachers to improve and modernize CTE programs and align workforce skills to the labor market (Bird & Rice, 2021)

Ferguson (2018) offered that policymakers, business leaders, educators, and parents seemed to agree that value was apparent in both academic knowledge and career preparation in schools. Keily (2021) reviewed 2021 legislative activity concerning secondary CTE and found an increase in attention from policymakers. Lawmakers in 46 states introduced at least 315 bills concerning CTE in 2021 (Keily, 2021).

Research Objective Two: Determine common categories and themes within the data
Common categories and themes emerged through the synthesis of the literature on CTE PD. The topics that emerged were classified into themes in eight broad categories: CTE characteristics, CTE PD, digital world/Generation Z students, college/career readiness, traditional/alternative certification, teacher community, laboratory safety, and administrator support.

CTE Teacher PD
PD is an integral component of teacher growth and is important for improving the quality of CTE education in U.S. schools (Desimone, 2011). The understanding that CTE curriculum needs to be fluid and change over time is not a new concept. Foster (1997) argued that for the U.S. to remain globally competitive, employees need to change to meet industry demands. Providing teachers with up-to-date knowledge and skills that align with industry will help equip students for employment.

Conrad and Watkins (2021) found the power of CTE programs rested in the strength of the teachers and administrators working to provide quality CTE for students. PD is important for improvement. Staff development lies at the heart of educational efforts to improve student achievement (Supovitz & Turner, 2000). Without frequent updates and training, any employee can become outdated and unable to provide recommendations for current practices (Seevers et al., 1997).

CTE teachers have numerous professional responsibilities including developing engaging learning activities in the classroom and laboratory, program budgeting, occupational analysis and curriculum development, supervising CTE organizations, developing recruitment, and public relations plans (Cannon et al., 2013) and one of the most critical areas of concern for the new teacher of vocational subjects is safety (Bott, 1998).

CTE Teacher PD Needs
PD is an influential factor in student learning and has elements that provide an overarching context for instructional improvement (Glickmen, 2002). Arnett-Hartwick and Cannon (2020) determined that pre-service and beginning technical education teachers benefit from professional organizations where they can network and 'bounce' ideas off each other, share lessons or projects, and seek or give advice. A sense of community is noted in the literature as an important factor in evaluating student persistence and success within postsecondary Agriculture, Food, and Natural Resources education degree programs (McKim et al., 2018). Moreover, a sense of community is beneficial for educators– deliberate efforts to incorporate opportunities for new teachers to network with other teachers are needed as a part of the PD program (Westfall-Rudd, 2011; Easterly & Myers, 2017). One of the most profound findings of McKendree and McKim's (2021) analysis of PD of teachers was how participatory PD challenged teachers in new and exciting ways. An opportunity to utilize their expertise, coupled with a desire for peer learning,

teachers learned from each other and changed their own perspectives of school-based agriculture education (McKendree & McKim, 2021).

Williams (2019) discovered when CTE teachers were asked to rank the importance of PD activities, 54.8% ranked "collaborating with experts in their CTE program area" as being the most important PD activity. Fletcher and Tyson (2017) recommended that business and industry partners play a stronger role in the development of curricula, preparation, and training of both students and teachers, and work-based learning experiences (i.e., internships, job shadowing, mentoring) of students as a strategy to solve some of the skills-gap reported in recent literature.

In a study of 181 secondary skilled and technical teachers, Cannon et al., (2010) determined CTE teachers viewed three of the top five perceived in-service needs as follows:

- developing curriculum-based school-to-work and/or school-to-career activities;
- establishing and organizing co-op/internships, and
  providing guidance and career exploration activities to students (Cannon et al., 2010).

In a follow-up study, Cannon et al., (2012) found that school superintendents had similar perceptions as teachers, with the top priorities being:

- developing curriculum-based school-to-work and school-to-career activities; and
- providing guidance and career exploration activities to students.

PD can improve teacher competence in the laboratory where safety and liability are a concern for CTE teachers. CTE teachers whose instructional practices occur in a laboratory are most vulnerable to liability issues and should take proactive measures to reduce risk (Wells & Hainline, 2021; Saucier et al., 2014). Saucier and McKim (2011) recommended agricultural mechanics coursework be integrated into teacher preparation in agricultural education programs and focus on areas related to laboratory and equipment maintenance and laboratory safety.

PD needs of teachers vary. Lieberman and Pointer Mace (2008) concluded that in most schools teachers were given a "one size fits all" set of PD workshops and called for reform to collaborative teacher communities. PD needs of agriculture teachers at the beginning of their careers differ from experienced teachers regarding their PD needs (Sorenson et al., 2014).

Support from school administrators is important for CTE programs. Cannon et al. (2013) determined that school principals serve as instructional leaders and have the responsibility to determine the training needs of CTE teachers and, input from principals and other stakeholders is foundational for CTE in-service planning. An advisory board that includes guidance counselors, administrators, other school counterparts, parents, and community employers can be established to align curriculum to workforce needs, creating a prime opportunity to educate and promote CTE programs to these stakeholders (Arnett-Hartwick & Cannon, 2019). Mundt and Connors (1999) evaluated a population of National Vocational Agricultural Teachers Association Outstanding Young Member Award winners and determined building the support of faculty,

counselors, and administrators within the school system was among the top four of their problems and challenges.
Additionally, administrative support can help with teacher retention. Hasselquist and Graves (2020) identified that school administrative support influenced teachers' job satisfaction and sense of worth, and encouraged teachers to remain in the profession, while unclear administrative expectations were noted as a reason for changing careers.

Several factors were identified in the literature related to teacher retention such as administrative, financial, collegial, and community support as well as teacher empowerment. Hasselquist and Graves (2020) found new insight regarding mid-career CTE teachers. The key experience for this group was the setting of boundaries and saying no to non-essential activities and opportunities, allowing them to establish priorities (Hasselquist & Graves, 2020).

Cannon et al. (2010) determined that limited studies have been conducted on teacher in-service needs in CTE content areas other than agricultural education. A few studies conducted on the teacher in-service needs of CTE programs in the areas of business/marketing, food, and technology emerged and their in-service needs compared to the needs in agricultural programs. Koundinya and Martin (2010) identified food safety as a critical PD area for CTE teachers reaching beyond the classroom with implications for international trade and public health. Kitchel et al. (2009) determined that business/marketing CTE teachers' in-service priorities were as follows:

- co-op/internship management;
- developing curriculum-based school-to-work/career activities;
- obtaining external funding; and
- public relations as top in-service priorities.

Arnett-Hartwick and Cannon (2019) found when evaluating novice and veteran teachers that PD was recognized as a problem area for technology education teachers because the PD needs of these teacher groups vary.

CTE College/Career Ready
Stone (2017) offered that as a nation, the US cannot compete with less developed nations on labor costs, so it must compete on the quality of goods and services produced. This market position requires a highly skilled workforce with a range of mid-level trade, technical, and professional skills as well as high-level skills, usually associated with a university education (Stone, 2017). State CTE administrators, university teacher educators, and educational professionals need to provide timely learning opportunities to meet the PD demand of CTE teachers. CTE programs are tasked with ensuring students are college and/or career-ready. Ames (2022) determined that CTE programs prepare students for careers without reducing college readiness.

Student career and college readiness and placement is a focus area in CTE literature. Stone (2017) reported middle-skill occupations represented viable career pathways; between 19%-30% of expected openings will require some level of postsecondary education, including community college degrees, diplomas, certificates, and other forms of formal and nonformal education and

training for entry (e.g., registered nurse). Alston et al. (2020) noted that it is critical to attract high-caliber CTE students who can navigate complex issues and problems. Bartholomew (2014) highlighted creativity, problem-solving, manual dexterity, and spatial perception as some of the positive skills gained by students benefiting from hands-on learning in CTE courses that will translate to the workplace.

Perceptions of college readiness and participation of CTE students vary among college professors. Community college faculty acknowledge the benefit of CTE programs as a path to prepare students for industry-required competencies, but they also offer that CTE programs must support students social and emotional development, providing an equitable education to promote life-long learning, sustainable employment, and growth (Gauthier, 2021). Relative to college prep students, CTE students were significantly less likely to transfer to a four-year college, but significantly more likely to earn either an associate degree or a certificate without transferring (Dietrich et al., 2017).

Lambeth et al. (2018) determined the CTE National Agenda needed revision since its inception in 2008 to reflect the contemporary issues and policies for the CTE profession, and that research and scholarship in academia conducted by professors should reflect focused and directed inquiry into the needs of CTE. Through collaborations with university faculty, secondary teachers, and state CTE administrators; research has shown continuing PD education can drive programs to be relevant and stay abreast as industry changes (Webb et al., 2019 & Cannon et al., 2012).

University faculty are influential. Miller and Mills (2019) found that faculty who were seen as caring made an impact on student engagement. The faculty who were seen as most caring were described as using humor, bringing in relatable examples, and interacting regularly with students (Miller & Mills, 2019). Cooperative land-grant university systems are examples of how knowledge and skills are disseminated from university faculty to the people. Similarly, the research and scholarship from the university faculty is disseminated to CTE professionals at the secondary level through PD.

PD needs are hierarchical and faculty PD is also important. Foor and Cano (2011) determined that faculty also benefit from PD. Ultimately, personal growth and satisfaction is the best predictor of a faculty member's level of overall job satisfaction (Foor & Cano, 2011).

Traditional and Alternative Certification

Traditional certification involves teacher preparation through a professional educational teacher preparation program, such as a university. Alternative certification is defined as teacher preparation through emergency certification, temporary certification, work-based programs, and structured university and/or private providers of alternatively labeled certification pathways (National Research Council, 2010).

Traditionally and alternatively certified CTE teachers may have different PD needs. Ritz et al. (2013) offered that some school districts employ teachers who lack proper certification due to a shortage of teacher education program graduates who decide to pursue a teaching career. Nearly a decade later the same phenomenon is occurring. A nationwide teacher shortage is causing an increase in practicing teachers with alternative certification causing diverse PD needs among

alternative and traditionally certified teachers (Coleman et al., 2020; Stair et al., 2019; Smalley et al., 2019).

Bowling and Ball (2018) determined that research in education broadly indicated a lack of consistency within the current alternative certification pathways and a lack of consistent/positive influence on student outcomes within alternatively certified teachers. Kerna (2012) determined that CTE instructors have the industry experience and in-depth content knowledge that was critical in the vocational classroom, but they were missing basic knowledge of pedagogical theory. Duncan et al. (2013) determined that the pedagogical means of educating students in CTE programs has drastically changed during the last century due to the variation in traditionally and alternatively certified teachers.

Duncan et al. (2013) found that traditionally certified business teachers, marketing teachers, family and consumer science teachers, health professions teachers, technology education teachers, and trade and industry teachers had higher perceived levels of self-efficacy for all areas examined except, "use of non-computer technology in teaching." The researchers identified the reasoning for this could be alternatively certified teachers have more industry and career experience (Duncan et al., 2013). Alternatively certified agriculture teachers may have additional training needs. Touchstone (2015) revealed that alternatively certified agriculture teachers have higher needs for skills in FFA, SAE, classroom management, and curriculum development.

Digital World/Generation Z

Mohr and Mohr (2017) described Generation Z students as digital natives, who were born between 1995-2010. Understanding generational shifts in student characteristics is a key component of effective PD. Generation Z students require creative approaches that combine social interactions, technology, and assignments that simulate real-life work situations or are community outreach projects (Mohr & Mohr, 2017). Elmore and McPeak (2019) offered Generation Z students need to be taught differently than past generations, mere verbal instruction may not only be redundant but disengaging to today's 'screenagers'. Elmore and McPeak (2019) noted that educators should incentivize learning by giving students the opportunity to solve real problems and serve real people.

Bunch et al. (2014) compared the effectiveness of lecture and discussion teaching methods and digital game-based learning on student achievement in agriculture and mathematics. The researchers found that using a game intended for learning did not diminish student achievement. They recommended providing prolonged and sustained PD opportunities for teachers to learn how to use a digital game-based delivery method effectively to increase student achievement in agriculture and mathematics (Bunch et al., 2014). Games have always been a part of human culture and now digital games are used by two-thirds of Americans- people of all ages, races, genders, and backgrounds (Entertainment Software Association, 2022). Content in a digital platform is an accepted and familiar platform for Generation Z students.

After evaluating smartphone availability and usage by agricultural teachers, Smith et al. (2018) determined PD opportunities provided by teachers who integrate technology successfully, can provide an opportunity to help teachers accept and use technology in their curriculum.

Integrating online videos in the classroom is educationally beneficial and engaging. To capitalize on the potential of online videos, educators can access YouTube, Ted-Ed, Vimeo, Hulu, or other options. YouTube is among the best options because it is user-friendly and presents a variety of topics (Riley, 2017). Digital video is progressing to virtual reality. Researchers have found that immersive media technology such as virtual reality, can complement traditional curriculum and provide insight not accessible otherwise (Pimentel & Kalyanaraman, 2022).

Some educators have found ways to use social media both in student activities and professional learning (Carpenter et al., 2020). Prestridge (2022) determined that online resources and an increase in accessibility have led teachers to go online to connect, share ideas, and expand their own professional learning opportunities on social media platforms. Social media platforms reported to be used by teachers are the Global Read Aloud Project which connected classrooms around the world (Carpenter & Justice, 2017), teachers are using Twitter (Xing & Gao, 2018; Rosenberg et al., 2016), Facebook (Kelly & Antonio, 2016), Pinterest (Schroeder, 2019), Reddit, and Instagram as tools for learning (Staudt & Carpenter, 2020).

Common categories and themes emerged through the synthesis of the literature on CTE PD. The topics that emerged were classified into themes in eight broad categories: CTE, PD needs, digital world/Generation Z, college/career readiness, traditional vs. alternative certification, community of teachers, laboratory safety PD, and administrator support. The categories were created by repeating traits within the category across all literature. For example, social network sites, digital gaming, and video were combined into digital world/Generation Z. Five of the manuscripts reviewed included more than one of the categories.

Table 3

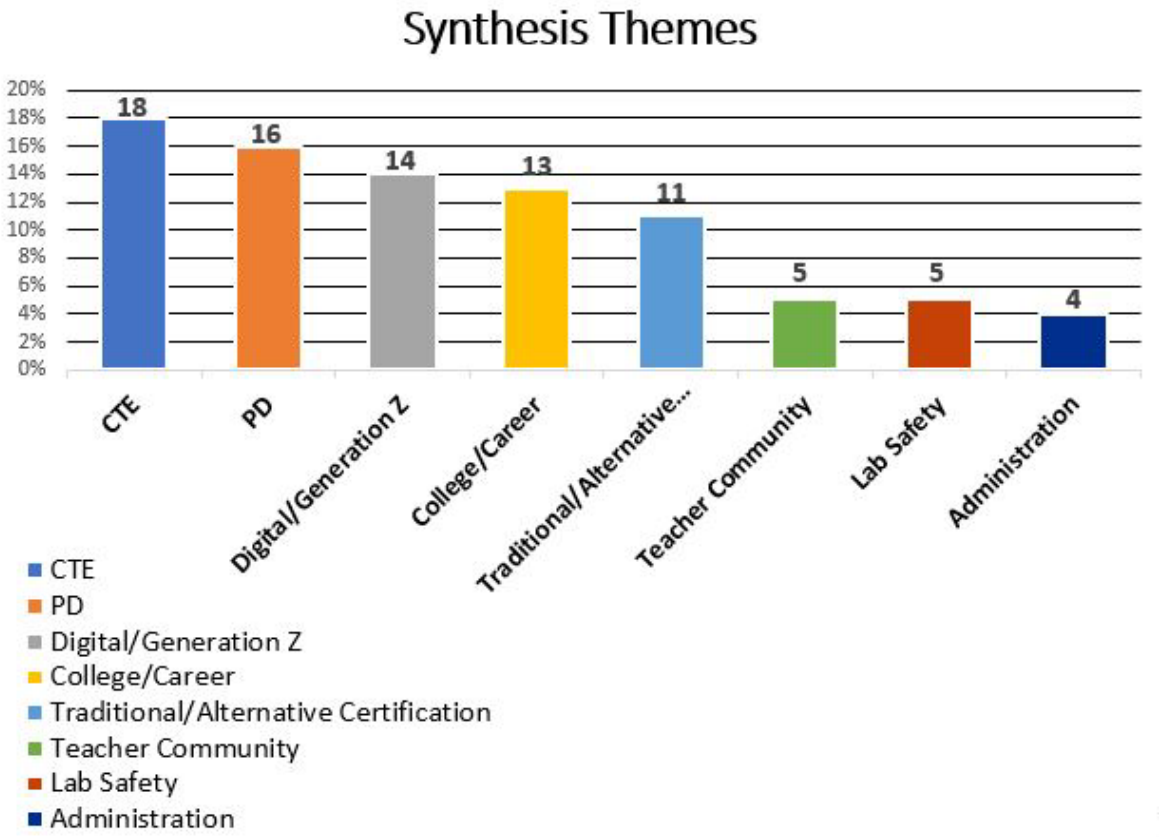
Matrix of Synthesis Themes

Author	Journal, Paper, Report
CTE (18 articles)	
Bird, T. D., & Rice, A. H. (2021)	*Journal of Agricultural Education*
English Standard Version Bible (2016)	Book
Food and Agriculture Organization (FAO) (2017)	Report
Ferguson, S., (2022)	Report
Gordon, H. R., (2014)	Book
Granovskiy, B. (2018)	Report
Ferguson, M., (2018)	*Phi Delta Kappan*
Hodge, E., Dougherty, S., & Burris, C. (2020)	Report
Idaho division of Career and Technical Education. (2022)	Report
Keily, T., (2021)	Report
Lambeth, J. M., Joerger, R. M., & Elliot, J. (2018)	*Journal of Research in Technical Careers*
Malkus, N. (2019)	Report
Seevers, B., & Graham, D., & Conklin, N. (2007)	Book
United States Bureau of Labor Statistics. (2022)	Report
Valentine, K. S., & Kosloski, M. F. (2021)	*Journal of Research in Technical Careers*
Youle, O., Raymer, K.M., Jordan, B., & Morris, T. (2013)	Paper
Zirkle, C., Jeffery, J., & Shrewe, L. (2019)	*Career and Technical Education Research*
Bishop, Y. (2022)	*eSTEAMED Journal*
PD Needs (16 articles)	
Arnett-Hartwick, S. E., & Cannon, J. (2019)	*Journal of Research in Technical Careers*
Cannon, J. G., Kitchel, A., & Duncan, D. W. (2010)	*Journal of STEM Teacher Education*
Cannon, J., Tenuto, P., & Kitchel, A. (2013)	*Career and Technical Education Research*
Desimone, L. M. (2011)	*Phi Delta Kappan*
Foor, R. M., & Cano, J. (2011)	*Journal of Agricultural Education*
Foster, P.N., (1997)	*Journal of Vocational and Technical Education*
Glickmen, C., (2002)	Book
Lieberman, A., & Pointer Mace, D. H. (2008)	*Journal of Teacher Education*
Miller, A. C., & Mills, B. (2019)	*Journal of the Scholarship of Teaching and Learning*
National FFA Organization. (2017).	Report
Seevers, B., & Graham, D., Gamon, J., Conklin, N. (1997)	Book
Sorensen, T. J., Lambert, M. D., & McKim, A. J. (2014)	*Journal of Agricultural Education*
Stone III, J. R. (2017)	*Peabody Journal of Education*
Supovitz, J. A., & Turner, H. M. (2000)	*Journal of Research in Science Teaching*
Webb, R. C., Westfall-Rudd, D. M., Scherer, H. H., & Rudd, R. D. (2019)	*Journal of Agricultural Education*
Williams, C. C. (2019)	Dissertation
Digital world-Generation Z (14 articles)	

Bunch, J. C., Robinson, J. S., Edwards, M. C., & Antonenko, P. D. (2014)	*Journal of Agricultural Education*
Carpenter, J. P., & Justice, J. E. (2017)	*LEARNing Landscapes*
Carpenter, J. P., Morrison, S. A., Craft, M., & Lee, M. (2020)	*Teaching and Teacher Education*
Elmore, T., & McPeak, A. (2019)	Book
Entertainment Software Association, E. (2022)	Report
Kelly, N., & Antonio, A. (2016)	*Teaching and Teacher Education*
Pimentel, D., & Kalyanaraman, S. (2022)	*Scientific Reports*
Riley, J. (2017)	*Journal of Teaching and Learning with Technology*
Rosenberg, J. M., Greenhalgh, S. P., Koehler, M. J., Hamilton, E. R., & Akcaoglu, M (2016)	*E-Learning and Digital Media*
Schroeder, S., Curcio, R., & Lundgren, L. (2019)	*Journal of Research on Technology in Education*
Staudt Willet, K. B., & Carpenter, J. P. (2020)	*Journal of Research on Technology in Education*
Smith, H. E., Stair, K. S., Blackburn, J. J., & Easley, M. (2018)	*Journal of Agricultural Education*
Xing, W., & Gao, F. (2018)	*Computers & Education*
Mohr, K. A., & Mohr, E. S. (2017)	*Journal of Empowering Teacher Excellence*
College/career readiness (13 articles)	
Alston, A. J., Roberts, R., & English, C. W. (2020)	*Journal of Research in Technical Careers*
Ames, T. (2022)	*Journal of Career and Technical Education*
Bartholomew, S. (2014)	*International Journal of Vocational and Technical Education*
Cannon, J. G., Kitchel, A., & Duncan, D. W. (2010)	*Journal of STEM Teacher Education*
Cannon, J. G., Kitchel, A., & Duncan, D. W. (2012)	*The Researcher*
Cannon, J.G., Kitchel, A., & Tenuto, P. (2012)	*Journal of Career and Technical Education*
Dietrich, C., Lichtenberger, E. and Kamalludeen, R., (2017)	*Journal of Career and Technical Education*
Fletcher Jr, E. C., & Tyson, W. (2017)	*Journal of Research in Technical Careers*
Gauthier, T. (2021)	*Journal of Research in Technical Careers*
Gordon, H. R., (2014)	Book
Kitchel, A., Cannon, J., & Duncan, D. (2009)	*Career and Technical Education Research*
Stone III, J. R. (2017)	*Peabody Journal of Education*
Webb, R. C., Westfall-Rudd, D. M., Scherer, H. H., & Rudd, R. D. (2019)	*Journal of Agricultural Education*
Traditional vs. alternative certification (11 articles)	
Bowling, A. M., & Ball, A. L. (2018)	*Journal of Agricultural Education*
Cannon, J., Tenuto, P., & Kitchel, A. (2013)	*Career and Technical Education Research*
Coleman, B. M., Bunch, J. C., & Thoron, A. C. (2020)	*Journal of Agricultural Education*
Conrad, M., & Watkins, L. (2021)	Report

Duncan, D., Cannon, J., & Kitchel, A. (2013)	*Career and Technical Education Research*
Krista, D. K. (2012)	*International Journal of Vocational and Technical Education*
National Research Council. (2010)	Report
Ritz, R., Burris, S., Brashears, T., & Fraze, S. (2013)	*Journal of Agricultural Education*
Smalley, S., Hainline, M. S., & Sands, K. (2019)	*Journal of Agricultural Education*
Stair, K., Figland, W., Blackburn, J., & Smith, E. (2019)	*Journal of Agricultural Education*
Touchstone, A. J. (2015)	*Journal of Agricultural Education*
Community of teachers (5 articles)	
Arnett-Hartwick, S., & Cannon, J. (2020)	*Online Journal of Workforce Education and Development*
Easterly III, R. G., & Myers, B. E. (2017)	*Journal of Agricultural Education*
McKendree, B., & McKim, A. J. (2021)	*Journal of Agricultural Education*
McKim, A. J., Sorensen, T. J., McKendree, R., & Pauley, C. M. (2018)	*Journal of Research in Technical Careers*
Westfall-Rudd, D. M. (2011)	*Journal of Agricultural Education*
Laboratory safety PD (5 articles)	
Bott, P.A., (1998)	Book
Koundinya, V., & Martin, R. A. (2010)	*Journal of Agricultural Education*
Saucier, P. R., & McKim, B. R. (2011)	*Journal of Agricultural Education*
Saucier, P. R., Vincent, S. K., & Anderson, R. G. (2014)	*Journal of Agricultural Education*
Wells, T., & Hainline, M. S. (2021)	*Journal of Agricultural Education*
Administrator support (4 articles)	
Hasselquist, L., & Graves, N. A. (2020)	*Career and Technical Education Research*
Mundt, J.P., & Connors, J. (1999)	*Journal of Agricultural Education*
Cannon, J., Tenuto, P., & Kitchel, A. (2013)	*Career and Technical Education Research*
Arnett-Hartwick, S. E., & Cannon, J. (2019)	*Journal of Research in Technical Careers*

Figure 2
Categories of themes from the synthesis of the literature



Conclusions

The reauthorization of the Perkins Act demonstrated that CTE programs are essential and are worth investing in to address industry workplace needs and college readiness. This synthesis of the literature revealed continual challenges in CTE PD, such as laboratory safety, administration support, curriculum development to match industry needs, college readiness, industry partnerships, teacher retention, and effective PD. Categories related to CTE PD have emerged from the literature that are relatively new concepts in the last decade. The categories included: the use of digital media by teachers and students, the characteristics of Generation Z students, and learning how to establish boundaries and prioritize activities.

Implications for Research and Practice

Conrad and Watkins (2021) found the power of CTE programs rests in the strength of the teachers and administrators working to provide quality CTE for students. Based on the findings of this study, there are five recommendations for future research.

First, reevaluating current CTE teachers' PD is recommended to help guide future in-service learning activities. Sorensen et al. (2014) determined the need for periodic PD needs assessments to be conducted within individual states.

Second, it is recommended to evaluate how PD activities are offered to ensure the activities are effective for teachers. Lieberman and Pointer Mace (2008) concluded that in most schools

teachers are given a "one size fits all" set of PD workshops and call for reform to collaborative teacher communities. Variations in PD needs of traditionally and alternatively certified teachers and veteran and novice teachers were recognized in the literature. Future research is recommended in individual schools to identify specific PD needs.

Third, further research is recommended on the topic of training teachers to establish priorities in their programs to promote better work/life balance to prevent teacher burnout. Fourth, it is recommended to conduct further research on the characteristics of Generation Z students and the use of digital platforms for teacher and student learning.

Fifth, it is recommended to explore college/career readiness further. Literature triangulation revealed a need to evaluate college or career exploration of CTE students, perhaps focusing on programs offered through guidance counselors to prepare students for post-graduation choices. The research suggested CTE pathways do not affect student college readiness, yet faculty suggested that CTE programs must support students' social and emotional development, providing an equitable education to promote life-long learning, sustainable employment, and growth (Gauthier, 2021). Additionally, CTE students were significantly less likely to transfer to a four-year college but significantly more likely to earn either an associate degree or a certificate without transferring (Dietrich et al., 2017).

References

Alston, A. J., Roberts, R., & English, C. W. (2020). Toward a holistic agricultural student recruitment model: A national analysis of the factors affecting students' decision to pursue an agricultural related degree. *Journal of Research in Technical Careers, 4*(1), 1-23. https://digitalscholarship.unlv.edu/cgi/viewcontent.cgi?article=1071&context=jrtc

Ames, T. (2022). Does career and technical education in high school increase the odds of college enrollment? *Journal of Career and Technical Education, 36*(1), 1-19. http://doi.org/10.21061/jtce.v35i1.a4

Arnett-Hartwich, S. E., & Cannon, J. (2019). Problems faced by secondary technology education novice and veteran teachers. *Journal of Research in Technical Careers, 3*(1), 1-12. https://files.eric.ed.gov/fulltext/EJ1245784.pdf

Arnett-Hartwich, S., & Cannon, J. (2020). Challenges for beginning secondary technology education teachers. *Online Journal of Workforce Education and Development, 10*(1), 1-14. https://core.ac.uk/download/pdf/286573438.pdf

Bartholomew, S. (2014). Why we cannot afford to lose CTE in schools. *International Journal of Vocational and Technical Education, 6*(2), 7-12. https://doi.org/10.5897/IJVTE2014.0149

Bird, T. D., & Rice, A. H. (2021). The influence of CASE on agriculture teachers' use of inquiry-based methods. *Journal of Agricultural Education, 62*(1), 260-275. https://doi.org/10.5032/jae.2021.01260

Bishop, Y. (2020). Can Noah's ark float? *eSTEAMED Journal*. https://www.futuresciencleaders.com/blog/2020/06/can-noahs-ark-float/

Bott, P. A. (1998). *Teaching your occupation to others: A guide to surviving the first year.* A Viacom Company.

Bowling, A. M., & Ball, A. L. (2018). Alternative certification: A solution or an alternative problem? *Journal of Agricultural Education, 59*(2), 109-122. https://doi.org/10.5032/jae.2018.02109

Bunch, J., Robinson, J. S., Edwards, M. C., & Antonenko, P. D. (2014). How a serious digital game affected students' animal science and mathematical competence in agricultural education. *Journal of Agricultural Education, 55*(3), 57-71. https://files.eric.ed.gov/fulltext/EJ1122359.pdf

Cannon, J. G., Kitchel, A., & Duncan, D. W. (2010). Identifying perceived professional development needs of Idaho secondary CTE teachers: Program management needs of skilled and technical science teachers. *Journal of STEM Teacher Education, 47*(1), 6. https://ir.library.illinoisstate.edu/jste/vol47/iss1/6

Cannon, J. G., Kitchel, A., & Duncan, D. W. (2012). Perceived teaching and learning professional development needs of Idaho secondary Career and Technical Education teachers. *The Researcher, 24*(1), 43-54. https://www.nrmera.org/wp-content/uploads/2016/02/Researcherv24n1Cannon.pdf

Cannon, J. G., Kitchel, A., & Tenuto, P. (2012). District superintendent perceptions of Idaho secondary CTE teachers' professional development needs. *Journal of Career and Technical Education, 28*(1). http://doi.org/10.21061/jcte.v28i1.572

Cannon, J. G., Tenuto, P., & Kitchel, A. (2013). Idaho secondary principals' perceptions of CTE teachers' professional development needs. *Career and Technical Education Research, 38*(3), 257-272. https://eric.ed.gov/?id=EJ1033548

Carpenter, J. P., & Justice, J. E. (2017). Can technology support teaching for global readiness? The case of the Global Read Aloud. *LEARNing Landscapes, 11*(1), 65-85. https://files.eric.ed.gov/fulltext/EJ1253494.pdf

Carpenter, J. P., Morrison, S. A., Craft, M., & Lee, M. (2020). How and why are educators using Instagram? *Teaching and Teacher Education, 96*(103149), 1-14. https://doi.org/10.1016/j.tate.2020.103149

Coleman, B. M., Bunch, J., & Thoron, A. C. (2020). Identifying agriscience teachers' instructinal practice professional development needs by certification type. *Journal of Agricultural Education, 61*(3), 86-100. https://files.eric.ed.gov/fulltext/EJ1270632.pdf

Conrad, M., & Watkins, L. (2021). *Landscape of CTE leaders. Career and Technical Education leadership series* (ED616683). https://files.eric.ed.gov/fulltext/ED616683.pdf

Corder, J., & Irlbeck, E. (2018). Agricultural communications skills, abilities and knowledge desired by employers compared to current curriculum: A literary review. *Journal of Agricultural Education, 59*(4), 177-193. https://eric.ed.gov/?id=EJ1200286

Desimone, L. M. (2011). A primer on effecitve professional development. *Phi Delta Kappan, 92*(6), 68-71. https://doi.org/10.1177/003172171109200616

Dietrich, C., Lichtenberger, E., & Kamalludeen, R. (2017). Predicting community college outcomes: Does high school CTE participation have a significant effect? *Journal of Career and Technical Education, 31*(1), 1-32. http://doi.org/10.21061/jcte.v31i1.1506

Duncan, D., Cannon, J., & Kitchel, A. (2013). Teaching efficacy: A comparison of traditionally and alternatively certified CTE teachers in Idaho. *Career and Technical Education Research, 38*(1), 57-67. https://doi.org/10.5328/cter38.1.57

Easterly III, R., & Myers, B. E. (2017). Characteristics of enthusiastic and growing school-based agricultural education teachers: A Delphi approach. *Journal of Agricultural Education, 58*(2), 1-19. http://www.jae-online.org/index.php/vol-58-no-2-2017/2047-characteristics-of-enthusiastic-and-growing-school-based-agricultural-education-teachers-a-delphi-approach

Elmore, T., & McPeak, A. (2019). *Generation Z unfiltered: Facing nine hidden challenges of the most anxious population.* Poet Gardener Publishing.

English Standard Version Bible. (2016). Crossway Bibles. https://biblehub.com/esv/genesis/6.htm

Entertainment Software Association. (2022). *Essential facts about the video game industry.* https://www.theesa.com/wp-content/uploads/2022/06/2022-Essential-Facts-About-the-Video-Game-Industry.pdf

Ferguson, M. (2018). Washington view: The past, present, and future of CTE. *Phi Delta Kappan, 100*(2), 64-65. https://journals.sagepub.com/doi/epub/10.1177/0031721718803575

Ferguson, S. (2022). *Understanding America's labor shortage.* U.S. Chamber of Commerce. https://www.uschamber.com/workforce/understanding-americas-labor-shortage

Fletcher Jr, E. C., & Tyson, W. (2017). Bridging technical skills gaps between high school students and local employers. *Journal of Research in Technical Careers, 1*(1), 20-31. https://digitalscholarship.unlv.edu/jrtc/vol1/iss1/4

Food and Agriculture Organizations of the United Nations. (2017). *The future of food and agriculture- Trends and challenges.* Rome. https://www.fao.org/3/i6583e/i6583e.pdf

Foor, R. M., & Cano, J. (2011). Predictors of job satisfaction among selected agriculture faculty. *Journal of Agricultural Education, 52*(1), 30-39. http://www.jae-online.org/vol-52-no-1-2011/1527-predictors-of-job-satisfaction-among-selected-agriculture-faculty.html

Foster, P. (1997). Lessons from history: Industrial arts/technology education as a case. *Journal of Vocational and Technical Education, 13*(2). http://journalcte.org/articles/10.21061/jcte.v13i2.672/

Gauthier, T. (2021). A survey of faculty perceptions of community college Career and Technial Education. *Journal of Research in Technical Careers, 5*(2), 45. https://digitalscholarship.unlv.edu/jrtc/vol5/iss2/3

Glickman, C. D. (2002). *Leadership for learning: How to help teachers succeed.* Association for Supervision and Curriculum Development.

Gordon, H. R. (2014). *The history and growth of career and technical education in America* (4th ed.). Waveland Press.

Granovskiy, B. (2018). *Reauthorization of the Perkins Act in the 115th Congress: The strenghening career and technical edcuation for the 21st century act* (ED593627). ERIC. https://files.eric.ed.gov/fulltext/ED593627.pdf

Greiman, B. C. (2009). Transformational leadership research in agricultural education: A synthesis of the literature. *Journal of Agricultural Education, 50*(4), 50-62. http://www.jae-online.org/vol-50-no-4-2009/42-transformational-leadership-research-in-agricultural-education-a-synthesis-of-the-literature.html

Hasselquist, L., & Graves, N. A. (2020). CTE teacher retention: Lessons learned from mid-career teachers. *Career and Technical Education Research, 45*(1), 3-16. https://doi.org/10.5328/cter45.1.3

Hodge, E., Dougherty, S., & Burris, C. (2020). *Tracking and the future of Career and Technical Education: How efforts to connect school and work can avoid the past mistakes of vocational education* (ED605784). ERIC. https://files.eric.ed.gov/fulltext/ED605784.pdf

Idaho Division of Career and Technical Education. (2022). *Secondary education.* https://cte.idaho.gov/programs-2/career-areas/

Johnston, M., Carey, R. N., Connell Bohlen, L. E., Johnston, D. W., Rothman, A. J., de Bruin, M. P., Groarke, H., Michie,S. (2021). Development of an online tool for linking behavior

change techniques and mechanisms of action based on triangulation of findings from literature synthesis and expert consensus. *Translational Behavioral Medicine, 11*(5), 1049-1065. https://doi.org/10.1093/tbm/ibaa050

Keily, T. (2021). *Secondary Career and Technical Education activity in 2021* (ED61529). ERIC. https://files.eric.ed.gov/fulltext/ED615929.pdf

Kelly, N., & Antonio, A. (2016). Teacher peer support in social network sites. *Teaching and Teacher Education, 56*, 138-149. https://www.sciencedirect.com/science/article/pii/S0742051X16300336

Kerna, K. D. (2012). Help wanted: Professional development and training for career and technical education faculty. *International Journal of Vocational and Technical Education, 4*(3), 38-45. https://academicjournals.org/journal/IJVTE/article-full-text-pdf/505D8F11257

Kitchel, A., Cannon, J., & Duncan, D. (2009). Program management educational needs of Idaho business and marketing teachers. *Career and Technical Education Research, 34*(3), 175-189. https://doi.org/10.5328/CTER34.3.175

Koundinya, V., & Martin, R. A. (2010). Food safety in-service educational needs of agriculture teachers. *Journal of Agricultural Education, 51*(4), 82-91. https://www.jae-online.org/attachments/article/1513/Vol%2051%20No%204%20pg%2082%20-%20Koundinya.pdf

Lambeth, J. M., Joerger, R. M., & Elliot, J. (2018). Merits of creating a revised CTE national research agenda for 2020. *Journal of Research in Technical Careers, 2*(1), 1-7. https://files.eric.ed.gov/fulltext/EJ1245760.pdf

Lieberman, A., & Pointer Mace, D. H. (2008). Teacher learning: The key to educational reform. *Journal of Teacher Education, 59*(3), 226-234. https://doi.org/10.1177/0022487108317020

Malkus, N. (2019). *The evolution of career and technical education 1982-2013.* American Enterprise Institute. https://vtechworks.lib.vt.edu/bitstream/handle/10919/95088/EvolutionCTE2013.pdf?sequence=1&isAllowed=y

McKendree, R. B., & McKim, A. J. (2021). Teacher changing the discipline: A case study of participatory professional development. *Journal of Agricultural Education, 62*(3), 72-84. https://doi.org/10.5032/jae.2021.03072

McKim, A. J., Sorensen, T. J., McKendree, R. B., & Pauley, C. M. (2018). Exploring student retention in postsecondary agriculture, food, and natural resources education programs. *Journal of Research in Technical Careers, 2*(2), 16-25. https://digitalscholarship.unlv.edu/jrtc/vol2/iss2/4

Miller, A. C., & Mills, B. (2019). 'If they don't care, I don't care': Millennial and Generation Z students and the impact of faculty faring. *Journal of the Scholarship of Teaching and Learning, 19*(4), 78-89. https://scholarworks.iu.edu/journals/index.php/josotl/article/view/24167

Mohr, K. A., & S, M. E. (2017). Understanding Generation Z students to promote a contemporary learning environment. *Journal on Empowering Teaching Excellence, 1*(1), 84-94. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1005&context=jete

Mundt, J. P., & Connors, J. J. (1999). Problems and challenges associated with the first years of teaching agriculture: A framework for preservice and in-service education. *Journal of*

Agricultural Education, 40(1), 38-48. https://www.jae-online.org/attachments/article/483/40-01-38.pdf

National FFA Organization. (2017). *FFA Statistics: About FFA.* https://www.ffa.org/about/what-is-ffa/statistics

National Research Council. (2010). *Preparing teachers: Building evidence for sound policy.* National Academies Press. https://books.google.com/books?hl=en&lr=&id=tS5kAgAAQBAJ&oi=fnd&pg=PR1&ots=pM3Bn1QxZS&sig=CwtZWCd2MiUq_1JAVzsn7b9X_7s#v=onepage&q&f=false

Oosterwyk, G., Brown, I., & Geeling, S. (2019). A synthesis of literature review guidelines from information systems journals. *ICICIS, 12*, 250-260. https://doi.org/10.29007/42v2

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutran, I., Hoffman, T. C., Mulrow, C. D., Shameer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hrobjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., …Moher, D. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Systematic Reviews, 10*(1), 1-11. https://systematicreviewsjournal.biomedcentral.com/articles/10.1186/s13643-021-01626-4

Pimentel, D., & Kalyanaraman, S. (2022). The effects of embodying wildlife in virtual reality on conservation behaviors. *Scientific Reports, 12*(1), 1-18. https://www.nature.com/articles/s41598-022-10268-y.pdf

Prestridge, S. (2019). Categorizing teachers' use of social media for their professional learning: A self-generating professional learning paradigm. *Computers & Education, 129*, 143-158. https://www.sciencedirect.com/science/article/pii/S0360131518303002

Riley, J. (2017). Integrating YouTube videos in online teacher education courses. *Journal of Teaching and Learning with Technology, 6*(1), 81-84. https://scholarworks.iu.edu/journals/index.php/jotlt/article/view/19526/29057

Ritz, R., Burris, S., Brashears, T., & Fraze, S. (2013). The effects of a time management professional development seminar on stress and job satisfaction of beginning agriscience teachers in West Texas. *Journal of Agricultural Education, 54*(3), 1-14. https://www.jae-online.org/attachments/article/1754/2012-0625%20Ritzr.pdf

Rosenberg, J. M., Greenhalgh, S. P., Koehler, M. J., Hamilton, E. R., & Akcaoglu, M. (2016). An investigation of State Educational Twitter Hashtags (SETHs) as affinity spaces. *E-Learning and Digital Media, 13*(1-2), 24-44. https://doi.org/10.1177/2042753016672351

Saucier, P. R., & McKim, B. R. (2011). Assessing the learning needs of student teachers in Texas regarding management of the agrcultural mechanics laboratory: Implications for the professional development of early career teachers in agricultural education. *Journal of Agricultural Education, 52*(4), 24-43. https://eric.ed.gov/?id=EJ956099

Saucier, P. R., Vincent, S. K., & Anderson, R. G. (2014). Laboratory safety needs of Kentucky school-based agricultural mechanics teachers. *Journal of Agricultural Education, 55*(2), 184-200. https://files.eric.ed.gov/fulltext/EJ1122311.pdf

Schroeder, S., Curcio, R., & Lundgren, L. (2019). Expanding the learning network: How teachers use Pinterest. *Journal of Research on Technology in Education, 51*(2), 166-186. https://doi.org/10.1080/15391523.2019.1573354

Seevers, B., Graham, D., & Conklin, N. (2007). *Education through cooperative extension* (2nd ed.). Ohio Agricultural Education Curriculum Material Services.

Seevers, B., Graham, D., Gamon, J., & Conklin, N. (1997). *Education through cooperative extension.* Delmar Publishers.

Smalley, S., Hainline, M. S., & Sands, K. (2019). School-based agricultural education teachers' perceived professional development needs associated with teaching, classroom management, and technical agriculture. *Journal of Agricultural Education, 60*(2), 85-98. https://www.jae-online.org/attachments/article/2232/60.2.6.pdf

Smith, H. E., Stair, K. S., Blackburn, J. J., & Easley, M. (2018). Is there an app for that?: Describing smartphone availability and educational technology adoption level of Louisiana school-based agricultural educators. *Journal of Agricultural Education, 59*(1), 238-254. https://files.eric.ed.gov/fulltext/EJ1176302.pdf

Sorensen, T. J., Lambert, M. D., & McKim, A. J. (2014). Examining Oregon agriculture teachers' professional development needs by career phase. *Journal of Agricultural Education, 55*(5), 140-154. https://www.jae-online.org/attachments/article/1869/2014-0900-sorensen.pdf

Stair, K., Figland, W., Blackburn, J., & Smith, E. (2019). Describing the differences in the professional development needs of traditionally and alternatively certified agriculture teachers in Louisiana. *Journal of Agricultural Education, 60*(3), 262-276. https://www.jae-online.org/attachments/article/2247/60.3.20.final.pdf

Staudt Willet, K. B., & Carpenter, J. P. (2020). Teachers on Reddit? Exploring contributions and interactions in four teaching-related subreddits. *Journal of Research on Technology in Education, 52*(2), 216-233. https://doi.org/10.1080/15391523.2020.1722978

Stone III, J. R. (2017). Introduction to pathways to a productive adulthood: The role of CTE in the American high school. *Peabody Journal of Education, 92*(2), 155-165. https://doi.org/10.1080/0161956X.2017.1302207

Supovitz, J. A., & Turner, H. M. (2000). The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching, 37*(9), 963-980. https://doi.org/10.1002/1098-2736(200011)37:9%3C963::AID-TEA6%3E3.0.CO;2-0

Touchstone, A. J. (2015). Professional development needs of beginning agricultural education teachers in Idaho. *Journal of Agricultural Education, 56*(2), 170-187. https://files.eric.ed.gov/fulltext/EJ1122784.pdf

United States Bureau of Labor Statistics. (2022). *Occupational outlook handbook: Career and technical education teachers.* https://www.bls.gov/ooh/Education-Training-and-Library/Career-and-technical-education-teachers.htm#tab-6

Valentine, K. S., & Kosloski, M. F. (2021). Developing the key constructs of career literacy: A Delphi study. *Journal of Research in Technical Careers, 5*(1), 1-22. https://digitalscholarship.unlv.edu/jrtc/vol5/iss1/1/

Webb, R. C., Westfall-Rudd, D. M., Scherer, H. H., & Rudd, R. D. (2019). Continuing professional education and collaborations between university faculty and agricultural education teachers. *Journal of Agricultural Education, 60*(4), 199-211. https://files.eric.ed.gov/fulltext/EJ1237321.pdf

Wells, T., & Hainline, M. S. (2021). Examining teachers' agricultural mechanics professional development needs: A national study. *Journal of Agricultural Education, 62*(2), 217-238. http://doi.org/10.5032/jae.2021.02217

Westfall-Rudd, D. M. (2011). Agricultural education teacher leaders' development of ownership and responsibility for the profession through participation in continuing professional

education program planning: A case study. *Journal of Agricultural Education, 52*(3), 148-161. https://files.eric.ed.gov/fulltext/EJ956087.pdf

Williams, C. C. (2019). *Characteristics of high-quality career and technical education teachers.* (Publication No. 13426487) [Doctoral dissertation, University of Idaho]. ProQuest Dissertations & Theses Global. (2271928061).

Xing, W., & Gao, F. (2018). Exploring the relationship between online discourse and commitment in Twitter professional learning communities. *Computers & Education, 126*, 388-398. https://doi.org/10.1016/j.compedu.2018.08.010

Youle, O., Raymer, B., Jordan, B., & Morris, T. (2013). The animals float two by two, hurrah! *Journal of Physics Special Topics, 12*(1), 1-2. https://journals.le.ac.uk/ojs1/index.php/pst/article/view/2169/2073

Zirkle, C., Jeffery, J., & Shrewe, L. (2019). A longitudinal study of alternatively licensed Career and Technical Teachers. *Career and Technical Education Research, 44*(1), 23-47. https://doi.org/10.5328/cter44.1.23

Classroom Management Strategies for Career Technical Education Teachers

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Abstract
Many skills are needed to be a successful CTE teacher. A simple search of readily available online databases finds that classroom management is one of the most critical skills teachers need. Classroom management involves creating a learning environment that keeps CTE students safe and focused on learning tasks. Thus, the purpose of this paper is multiple-fold: (1) to provide an overview of selected classroom management literature, (2) to offer CTE teachers a menu of strategies for possible use in their respective educational settings, and (3) to share classroom management insights of an educator with extensive CTE teaching and administrative experience in public K-12 schools.

Introduction

The significance of classroom management cannot be overstated. A search of scholarly databases using the descriptor "classroom management" will yield a plethora of citations. However, a more targeted search of the ERIC database combining the subject descriptors "classroom management" and "career and technical education" did not yield a single citation. This dearth of citations underscores the pressing need for specific classroom management resources tailored to the unique context of CTE. CTE teachers are unique because teaching such subjects includes classroom instruction and hands-on laboratory application, each requiring different management strategies. Selected classroom management-related literature is presented in this paper.

What is Classroom Management

Hope (2021) described classroom management as a teacher-created environment where students can learn effectively. Emphasizing the importance of classroom management, Cescon (2021) explained that students can be challenging to manage, even on the best days. As such, the teacher must set expectations that balance firmness and fairness for classroom management policies. Cescon (2021) suggested several general strategies for classroom management. Among these general were: (1) set clear expectations, (2) model respect, (3) personal connections, (4) bell ringer activities, (5) no downtime during lab work, and (6) differentiated instruction. Rabadi and

Ray (2017) perhaps stated it best when they noted that "there is no silver bullet" regarding successful classroom management. Adams and Ray (2016) acknowledged that an effective classroom is the most fundamental factor needed to facilitate student learning. There are three critical areas of classroom management: (1) setting clear expectations, (2) building classroom rapport, and (3) time on task.

Setting Clear Expectations

Not surprisingly, several writers have stressed the importance of setting clear expectations (e.g., Cescon, 2021; Hope, 2021; Johnson, 2016; Rabadi & Ray, 2017). Cescon (2021) noted that students needed structure and wanted to know what was expected when entering the classroom. Regarding expectations, Cescon (2021) suggested that teachers consider policies for homework submission, participation, restroom breaks, and technology use. Building on the thoughts of Cescon (2012), Hope (2021) reported that students need to know what is expected of them and why it is expected. Hope (2021) also explained that students must feel safe and connected to the larger classroom community to maximize academic achievement. Similarly, Rabadi and Ray (2017) reported that students need structure and safety to learn. Rabadi and Ray (2017) emphasized that teachers must rely on classroom awareness and instinct to be effective. They further explained that nothing is easy about trying to guide distractable students along the learning journey. Johnson (2016) noted that it is essential to establish a classroom management process where positive student actions are encouraged, and negative student actions are discouraged.

Building Classroom Rapport

Many writers have emphasized the importance of building classroom rapport (e.g., Cescon, 2021; Dustova & Cotton, 2015; Franklin & Harrington, 2019; & Tingley, n.d.). Cescon (2021) stressed the importance of personal connections, as teachers are among the most influential people in student lives for the better. Further support is provided by Johnson (2016), who expressed that relationships are a critical component of successful classroom management. Rabadi and Ray (2017) suggested that successful classroom management hinges on a balance of warmth and firm boundaries. Tingley (n.d.) emphasized that bad student behavior cannot be ignored and that teachers need to model the conduct expected of students. Cescon (2021) reinforced that by modeling respect, students realize that the teacher seeks what is in their best interests. In related thoughts, Dustova and Cotton (2015) stated that setting positive expectations begins with teachers. They went on to explain that building relationships with students is essential to classroom management. Franklin and Harrington (2019) suggested that meaningful teacher-student relationships are the first step in effective classroom management and teaching.

Time on Task

Cescon (2021), Johnson (2016), and Tingley (n.d.) have all proposed strategies for keeping students on task productively and safely. Bell ringers are frequently used to get students focused upon entering the classroom. Cescon (2021) noted that daily bell ringers help engage students quickly as they enter the classroom and set the tone for the day. As Tingley (n.d.) explained, instructional time does not need to be disrupted when students understand and follow classroom processes. Johnson (2016) discussed the importance of lesson planning for creating productive learning classrooms. Lesson plans where students transition from one activity to another and are on task are essential as they stay focused on learning (Johnson, 2016). Cescon (2021) noted that

not all students learn at the same speed and that it is essential to have supplemental activities to avoid instructional downtime. Placing students in small groups progressing at similar speeds results in more time on task and less disruption (Cescon, 2021).

Menu of Classroom Management Strategies

Next is a menu of strategies CTE teachers can adapt to their educational settings. These strategies include bell ringer, homework collection, and end-of-lab cleanup and dismissal.

Sample Steps for Beginning a Lecture Classroom Day with a Bell Ringer.

Step	Process	Benefits/Notes
Step 1	Students enter the classroom and take assigned seats.	Students are on an established routine. This established routine provides flexibility while the CTE teacher manages other tasks.
Step 2	Students complete the bell ringer posted on the learning management system.	The bell ringer serves as an anticipatory set for the lesson that day.
Step 3	Students submit bell ringer responses via the learning management system.	Students receive credit for thoughtful bell ringer responses.

Sample Steps for End of Lab Cleanup and Dismissal

Step	Process	Benefits/Notes
Step 1	The lead student designee announces the time to begin lab-based cleanup.	This process simulates the real-world end of a workday.
Step 2	Students begin their assigned cleanup tasks.	This process simulates the real-world end of a workday. Tasks change weekly, so students work through all lab areas multiple times during the school year.
Step 3	The lead student designee confirms that assigned cleanup tasks have been completed.	This process simulates the real-world end of a workday. All learners serve as the lead students multiple times during the school year.
Step 4	Students collect their personal belongings and return to their seats.	This process simulates the real-world end of a workday.

Step 5	The passing bell rings. The teacher dismisses the students.	This process simulates the real-world end of a workday.

Sample Steps for Assignment Collection Upon Classroom Entry

Step	Process	Benefit
Step 1	Make sure your assignment meets all criteria.	Learners review their work before grading, confirming that all assignment criteria have been met before submission.
Step 2	Place your assignment in the homework tray on the teacher's desk.	Assignments are submitted following a consistent process.
Step 3	Take your seat and begin the day's bell ringer.	Learners transition from submitting assignments to taking their seats to the daily bell ringer, which allows the teacher to complete administrative tasks.

Sample Steps for Assignment Collection via Learning Management System

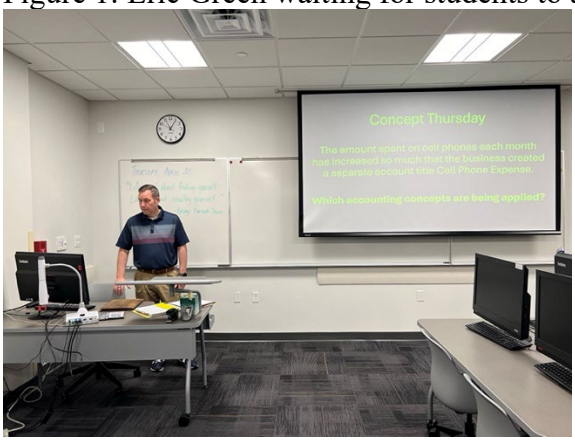
Step	Process	Benefit
Step 1	Make sure your assignment meets all criteria.	Learners review their work before grading, confirming that all assignment criteria have been met before submission.
Step 2	Upload your assignment using the appropriate learning management system link.	Assignments are submitted following a consistent process.
Step 3	Confirm that the correct file has been submitted to the learning management system.	Learners can confirm via review of the submitted file that the assignment that was intended to be submitted was the one that was uploaded.

Interview with Eric Green, an educator with extensive teaching and administrative experience in public K-12 schools

Eric Green is a former Indiana CTE business education teacher. In addition to his experiences as an Indiana CTE business education teacher, Eric has served as a high school principal and corporation assistant superintendent. Eric recently completed his Ed.D. in Educational

Leadership at Ball State University. The interview questions and Eric's responses are noted below.

Figure 1: Eric Green waiting for students to arrive with the day's bell ringer on the screen.



What are the most challenging aspects of classroom management in a CTE classroom?
In my experience, the most challenging aspect of classroom management in a CTE classroom is keeping students engaged and motivated. With so many distractions outside the classroom, holding students' attention and ensuring they are fully invested in the material can be difficult. Additionally, CTE classes often involve hands-on learning and technical skills, which can be more challenging and require more supervision and guidance. Safety is also a significant concern for the CTE classroom, as there are countless opportunities for someone to become injured.

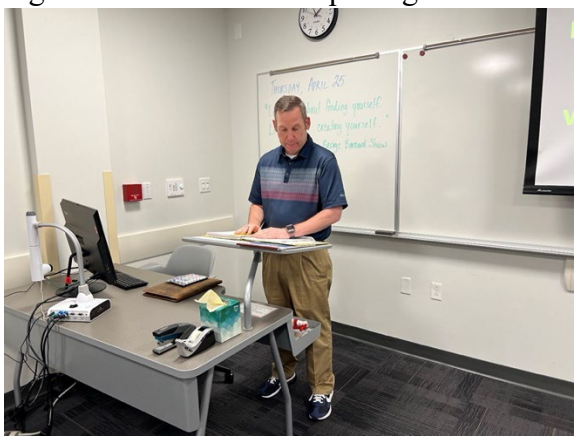
In your opinion, what are the leading causes of misbehavior in a CTE classroom?
There can be a variety of reasons why students might misbehave in a CTE classroom. In some cases, misbehavior is unintentionally caused by the teacher. CTE teachers must be organized with a clear classroom management plan detailing the room/lab/workshop's rules, procedures, and safety protocol. Allow students to know the "why" behind the rules and procedures. Students are more likely to self-regulate when they know where the boundaries are and why. Students will still test those boundaries occasionally; to them, it is a type of "quality check" to ensure that you consistently enforce your classroom expectations. With these consistent boundaries, getting students back on the right track is easier when they know the expectations and that you are inclined to enforce them.

Some potential causes for students' disengagement or uninterest in the material being taught are struggling with the content, being overwhelmed by the workload, and personal or emotional issues impacting their behavior. It is crucial to approach each situation with empathy and understanding while consistently enforcing expectations for appropriate behavior.

How do you deal with disruptive and challenging behaviors?
Dealing with disruptive and challenging behaviors can be difficult, but remaining calm and maintaining a positive attitude is essential. Your response to the disruption can determine the situation's outcome in either a positive or negative way. One effective strategy is to address the behavior directly and quickly, using clear and concise language. It is also essential to listen to the

student's perspective and try to understand the underlying reasons for their behavior. Use the situation as a teaching moment. Ask students questions that require them to reflect on their behavior, such as, "What is the proper procedure for our class?" "What are the safety guidelines for ___ (preparing to weld, using the safety guard on the table saw, etc.)? If necessary, you may need to implement consequences or involve a school counselor or administrator. Always prioritize the safety and well-being of all students involved and seek support and guidance if required. Never feel like you must tackle all student discipline issues alone; sometimes, outside support is the only way to resolve the issue.

Figure 2: Eric Green completing administrative tasks while students engage with the bell ringer.



Do you think there is a specific way of avoiding student misbehavior?
There is no one-size-fits-all approach to avoiding student misbehavior. A successful CTE teacher can reduce these disruptions by clearly defining classroom rules and safety procedures. The CTE teacher should then consistently enforce those rules and procedures in a non-threatening way.

CTE teachers have a unique opportunity to engage students in a way impossible in other subject areas. A significant component of student misbehavior is related to student engagement. The hands-on nature of CTE allows teachers to create an opportunity for students to be highly engaged. High engagement typically results in fewer discipline issues. The more responsibilities you can give students, the more invested they will become. Rotating safety officers and assigned workshop maintenance or cleaning duties are activities that increase engagement through increased student responsibility.

Developing authentic relationships with your students is another effective strategy to prevent or address misbehavior. Students thrive in an environment with approval, appreciation, positive reinforcement, and high expectations. Modeling that mistakes are a learning opportunity and that everyone can be successful can create an environment with fewer disruptive behaviors.

What management strategies do not work well in a CTE classroom?
In a CTE classroom, specific management strategies may not work well. For example, being too strict or authoritarian can create a hostile learning environment and cause students to disengage or even rebel. This typically happens when a teacher corrects or punishes a student in front of the class. Corrective action should always take place privately. In addition, group punishments are

rarely effective. For example, deciding to keep all students from working on a significant project in the automotive shop because of a small number of students' misbehavior will erode student motivation and engagement. Similarly, being too lenient or permissive can lead to chaos and a lack of respect for rules and boundaries (as well as be dangerous). It is essential for CTE teachers to find a balance between being firm and supportive and to adapt their management style to the needs and personalities of their students. Students will usually meet your expectations, so set them high from the beginning.

Figure 2: Eric Green is ready to begin the day's lesson after completing administrative tasks.

In terms of classroom management, what do administrators expect of CTE teachers?
Administrators expect CTE teachers to maintain a positive and safe learning environment for their students. This is usually the number one priority in an administrator's eyes. CTE teachers should also establish clear expectations for behavior and enforce them consistently (This is critically important). When the support of an administrator is needed, strong CTE teachers will attempt several methods to resolve the issue before escalating the situation to the administrative level. One of the most critical steps to take is to have consistent contact with the parents or guardians of your students. Administrators are always there for support but usually are more receptive when the CTE teacher has documented that they have done their part to correct inappropriate behavior.

Summary
Many skills are needed to be a successful CTE teacher. One such skill is classroom management. Classroom management involves creating a learning environment that keeps CTE students safe and on learning tasks. Thus, the purpose of this paper is multiple-fold: (1) to provide an overview of selected classroom management topics, (2) to offer CTE teachers a menu of strategies for possible use in their respective educational settings, and (3) to share classroom management insights of an educator with extensive CTE teaching and administrative experience in public K-12 schools.

References
Adams, M. E. & Ray, P. (2016). A classroom management primer for middle and secondary school teachers. Retrieved from https://www.in.gov/gwc/cte/files/classroom-management-final.pdf

Cescon, M. (2021). Classroom management strategies for health science teachers. Retrieved from https://www.aeseducation.com/blog/best-classroom-management-strategies-cte-health-science-teachers

Dustova, G. & Cotton, S. (2015). Classroom management strategies. *The CTE Journal, 3*(2), 32-42.

Franklin, H. & Harrington, I. (2019). A review of effective classroom management and strategies for student engagement: Teacher and student roles in today's classrooms. *Journal of Education and Training Studies, 7*(12), 1–12.

Hope, M. (2021). Avoiding common classroom management missteps. Retrieved from https://www.ascd.org/el/articles/avoiding-common-classroom-management-missteps

Johnson, B. (2016). The 5 priorities of classroom management. Retrieved from https://www.edutopia.org/blog/5-priorities-classroom-management-ben-johnson

Rabadi, S. & Ray, B. (2017). 5 principles of outstanding classroom management. Retrieved from https://www.edutopia.org/article/5-principles-outstanding-classroom-management

Tingley, C. S. (n.d.). 7 habits of highly effective classroom management. Retrieved from https://www.wgu.edu/heyteach/article/7-habits-highly-effective-classroom-management2004.html

Importance of Teaching Agricultural Mechanics by Certification Type

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Abstract
Traditional agricultural education teacher preparation programs face dilemmas in shifting licensure requirements, challenges in recruiting preservice teachers for a career in school-based agricultural education (SBAE), and an absence of diverse teacher candidates resulting in a serious teacher shortage (Smith et al., 2022). To meet the need for teachers, many states have implemented alternative routes to licensure to fill the demand. With an outpouring of alternatively certified teachers entering the profession and research supporting better teaching performance from traditionally certified teachers (Lublin, 2022; Nakai & Turley, 2003), concern for the retention of these teachers exists. Since SBAE teachers are typically expected to teach agricultural mechanics coursework, it is vital that appropriate training is received (Granberry et al., 2023; Wells et al., 2013). Further, Floyd (2020) posited one of the reasons agricultural education teachers leave the profession is lack of preparation. The purpose of this study was to identify traditionally and alternatively certified Iowa SBAE teachers' perceived level of importance to teach agricultural mechanics. Ajzens (1991) Theory of Planned Behavior guided this study. Viewed through the lens of the theory of planned behavior, the findings from this study conceptualize how SBAE teachers' attitudes toward a specified behaviors, subjective norms, and perceived behavioral control, together shape an individual's behavioral intentions and behaviors (Montano & Kasprzyk, 2015). Results of this study conclude that traditionally certified teachers identify all five agricultural mechanics constructs as more important than their alternatively certified peers. Additionally, approximately 91% of the alternatively certified teachers in Iowa had no post-secondary training in agricultural mechanics. We recommend that alternatively certified teachers be required to participate in agricultural mechanics professional development or complete specific coursework before receiving a teaching license.

Introduction
Teacher shortages have been a common issue for many years and have traditionally been attributed to fluctuations in educational financing, teacher migration, retirement age, and increasing student enrollment (Darling-Hammond et al., (2023); Ingersoll & Smith, 2003). With the current teacher shortfall, incentive programs have been designed to recruit new teachers to the profession to fill these unfilled positions. However, implementation of these efforts alone will not fix the staffing problems many schools currently face (Hirsch, et al., 2001). Due to the

lack of teachers, many school systems have been forced to lower their hiring standards for teacher quality (Will, 2023).

The means of educating students in agricultural education programs has changed drastically over the past century. Traditional agricultural education teacher preparation programs currently face dilemmas in shifting licensure requirements, challenges in recruiting preservice teachers for a career in school-based agricultural education (SBAE), and an absence of diverse teacher candidates resulting in a serious teacher shortage (Smith, et al., 2022). To meet the growing needs for agricultural education teachers, states have resorted to alternative routes to teacher certification for the preparation of candidates as an option to fill an ever-increasing number of teaching vacancies (Povich, 2023). According to the most recent national Agricultural Education supply and demand study (Smith et al., 2022), 16.7% of the new SBAE teachers hired in 2022 had completed an alternative route to licensure. Non-traditional routes to entering the teaching profession can include professional experience, occupational competency, and the completion of a baccalaureate degree in a requisite subject area (Ruhland & Bremer, 2003). Rocca and Washburn (2006) suggested that alternatively certified agricultural education teachers tend to have more years of experience in the agricultural industry while at the same time are missing valuable teaching experience as noted by Knobloch and Whittington (2002).

Traditionally certified teachers are those who have completed a traditional post-secondary teacher preparation program. Traditionally certified teachers have been considered more successful and highly rated then those who entered the profession through alternative programs or without preparations (Darling-Hammond, et al., 2002). Specifically, traditionally certified teachers have been considered superior in almost every dimension of teaching including curriculum and assessment, classroom management, learning styles, awareness of learning styles, and knowledge of students (Darling-Hammond et al., 2002; Lublin, 2022; Nakai & Turley, 2003. Knobloch and Whittington (2002) found that new agricultural education teachers who completed a traditional teacher preparation program including student teaching were more confident than alternatively certified peers. However, Graham and Garton (2003) suggested that there was no direct difference between certification type and teaching performance among school based agricultural education (SBAE) teachers. With these recent changes in the types of certification required for state licensure, concerns exist regarding whether alternatively certified teachers are meeting the needs of their students (Rocca & Washburn, S, 2006)

Research has also indicated that an adequate pre-service preparation program and support of novice teachers are very important in improving teacher quality, competency, and retention of teachers (Granberry et al., 2023; Ruhland & Bremer, 2003). The lack of adequate pre-service preparation programs, especially for alternative certifications programs, has led to a decrease in teacher quality and competency (Feistritzer & Haar, 2008). Alternatively certified teachers vary widely in the amount preparation received prior to entering the classroom. These individuals may possess little experience and require higher levels of support in order to become successful teachers (Hainline & Wells, 2024; Ruhland & Bremer, 2003). Ford, et al. (2008) established that alternatively certified teachers were least competent in agricultural mechanics when compared to other courses taught in the high school agricultural education curriculum. The lack of preparation to teach agricultural mechanics has driven away many young teachers from teaching agricultural mechanics content (Dyer & Andreason, 1999). Research has also indicated that more training for

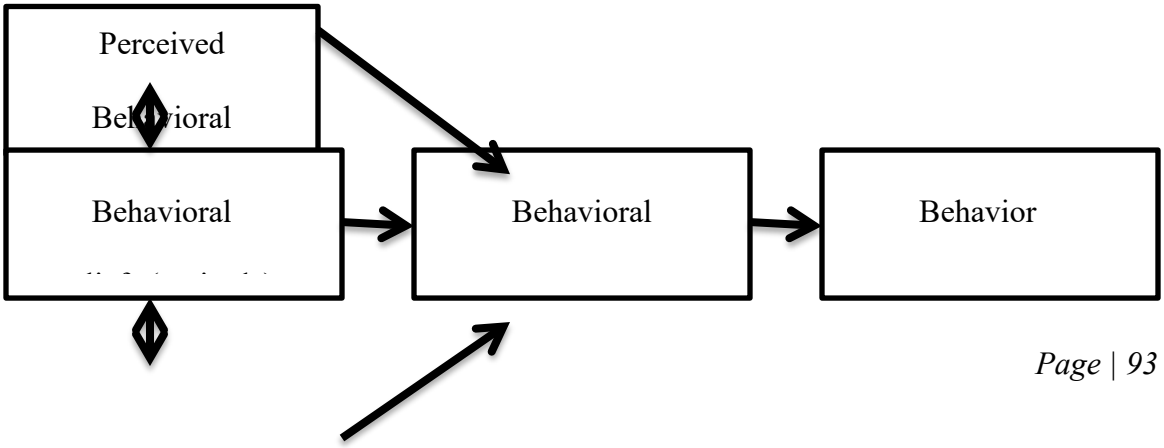
both traditional and alternatively certified teachers is necessary in order to adequately prepare them for teaching agricultural mechanics (Buriak & Harper, 2001; Clark et al., 2021).

Increased exposure received in agricultural mechanics at the secondary level can lead to an increased number of agricultural mechanics courses and skills being taught when those students become teachers (Wells, et al., 2013). Since school-based agricultural education teachers are typically expected to teach agricultural mechanics coursework, it is vital that appropriate training at the post-secondary level is received (Byrd et al., 2015; Wells et al., 2013). Previous research has indicated that experience in a specific content area can also create a higher level of self-confidence for teachers regarding a given subject (Burris, et al., 2010; Granberry et al., 2022; Stripling & Roberts, 2012). Increased formal exposure to agricultural mechanics content can allow for the increased development of skills and an increased desire by teachers to teach that content (Wells et al., 2013).

Theoretical Framework

Ajzens (1991) Theory of Planned Behavior states that attitude toward a specified behavior, subjective norms, and perceived behavioral control, together shape an individual's behavioral intentions and behaviors (Montano & Kasprzyk, 2015). The specific considerations drive the theory: behavioral beliefs (attitude), perceived behavioral control, and subjective norms. In respect to each of these aspects, behavioral beliefs produce the favorable or unfavorable attitude to the behavior Ajzens (1991) When one's belief about a task or behavior is unfavorable, that person's attitude toward that task will lead to a lower level of performance. Ajzen's theory (1991) also considers subjective norms as a representation of the perceived social pressures on the individual to perform certain tasks. Subjective norms impact how an individual views the importance of a particular task. Perceived behavioral control refers to the extent to which teachers view themselves as being capable of teaching the curriculum. Often the perceived behavioral control reflects an individual's past experiences and anticipated obstacles (Ajzen, 2002). Teachers who are not confident in their own ability to perform needed skills may feel uncomfortable teaching the associated task (Saucier & Krysher, 2014).

Figure 1 depicts the relationship between the three main considerations within the Ajzen's (2002) Theory of Planned Behavior: perceived behavioral control, behavioral beliefs (attitude), and subjective norms. Subjective norms and normative beliefs are associated with an individual's decision to approve or disapprove a particular behavior, often weighted by the person's motivation and attitude (Saucier & Krysher, 2014). Attitude is determined by the individual's beliefs of the outcomes of performing the learned behavior. A person who holds a strong belief that is positively valued, will perform the behavior with a positive attitude.



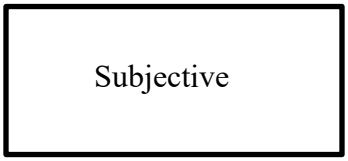


Figure 1. Theory of Planned Behavior

Perceived behavioral control considers situations where the individual may not have control over that particular behavior. The perceived behavioral control considers the subjective norms, normative beliefs, and behavioral beliefs (attitude) of the individual, to describe a behavior that should occur (Saucier & Krysher, 2014). An individual that believes in certain subjective norms to a behavior should perform that behavior when motivated and will then hold a positive normative belief. The relationship between these three factors controls a person's behavioral intention. Since a person's behavioral intention is a combination of attitude, self-efficacy, norms, and perceived control, therefore positive behavioral intention will support the performance of the new behavior. However, if the behavioral intention is negative a person's attitude, self-efficacy, and perceived control will inhibit the person from wanting to perform a task and not learn that new behavior. A lack of continuity in any of these three factors inhibits the person from reaching the behavioral intention and then implementing such learned behavior.

Agricultural mechanics has often been associated with high levels of stress and anxiety for many agricultural education teachers (Foster, 1986; Granberry, 2021). Attitude is often deemed as the most important underlying piece to a person's behavioral intention and then learned behavior. Seemingly low levels of attitude to perform tasks in agricultural mechanics have drawn teachers to avoid teaching agricultural mechanics or leaving the profession altogether (Walker, et al., 2004). Walker et al., (2004) identified the level of like or dislike in performing certain responsibilities in agricultural education between three groups movers, leavers, and stayers. Leavers had the lowest enjoyment levels in agricultural mechanics, and it was the most disliked and least taught construct (Walker et al., 2004). Conceptualized for this study, low levels of behavioral beliefs (attitude), subjective norms, and perceived behavioral control regarding agricultural mechanics curricular content could indicate a decreased likeliness that an individual will have a positive intention to teach that particular curriculum or skill.

Purpose and Objectives

Considering the critical need stated by the American Association for Agricultural Educators Research Priority Area 3: "Sufficient Scientific and Professional Workforce that address the Challenges of the 21st Century" (Stripling & Ricketts, 2016, p. 29), the purpose of this study was to identify traditionally and alternatively certified secondary agricultural education teachers' perceived importance to teach agricultural mechanics. As the agricultural industry grows, the desire for basic education from students in the principles of agricultural mechanics will continue to grow. Agricultural education teachers are responsible for providing the needed training in this content area to their SBAE students (Ramsey & Edwards, 2011). Providing training in a technology-rich field, like agricultural mechanics, will help to prepare students for the rigors, needs, and challenges of the real world (Roberts, et al., 2016). This study aligns with the American Association for Agricultural Education's National Research Value: Increasing Prosperity through innovation in Agricultural, Food, and Natural Resource Systems by

connecting STEM content aligned to agricultural mechanics curriculum (AAAE, 2023). The following objectives emerged from the purpose of this study:

1. Describe selected characteristics of traditional and alternatively certified teachers and their agricultural education programs; and
2. Compare traditional and alternatively certified teachers' perceived importance to teach agricultural mechanic within five agricultural mechanics constructs.

Methods

This descriptive study was conducted as part of a larger study in agricultural mechanics education and utilized survey research methods to summarize characteristics, attitudes, and opinions to accurately describe a norm (Ary, et al., 2006). A paper-based questionnaire was used to address the objectives of this study. Three sections, which included 54 skills relating to agricultural mechanics, formed the instrument. The 54 skills were separated into five constructs within the subject area of agricultural mechanics and included: Mechanic Skills, Structures/Construction, Electrical Skills, Power and Machinery, and Soil and Water. Respondents were asked to use a five-point summated scale to rate their perceived importance to teach all 54 skills in agricultural mechanics. Section two consisted of 15 demographic questions relating to the teacher, and section three included nine questions about the agricultural education program and various school characteristics.

Content validity was reviewed by a team of five university faculty members with expertise in the fields of agricultural mechanics and agricultural education. An initial electronic version of the instrument was pretested through a pilot study with a group of 12 agricultural education teachers in a nearby state following the recommendations of Dillman, et al. (2009). Suggestions from this pilot study led us to adopt a paper-based, rather than electronic, instrument. *Post-hoc* reliability was estimated following the suggestions of Gliem and Gliem (2003) and resulted in reliability coefficients for importance. Reliability coefficients for perceived importance to teach within each construct were calculated as follows: Mechanic Skills ($\alpha = .966$), Structures/Construction ($\alpha = .976$), Electrical Skills ($\alpha = .960$), Power and Machinery ($\alpha = .971$), and Soil and Water Skills ($\alpha = .907$).

Table 1

Reliability Coefficients of Instrument Constructs- Cronbach's Alpha

Construct	*Number of Items*	*a**
Structures and Construction	9	.976
Agricultural Mechanics	19	.966
Electricity	6	.960
Soil and Water	5	.907
Power and Machinery	15	.971

Note. *Cronbach's alpha. > .9 = Excellent, >.8 = Good, >.7 = Acceptable, >.6 = Questionable, >. 5 = Poor, and <.5 = Unacceptable (George & Mallery, 2003).

A convenience sample guidelines and data were collected from attendees during the Iowa agricultural education teachers' conference. The purpose behind targeting this sample was based on the likelihood for them to be involved in additional professional development activities in the future. A questionnaire was distributed to each secondary teacher ($N = 130$) in attendance and asked that it be completed by the end of the conference. Participants were offered a power tool institute safety curriculum as incentive to complete and return the questionnaire. Instruments were returned from 103 of the 130 attendees, yielding a 79.2% response rate. No additional efforts were made to obtain data from non-respondents. Non-response errors were addressed following the suggestions of Miller and Smith (1983) by comparing respondents' personal and program demographic data to data from the Iowa Department of Education (2010). No significant differences $(p < 0.05)$ for gender, age, highest degrees held, years of teaching experience, or size of school community between respondents and the general population of agricultural education teachers in Iowa based on a Pearson's χ^2 analysis. Data were coded and analyzed using SPSS 24.0. In this study, we use descriptive statistics to provide baseline data regarding the importance of agricultural mechanics skills as perceived by traditionally and alternatively certified SBAE teachers in Iowa. Due to the purposively selected sample, findings from this study should be interpreted with care and not extrapolated beyond the target population.

Results

Objective one sought to describe selected characteristics of traditional and alternatively certified teachers and their agricultural education programs. Table 2 provides a summary of the respondent's demographics. Of sixty-eight traditionally certified teachers, 51 were male and 17 female, while thirty-three of the alternatively certified teachers included 17 male and 16 female teachers. The highest percentage of the traditionally (n=41, 60%) and alternatively (n= 22, 67%) certified teachers possessed a bachelor's degree while 27 (40%) of the traditionally certified teachers and 11 (33%) of alternatively certified teachers reported receiving a master's degree. Approximately one-third of traditionally (n=20, 30%) and alternatively (n=11, 33.4%) certified teachers in our study reported completing 0-5 years of teaching. It can also be noted that a great disparity existed between traditionally certified teachers with 30 or more years of experience (n = 14, 20.6%) and alternatively certified teachers (n = 2, 6.1%).

Table 2
Summary of Respondents' Demographic Characteristics

	Traditionally Certified		Alternatively Certified	
	f	%	*f*	%
Gender				
Male	51	75.0	17	51.5
Female	17	25.0	16	48.5
Highest Level of Education				
Bachelor's Degree	41	60.0	22	67.0
Master's Degree	27	40.0	11	33.0
Years of Teaching				
0-5	20	30.0	11	33.4
6-10	11	16.0	10	30.3
11-15	6	8.9	5	15.2
16-20	6	8.9	1	3.0
21-25	3	4.5	2	6.0
26-30	8	11.8	3	9.1
More than 30	14	20.6	2	6.1

Table 3 provides a summary comparison of program demographics by route to certification. Although not collected from respondents in this study, we used population parameters from a study completed by Shultz, et al. (2014) which described the respondents at the time of the study. The majority of agricultural education teachers were located in rural locations (*n*=55), followed by small urban areas (*n*=19), and urban (*n*=2). The majority of schools had one agricultural education teacher (89.7%). Additionally, over half of the alternative certified teachers in this study had not completed agricultural mechanics coursework at the secondary or post-secondary levels.

Table 3
Summary of Program Demographics

	Traditionally		Alternatively Certified	
	f	%	*f*	%
Campus Location Designation				
Rural (Population less than 5,000)	53	79.1	25	78.1
Small Urban (Population between 5,000 and 20,000)	13	19.4	6	18.8
Urban (Population greater than 20,000)	1	1.5	1	3.1
Number of Agricultural Science Teachers				
1 Teacher	61	89.7	27	90.0
2 Teacher	4	5.9	3	10
3 Teacher	2	2.9	0	0
4 Teacher	1	1.5	0	0

Number of Secondary Agricultural Mechanics Courses Completed				
0	24	36.4	19	59.4
1-2	28	42.4	10	31.2
More than 3	14	21.2	3	9.4
Number of Post-Secondary Agricultural Mechanics Courses Completed				
0	21	31.3	16	51.6
1-2	27	40.3	9	29.1
More than 3	19	28.4	6	19.3

Table 4 displays the grand means of both traditionally and alternatively certified teachers' perceived importance to teach agricultural mechanics by construct area. Traditionally certified teachers had higher grand means in all five of the construct areas. Within those five construct areas the *Structures and Construction* construct had the highest grand mean for both traditional (GM=3.76) and alternative certification teachers (GM=2.78). Finally, *Soil and Water* had the lowest grand mean (M=2.85) for traditionally certified teachers, while *Electricity* had the lowest grand mean (GM=2.07) for alternatively certified teachers.

Table 4

Respondent Reported Perceived Importance to Teach Agricultural Mechanics by Construct Area and Certification Route

			Traditionally Certified			Alternatively Certified	
Construct	Skill	*n*	*M*	*SD*	*N*	*M*	*SD*
Structures and Construction	9	57	3.76	0.97	30	2.78	1.24
Power and Machinery	15	49	3.50	1.04	31	2.27	1.23
Mechanics	19	50	3.15	1.02	28	2.28	1.06
Electricity	6	52	3.04	1.08	30	2.07	1.13
Soil and Water	5	48	2.85	0.95	30	2.38	1.11

Note: The Importance scale, 1 = not important, 2= some importance, 3= moderately important, 4= strong importance, 5 = very strong importance

Table 5 reports mean, and standard deviations of respondents perceived importance to teach specific skills within the *Mechanics* construct by certification type. The grand mean for the mechanics skills construct was (*M* = 3.15) for traditionally certified and (*M* = 2.28) for alternatively certified teachers (Table 4). Traditionally certified respondents reported welding safety as the most important competency to teach, *(M*=4.72) followed by SMAW Welding (Arc)

(*M*=4.36). Traditionally certified teachers also reported GMAW Welding (MIG) as an important competency to teach in mechanics (*M*=4.30). Alternatively certified teachers had a slightly different perception of the competencies that should be of importance to teach in the *Mechanics* construct. Alternatively certified teachers reported Welding Safety as the most important competency area to teach (*M*=4.67). They also reported Mechanical Safety (*M*=4.34*)* and Plasma Cutting (*M*=4.30) as being highly important to teach in the mechanical skills construct.

Table 5

Respondent Reported Perceived Importance to Teach Mechanics Skills by Certification Type

	Traditionally Certified			Alternatively Certified		
Competency Area	*n*	*M*	*SD*	*n*	*M*	*SD*
Oxy-Acet. Welding	64	3.97	0.906	33	3.64	1.220
Metallurgy & Metal Work	55	3.27	1.113	30	3.03	1.033
SMAW Welding (Arc)	64	4.36	0.804	32	4.22	1.070
Oxy-Propylene Cutting	50	3.26	1.291	30	3.13	1.358
Welding Safety	64	4.72	0.654	33	4.67	1.021
Hot Metal Work	52	3.04	1.154	30	3.00	1.114
Oxy-Acet. Cutting	65	4.15	0.852	33	4.12	0.992
GMAW Welding (MIG)	61	4.30	0.843	32	4.28	1.085
Oxy-Acet. Brazing	61	3.34	1.078	31	3.32	1.249
Soldering	56	3.32	1.064	33	3.42	1.226
Cold Metal Work	52	3.02	1.180	30	3.13	1.106
Mechanical Safety	58	4.22	1.060	32	4.34	1.096
Computer-Aided Design	51	3.31	1.140	29	3.45	1.152
GTAW Welding (TIG)	55	3.62	0.991	28	3.79	1.315
Tool Conditioning	51	3.22	1.238	31	3.39	1.256
Pipe Cut. & Thread	52	3.10	1.192	29	3.28	1.192
Plasma Cutting	57	4.00	0.945	30	4.30	1.119
Fencing	52	3.12	1.308	29	3.66	1.096
Plumbing	54	3.33	1.229	30	3.53	1.074

Note: The Importance scale, 1 = not important, 2= some importance, 3= moderately important, 4= strong importance, 5 = very strong importance

Traditionally and alternatively certified teachers were asked to report their perceived level of importance to teach nine different competencies within the *Structures/Construction* construct. The grand mean for this construct was higher for traditional certified teachers (*GM*=3.76) than alternatively certified teachers (*GM*=2.78) (Table 4). Traditionally and alternatively certified teachers reported Construction and Shop Safety as the most important skill to teach (*M*=4.38 and *M*=4.59 respectively). Additionally, the Woodworking Power Tools skill indicated the highest mean scores for both traditionally (*M*=4.24) and alternatively (*M*=4.22) certified teachers.

Table 6

Respondent Reported Perceived Importance to Teach Structures/Construction Skills by Certification Type

	Traditionally Certified			Alternatively Certified		
Competency Area	*n*	*M*	*SD*	*n*	*M*	*SD*
Woodworking Hand Tools	62	4.06	0.827	32	3.94	1.134
Woodworking Power Tools	62	4.24	0.843	32	4.22	1.070
Construction Skills (Carpentry)	61	3.98	0.991	30	3.97	0.999
Bill of Materials	60	4.17	0.960	31	4.26	0.893
Concrete	57	3.61	1.031	30	3.77	1.006
Construction and Shop Safety	60	4.38	0.865	32	4.59	0.665
Drawing and Sketching	56	3.75	0.995	30	3.97	0.850
Selection of Materials	58	3.93	0.896	31	4.26	0.773
Fasteners	57	3.60	1.100	31	3.97	0.983

Note: The Importance scale, 1 = not important, 2= some importance, 3= moderately important, 4= strong importance, 5 = very strong importance

Table 7 depicts the perceived importance of teaching specific skills from the *Electricity* construct as reported by both traditionally and alternatively certified teachers in our study. Traditionally certified teachers indicated a moderate level of importance of the construct (*GM* = 3.04) while alternatively certified teachers indicated the construct held some importance (*GM* = 2.07) (Table 4). Both groups of teachers identified Electrical Safety as the highest among construct skills with a strong level of importance (*M*=4.21 and *M*=4.13 respectively).

Table 7

Respondent Reported Perceived Importance to Teach Electricity Skills by Certification Type

	Traditionally Certified			Alternatively Certified		
Competency Area	*n*	*M*	*SD*	*n*	*M*	*SD*
Electrical Safety	57	4.21	1.114	31	4.13	1.056
Wiring Skills	59	3.86	1.090	31	3.84	1.128
Electricity Controls	58	3.55	1.127	30	3.60	1.133
Electrician Tools	56	3.67	1.243	31	3.84	1.098
Type of Electrical Motors	56	3.27	1.243	30	3.50	1.167
Cleaning Motors	52	3.17	1.248	30	3.53	1.167

Note: The Importance scale, 1 = not important, 2= some importance, 3= moderately important, 4= strong importance, 5 = very strong importance

Table 8 depicts the perceived level of importance to teach each of the fifteen competency areas in the *Power & Machinery* construct by certification type. Traditionally certified teachers reported moderate importance (*GM*=3.50) while the alternatively certified teachers reported some importance (*GM*=2.27). Both groups identified a strong level of importance to teach Small Engine Safety, Small Engine Services-4 cycle, and tractor safety respectively.

Table 8

Respondent Reported Perceived Importance to Teach Power & Machinery Skills by Certification Type

	Traditionally Certified			Alternatively Certified		
Competency Area	*n*	*M*	*SD*	*n*	*M*	*SD*
Small Engine Services – 2 cycle	56	3.80	1.034	33	3.97	1.075
Small Engine Services – 4 cycle	56	4.00	0.953	33	4.00	1.118
Small Engine Overhaul	55	3.89	1.031	32	3.94	1.162
Small Engine Safety	56	4.34	0.859	33	4.24	0.902
Tractor Service	52	3.58	1.144	32	3.66	1.153
Tractor Maintenance	52	3.73	1.157	32	3.75	1.078
Tractor Overhaul	51	3.18	1.178	32	3.34	1.066
Tractor Selection	49	3.18	1.112	32	3.50	1.218
Tractor Operation	51	3.29	1.154	32	3.63	1.100
Tractor Safety	53	3.92	1.222	32	4.00	1.136
Tractor Driving	52	3.46	1.244	32	3.56	1.243
Service Machinery	52	3.50	1.094	32	3.59	1.103
Machinery Selection	51	3.39	1.078	32	3.53	1.107
Machinery Operation	53	3.43	1.152	31	3.55	1.080
Power & Machinery Safety	55	3.96	1.186	31	4.03	1.197

Note: The Importance scale, 1 = not important, 2= some importance, 3= moderately important, 4= strong importance, 5 = very strong importance

Table 9 depicts the perceived importance of teaching specific skills within the Soil and Water construct. Both groups identified the construct as having some importance (Table 4). Both certification groups identified Global Positioning Systems as having a strong level of importance in the agricultural education curriculum (Traditionally Certified - *M* = 4.23, Alternatively Certified – *M = 4.24)*. All other skill areas were identified as moderately important.

Table 9

Respondent Reported Perceived Importance to Soil and Water Skills by Certification Type

	Traditionally Certified			Alternatively Certified		
Competency Area	*n*	*M*	*SD*	*n*	*M*	*SD*
Global Positioning Systems	56	4.23	0.894	33	4.24	0.936
Legal Land Descriptions	59	3.98	0.974	32	3.91	1.118
Use of Survey Equipment	57	3.75	1.023	31	3.52	1.180
Differential Leveling	48	3.27	1.144	30	3.20	1.243
Profile Leveling	48	3.13	1.104	30	3.10	1.242

Note: The Importance scale, 1 = not important, 2= some importance, 3= moderately important, 4= strong importance, 5 = very strong importance

Conclusions

The purpose of this study was to identify traditionally and alternatively certified secondary agricultural education teachers' perceived level of importance to teach agricultural mechanics in the SBAE curriculum. The first objective sought to describe selected characteristics of traditionally and alternatively certified teachers and their agricultural education programs in Iowa. We conclude that alternatively certified agricultural education teachers in Iowa are an important subset of the teacher demographic and that their needs should be identified. Specifically, alternatively certified teachers made up approximately one-third of our study's respondents, significantly surpassing the 19.4% of new SBAE teachers (Smith, et al., 2022 and 15% of all teachers (United States Department of Education, 2015) who recently completed alternative routes to licensure in the United States. Additionally, as we consider the primary purpose of this study it is important to note that over one-half (*n*=51%) of the alternatively certified teachers had no post-secondary training in agricultural mechanics of any kind at the time of completing this study's questionnaire.

When considering previous research, Wells et al., (2013) found a positive relationship between training and intention to teach after completing a post-secondary agricultural mechanics course Roberts (2016) posited that experiential training allows for individuals to develop increased comprehensive skills. Krysher, et al. (2012) indicated that agricultural education teachers who participate in additional experiential learning activities (i.e., professional development in agricultural mechanics), gain a positive learning experience, which can have a positive influence on gravitating toward teaching particular levels of the content and therefore the importance they place upon those skills in the curriculum.

In exploring objective two, we reported traditionally and alternatively certified teachers' perceived importance to teach agricultural mechanics. When considering the five primary constructs of agricultural mechanics education included in this study, traditionally certified teachers identified four of the five constructs as being moderately important for inclusion in their agricultural education program. Alternatively certified teachers, however, identified all five of the constructs as having some importance. Walker et al., (2004) suggested that teachers who left the profession indicated that agricultural mechanics was their lowest desired course to teach. Burris et al., (2010) also found that teachers felt less comfortable teaching agricultural mechanics, and if given the choice would stray from teaching agricultural mechanics in their own curriculum. We believe that is could be directly attributed to the lack of training and positive experiences received by alternatively certified SBAE teachers prior to entering the classroom.

Ajzen's (1991) Theory of Planned Behavior supports the notion that positive behavioral intentions on a skill or area leads to positive behaviors to teach the newly learned skill or area. The lack of positive learning experiences in agricultural mechanics at both the secondary and post-secondary levels may have negatively impacted alternatively certified teachers' competency and willingness to teach this important component of the agricultural education curriculum. It takes multiple influences on an individual's behavior and positive learning experiences to attain new skills. Stripling & Roberts (2012) and Burris et al. (2010) have both indicated that more experience in a particular content area (such as agricultural mechanics) creates a higher self-confidence in the curriculum area. More exposure received in agricultural mechanics at the post-

secondary level can lead to an increased number of agricultural mechanics courses and skills being taught at the high school level (Wells et al., 2013).

Implications and Recommendations

When considering the lack of agricultural mechanics skills training required by alternatively certified SBAE teachers in Iowa, we recommend increased exposure to agricultural mechanics content and entry-level agricultural mechanics coursework to build foundational skills. Building foundational skills will perhaps lead to more positive behavioral intentions of traditional and alternatively certified teachers to teach agricultural mechanics at the secondary level. This has direct implications for traditional and alternative teacher licensure programs as well as the agricultural education profession.

Alternative licensure program coordinators and faculty should partner with traditional college and university program providers or develop relationships with community colleges or technical schools to provide critical skills training in agricultural mechanics. Additionally, alternative routes to SBAE licensure should integrate specific methods for teaching the critical skills identified in this study into the preparation program.

Alternatively certified teachers vary widely in the amount of teacher preparation courses at the post-secondary level. Therefore, with the expectations of agricultural mechanics to be taught at the secondary level, it is imperative that agricultural education teachers receive training in agricultural mechanics (Wells et al., 2013). Ford, et al. (2008) concluded that agricultural mechanics was the course in which alternatively certified teachers are least competent. Requiring alternatively certified teachers to receive training in agricultural mechanics before being licensed to teach will allow for increased competency and willingness to teach this important curricular content.

We also recommend that traditional and alternatively certified teachers have more opportunity for professional development in agricultural mechanics. Even though this study did not specifically look at the in-service needs of traditional and alternatively certified teachers, it is alarming how many chose to deem agricultural mechanics skills as less important to other courses in agricultural education in previous research (Walker et al., 2004). The in-service needs of traditional and alternatively certified teachers can be vastly different. However, in respect to agricultural mechanics curriculum both traditional and alternatively certified could use more professional development in this curriculum area. With agriculture continuously changing and advancing, teachers must be prepared to teach and keep up to date with these new innovations (Doerfert, 2011). By providing additional training and professional development for traditionally and alternatively certified teachers in various agricultural mechanics skills, SBAE teachers will gain the necessary skills and competencies to teach agricultural mechanics at the secondary level.

Additional research should be conducted to determine if early career teacher perceptions can be influenced by completing high quality, relevant professional development. Burris et al., (2013) contended professional development could help with teacher retention. This line of research could help program coordinators and faculty determine best practices for future professional development which should lead to a more positive perception of agricultural mechanics in SBAE. Retention of alternatively certified teachers is critical to help combat the huge teacher

shortage problem. With an ever-increasing number of alternatively certified teachers entering SBAE, the time to act is now!

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211.

Ajzen, I. (2002). Perceived behavioral control, Self-Efficacy, locus of control, and the theory of planned Behavior1. *Journal of Applied Social Psychology*, *32*(4), 665-683.

American Association for Agricultural Education (AAAE). (2023). *AAAE research values*.

Ary, D., Jacobs, L., Razavieh, A., & Sorensen, C. (2006). Introduction to research in education. (7th ed.). Wadsworth Publishing.

Buriak, P. & Harper, J. (2001). *Using classroom research to improve instruction.* [Paper Presentation] 20th National Agricultural Mechanics Professional Development Seminar and Blue Ribbon Presentation.

Burris, S., McLaughlin, E., McCulloch, A., Brashears, T., & Fraze, S. (2010). A comparison of first and fifth year agriculture teachers on personal teaching efficacy, general teaching efficacy, and content efficacy. *Journal of Agricultural Education, 51*(1), 22-31. doi: 10.5032/jae.2010.01022

Byrd, A., Anderson, R., Paulsen, T., & Schultz, M. (2015). Does the number of post-secondary agricultural mechanics courses completed affect teacher competence? *Journal of Agricultural Education*. *56*(1), 20-31. doi: 10.5032/jae.2015.01020

Clark, T. K., Anderson, R., & Paulsen, T. H. (2021). Agricultural mechanics preparation: How much do school based agricultural education teachers recieve? *Journal of Agricultural Education, 62*(1), 17–28. https://doi.org/10.5032/jae.2021.01017Darling-Hammond, L., Chung, R., & Frelow, F. (2002). Variation in teacher preparation: How well do different pathways prepare teachers to teach*? Journal of Teacher Education*, 53(4), 286-303. doi: 10.1177/0022487102053004002

Darling-Hammond, L., DiNapoli Jr, M., & Kini, T. (2023). The federal role in ending teacher shortages. Learning Policy Institute.

Dillman, D., Smyth, J., & Christian, L. (2009). Internet, mail, and mixed-mode surveys: The tailored design method (3rd ed.). John Wiley & Sons, Inc.

Doerfert, D. (Ed.) (2011). National research agenda: American Association for Agricultural Education's research priority areas for 2011-2015. Lubbock, TX: Texas Tech University, Department of Agricultural Education and Communications.

Dyer, J., & Andreason, R. (1999). Safety issues in agricultural education laboratories: A synthesis of Research. *Journal of Agricultural Education*, 40(2), 46-54. doi: 10.5032/jae.1999.02046

Feistritzer, C., & Haar, C. (2008). *Alternate routes to teaching*. Prentice Hall

Floyd, K. (2020). Factors to teacher retention in leave: Secondary agricultural education. Murray State Theses and Dissertations. 192. https://digitalcommons.murraystate.edu/etd/192

Foster, R. (1986). *Anxieties of Agricultural Education Majors Prior to and Immediately Following the Student Teaching Experience* [Paper Presentation]. Thirteenth Annual National Agricultural Education Research Meeting. Dallas, Texas.

Ford, R., Shinn, G., & Lawver, D. (2008). Perspectives of successful agricultural science and technology teachers on their preparation to teach agricultural mechanics. *Journal of Southern Agricultural Education Research*, *58*(1), 18-31.

George, D. and Mallery, P. (2003) SPSS for Windows Step by Step: A Simple Guide and Reference. 11.0 Update (4th edn). Boston, MA: Allyn & Bacon

Graham, J., & Garton, B. (2003). Certification measures: Are they predictive of secondary agriculture teacher performance? *Journal of Agricultural Education*, *44*(3), 54-65. doi: 10.5032/jae.2003.03054

Gliem, J., & Gliem, R. (2003). *Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales*. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.

Granberry, T., Roberts, R., & Blackburn, J. J. (2022). "A Challenge that I'm Willing to Take On:" The Self-Efficacy of Female Undergraduate Students in Agricultural Mechanics. Journal of Agricultural Education, 63(3), 44–58. https://doi.org/10.5032/jae.2022.03044

Granberry, T., Blackburn, J. J., & Roberts, R. (2023). The state of agricultural mechanics in the preparation of school-based agricultural education teachers. Journal of Agricultural Education, 64(4), 144-158. https://doi.org/10.5032/jae.v64i4.160

Hirsch, E., Koppich, J., & Knapp, M. (2001). *Revisiting what states are doing to improve the quality of teaching. An update on patterns and trends. Center for the Study of Teaching and Policy, University of Washington*.

Ingersoll, R., & Smith, T. (2003). The wrong solution to the teacher shortage. *Educational Leadership*, *60*(8), 30-33.

Iowa Department of Education (2010). Iowa High school agricultural education contract summary. https://docs.google.com/a/iowa

Knobloch, N., & Whittington, M. S. (2002). Novice teachers' perceptions of support, teacher preparation quality, and student teaching experience related to teacher efficacy. *Journal of Vocational Education Research*, *27*(3), 331-341.

Krysher, S., Robinson, J., Montgomery, D., & Edwards, M. (2012). Perceptions of teaching ability during the student teaching experience in agricultural education. *Journal of Agricultural Education, 53*(4), 29-40. doi: 10.5032/jae.2012.04029

Lublin, C. S. (2022). A qualitative descriptive study of the motivations of alternatively certified teachers in Florida. (Publication No. 29258936) [Doctoral dissertation, Grand Canyon University]. ProQuest Dissertations & Theses Global.

Miller, L., & Smith, K. (1983). Handling nonresponse issues. *Journal of Extension*, 21(5), 45 – 50.

Montano, D., & Kasprzyk, D. (2015). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. *Health behavior: Theory, research and practice*

Nakai, K., & Turley, S. (2003). Going the alternate route: Perceptions from non-credentialed teachers. *Education*, *123*(4), 831-846.

Povich, E. (2023). Plagued by teacher shortages, some states turn to fast-track credentialing. *National Conference of State Legislatures*. https://www.ncsl.org/state-legislatures-news/details/plagued-by-teacher-shortages-some-states-turn-to-fast-track-credentialing

Ramsey, J., & Edwards, M. (2011). Entry-level technical skills that agricultural industry experts expected students to learn through their supervised agricultural experiences: A modified Delphi study. *Journal of Agricultural Education*, *52*(2), 82-94. doi: 10.5032/jae.2011.02082

Rocca, S., & Washburn, S. (2006). Comparison of teacher efficacy among traditionally and alternatively certified agriculture teachers. *Journal of Agricultural Education*, *47*(3), 58-69. doi: 10.5032/jae.2006.03058

Roberts, T., Harder, A., & Brashears, M. T. (Eds). (2016). American Association for Agricultural Education national research agenda: 2016-2020. Gainesville, FL: Department of Agricultural Education and Communication.

Ruhland, S., & Bremer, C. (2003). Perceptions of traditionally and alternatively certified career and technical education teachers. *Journal of Vocational Education Research*, *28*(3), 285-302.

Saucier, P., & Krysher, S. (2014). Selected factors influencing Missouri school-based agricultural educators to instruct agricultural mechanics curriculum. *Journal of Agricultural systems, Technology, and Management.* 25, 1-11.

Shultz, M., Anderson, R., Shultz, A., & Paulsen, T. (2014). Importance and capability of teaching agricultural mechanics as perceived by secondary agricultural educators. *Journal of Agricultural Education*, *55*(2), 48-65. doi: 10.5032/jae.2014.02048

Smith, A., Lawver, R., & Foster, D. (2022). National agricultural education supply and demand study, 2022 Executive Summary. http://aaaeonline.org/Resources/Documents/NSD2022Summary.pdf

Stripling, C., & Roberts, T. (2012). Florida pre-service agricultural education teachers' mathematics ability and efficacy. *Journal of Agricultural Education, 53*(1), 109-122. doi: 10.5032/jae.2012.01109

Stripling, T., Ricketts, J. (2016). Research Priority 3: Sufficient scientific and professional workforce that addresses the challenges of the 21st century. *American Association for Agricultural Education National Research Agenda*, 2016-2020, 29-34

United States Department of Education. (2015, June). Highly qualified teachers enrolled in programs providing alternative routes to teacher certification or licensure. http://www2.ed.gov/about/offices/list/opepd/ppss/reports.html

Walker, W., Garton, B., & Kitchel, T. (2004). Job satisfaction and retention of secondary agriculture teachers. *Journal of Agricultural Education*, *45*(2), 28-38. doi: 10.5032/jae.2004.02028

Wells, T., Perry, D., Anderson, R., Shultz, M., & Paulsen, T. (2013). Does prior experience in secondary agricultural mechanics affect pre-service agricultural education teachers' intentions to enroll in post-secondary agricultural mechanics coursework? *Journal of Agricultural Education*, *54*(4), 222-237. doi:10.5032/jae.2013.04222

Will, M. (2023). What will teacher shortages look like in 2024 and beyond? A researcher weighs in. *Education Week*. https://www.edweek.org/leadership/what-will-teacher-shortages-look-like-in-2024-and-beyond-a-researcher-weighs-in/2023/12?s_kwcid=AL!6416!3!602270476281!!!g!!&utm_source=goog&utm_medium=cpc&utm_campaign=ew+dynamic+recent&ccid=dynamic+ads+recent+articles&ccag=recent+articles+dynamic&cckw=&cccv=dynamic+ad&gad_source=1&gclid=Cj0KCQjw2PSvBhDjARIsAKc2cgOzyLsmoJgJLQIizSkA6BU4wqwyIzi7R_FY3dzzzj78r1on2C7chI0aAvgmEALw_wcB

Strengths of State FFA Officers Through the Years

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Abstract
The depth and strength of agricultural professions, in all facets, rely on self-aware and purposed-driven individuals armed with accurate confidence in personal competencies. In this descriptive study, a convenience sample of state FFA officers (N=3,283) in the National FFA Organization were administered the Clifton StrengthsFinder® assessment, from 2006-2010 and 2012-2015, as a tool provided by the National FFA Organization as part of a state FFA officer leadership training program. Authentic leaders have a profound sense of self, which can be essential in shaping a strengths-based organization. Strengths provide an opportunity to develop state FFA officer self-awareness and authentic leadership skills that are highly transferable to current student interests and any future schooling or career path chosen. This pre-existing data was studied and outlines the trends in the top five signature talent themes of this sample population, the most frequently shared talents in this sample are Achiever (36.83%), Responsibility (32.17%), Restorative (29.33%), Includer (28.88%) and Learner (25.46%). Future research recommendations include following up with a random selection of state officer teams at the conclusion of their state officer year with reflection on the impact, utility and rigor of strengths, and strengths training program may shed valuable insight. Additionally, a one- year post survey, followed by a five-year post survey, could also help identify the impact and utility of the strengths component to state FFA officers. The State and National FFA Organizations should also consider these findings with regard to all leadership development programming. Also including a random sample population of students to complete the StrengthsFinder® assessment both in FFA and not in FFA could provide an opportunity for comparison in student talents, which lay groundwork in relation to student motivations, interests, and retention.

Introduction
Students today want to pursue careers that will be personally and professionally rewarding and are aligned with their values and interests (National Research Council, 2009; Quinlan et al., 2022). Well-known, the basis of the National FFA Organization is reflected in the mission, "FFA makes a positive difference in the lives of students by developing their potential for premier leadership, personal growth and career success through agricultural education" (National FFA Organization, 2016, p. 7). Every student is unique, has individual needs, interests, motivations and aspirations. Better understanding the diversity of students in our classrooms may provide more understanding of effective educational practices, and could lead to improved learning

environments (Woolfolk, 2010). Nurturing and growing leadership skills are essential for students who are developing professional competencies and majoring in the field of agricultural and life sciences (Strong et al., 2013).
Velez et al. (2015) posited "agricultural leadership education opportunities are prevalent and growing across the nation," (p. 124). Modern views of leadership focus more on authenticity, with the concept that leaders are most effective when they are being themselves and holding true to that (Gardner et al., 2021; Linley et al., 2007). The depth and strength of the agricultural profession, in all facets, rely on self-aware and purpose-driven individuals armed with accurate confidence in personal competencies. Providing empowerment and preparation in this self-awareness and understanding others paves the way to be agents of social change (DeMink-Carthew, et al., 2020; Wisner, 2011).

Additionally, autonomy promotion is commonly used as a pedagogical approach in social change centered youth leadership programs (Buzinde et al., 2019). Agency and determination through critical social analyses are used to advance community development and well-being of youth. Horstmeier and Nall (2007) explored youth leadership development from a national perspective on FFA member role and activity context in 2007. Recommendations from the study highlight a perpetuation of members experiencing a continuum of leadership development activities, which should include an emphasis on assisting youth to gain skills that help them better understand self and interaction with others (Horstmeier & Nall, 2007). The study goes on to bring attention to the potential need for even more opportunities of community and group development experiences to plug in adequate personal development experiences (Horstmeier & Nall, 2007). The rapid pace of today's societal change makes learning part of almost every environment and effectively connecting with people in those environments can be pivotal in success (Clifton et al., 2006).

Development of state FFA officers was considered in a study completed by Hoover & Bruce (2006) where they evaluated that holding a state level FFA office engages youth in self-exploration and discovery of strengths and weaknesses. In addition, it provides an avenue to receive recognition for competence, which is a long-term consequence associated with serving as a state FFA officer in Pennsylvania. Results also indicated support of positive adolescent development, transference of leadership skills, and purposeful civic and community engagement were also benefits (Hoover & Bruce, 2006).

Two identified contributions, recruitment of new students to the college of agriculture and leadership in campus organizations, were identified as being made to undergraduate student leadership involvement by former 4-H and FFA members (Park & Dyer, 2005). Park and Dyer (2005) examined potential relationships between involvement in FFA and 4-H and increased undergraduate student leadership involvement at a land-grant college of agriculture.

Nearly 500 colleges and universities have explored the application of strengths (Bowers & Lopez, 2010). At Michigan Ross School of Business, students who reported having a strong understanding of their own strengths were more engaged with school and more hopeful for the future (Gallup, 2016). While they measured success in multiple ways, the University of Southern Maine initially sought the strengths program to aid efforts to increase first-year students' retention and a slight increase in retention was noted (McCarville, 2016).

Goleman, et al. (2002) discussed how "the ability of a leader to pitch a group into an enthusiastic, cooperative mood can determine its success. On the other hand, whenever emotional conflicts in a group bleed attention and energy from their shared tasks, a group's performance will suffer" (p.14). In a study by Lehnert (2009) results indicated that participants who engaged in the strengths training thus reported greater gains on the five dimensions of Kouzes and Posner's (2007) Leadership Challenge Model. These ideas all support the key role of not only strengths awareness and utilization of self-identified strengths, but also those of teammates' strengths. Five practices uncovered common to personal-best leadership experiences, which are part of the model, include model the way, inspire a shared vision, challenge the process, enable others to act, and encourage the heart (Kouzes & Posner, 2007). Analyzing through strengths-colored glasses, according to the research, has shown that one can view oneself, their future, and others all differently (Clifton, et al., 2006).

Finding out what gives meaning to others' efforts proves as an element of envisioning the future (Kouzes & Posner, 2007). Utilizing strengths has been associated with significantly higher levels of happiness, well-being and fulfillment, leading to a greater degree of authenticity (Linley et al., 2007). At a midwestern university, students reported influential leadership growth upon receiving their strengths results (Bayer, 2012). Another study supported that the "focus on students' strengths fostered a positive perception of the university and encouraged students to feel as though they uniquely and positively impacted the university community with their particular combination of strengths" (Soria & Stubblefield, 2015, p. 630).

Analysis of state FFA officer teams can provide insight into the true diversity of talents among student members, while providing a glimpse towards the future. Balancing work according to the strengths of the team and of the collective introduces a higher-level of strengths implementation and strengths-based teamwork (Linley et. al. 2007). Buckingham & Clifton (2001) discussed how all strengths have a 'shadow side', underscoring the importance to find balance with using strengths, not to let them overpower other people or talents inappropriately. Organizations like the National FFA Organization are challenged to keep pace with society, while continuing to prepare students for vigorous personal growth and provide unique and challenging leadership opportunities, which can pave a solid path to a number of experiences that lead to career success.

The Clifton StrengthsFinder® is a web-based assessment that measures the presence of 34 talents organized into themes (Clifton et al., 2006). A theme is a category of talents, which are defined as recurring and consistent patterns of thought, feeling, or behavior (Buckingham & Clifton, 2001). The intentional purpose of the assessment is to nurture personal growth through discussion with others and as a tool for self-awareness (Asplund et al., 2009).

Figure 1

Talent	Definition
Achiever®	People exceptionally talented in the Achiever theme work hard and possess a great deal of stamina. They take immense satisfaction in being busy and productive.
Activator®	People exceptionally talented in the Activator theme can make things happen by turning thoughts into action. They are often impatient.
Adaptability®	People exceptionally talented in the Adaptability theme prefer to go with the flow. They tend to be "now" people who take things as they come and discover the future one day at a time.
Analytical®	People exceptionally talented in the Analytical theme search for reasons and causes. They have the ability to think about all the factors that might affect a situation.
Arranger™	People exceptionally talented in the Arranger theme can organize, but they also have a flexibility that complements this ability. They like to determine how all of the pieces and resources can be arranged for maximum productivity.
Belief®	People exceptionally talented in the Belief theme have certain core values that are unchanging. Out of these values emerges a defined purpose for their lives.
Command®	People exceptionally talented in the Command theme have presence. They can take control of a situation and make decisions.
Communication®	People exceptionally talented in the Communication theme generally find it easy to put their thoughts into words. They are good conversationalists and presenters.
Competition®	People exceptionally talented in the Competition theme measure their progress against the performance of others. They strive to win first place and revel in contests.
Connectedness®	People exceptionally talented in the Connectedness theme have faith in the links among all things. They believe there are few coincidences and that almost every event has meaning.
Consistency™	People exceptionally talented in the Consistency theme are keenly aware of the need to treat people the same. They try to treat everyone with equality by setting up clear rules and adhering to them.
Context®	People exceptionally talented in the Context theme enjoy thinking about the past. They understand the present by researching its history.

Deliberative™	People exceptionally talented in the Deliberative theme are best described by the serious care they take in making decisions or choices. They anticipate obstacles.
Developer®	People exceptionally talented in the Developer theme recognize and cultivate the potential in others. They spot the signs of each small improvement and derive satisfaction from evidence of progress.
Discipline™	People exceptionally talented in the Discipline theme enjoy routine and structure. Their world is best described by the order they create.
Empathy™	People exceptionally talented in the Empathy theme can sense other people's feelings by imagining themselves in others' lives or situations.
Focus™	People exceptionally talented in the Focus theme can take a direction, follow through, and make the corrections necessary to stay on track. They prioritize, then act.
Futuristic®	People exceptionally talented in the Futuristic theme are inspired by the future and what could be. They energize others with their visions of the future.
Harmony®	People exceptionally talented in the Harmony theme look for consensus. They don't enjoy conflict; rather they seek areas of agreement.
Ideation®	People exceptionally talented in the Ideation theme are fascinated by ideas. They are able to find connections between seemingly disparate phenomena.
Includer®	People exceptionally talented in the Includer theme accept others. They show awareness of those who feel left out and make an effort to include them.
Individualization®	People exceptionally talented in the Individualization theme are intrigued with the unique qualities of each person. They have a gift for figuring out how different people can work together productively.
Input®	People exceptionally talented in the Input theme have a craving to know more. Often they like to collect and archive all kinds of information.
Intellection®	People exceptionally talented in the Intellection theme are characterized by their intellectual activity. They are introspective and appreciate intellectual discussions.
Learner®	People exceptionally talented in the Learner theme have a hreat desire to learn and want to continuously improve. The process of learning, rather than the outcome, excites them.

Maximizer®	People exceptionally talented in the Maximizer the focus on strength as a way to stimulate personal and group excellence. They seek to transform something strong into something superb.
Positivity®	People exceptionally talented in the Positivity theme have contagious enthusiasm. They are upbeat and can get others excited about what they are going to do.
Relator®	People exceptionally talented in the Relator theme enjoy close relationships with others. They find deep satisfaction in working hard with friends to achieve a goal.
Responsibility®	People exceptionally talented in the Responsibility theme take psychological ownership of what they say they will do. They are committed to stable values such as honesty and loyalty.
Restorative™	People exceptionally talented in the Restorative theme are adept at dealing with problems. They are good at figuring out what is wrong and resolving it.
Self-Assurance™	People exceptionally talented in the Self-Assurance theme feel confident in their ability to manage their own lives. They possess an inner compass that gives them confidence that their decisions are right.
Significance™	People exceptionally talented in the Significance theme want to be very important in others' eyes. They are independent and want to be recognized.
Strategic™	People exceptionally talented in the Strategic theme create alternative ways to proceed. Faced with any given scenario, they can quickly spot the relevant patterns and issues.
WOO™	People exceptionally talented in the Woo theme love the challenge of meeting new people and winning them over. They derive satisfaction from breaking the ice and making a connection with someone.

Knowing talents and areas of potential strength help individuals become more of who they are. Strengths identification and development can be an aid to being a more genuine version of self. StrengthsFinder® helps "find where you have the greatest potential for a strength" (p. 78) by aiming to "identify the strongest aspects of your mental network, your signature themes" (Buckingham & Clifton, 2001, p. 141).

Conceptual Framework

Authentic leadership serves as one piece of framework for this study. Luthans and Avolio (2003) outlined authentic leadership in the context of an organization as "a process that draws from both positive psychological capacities and a highly developed organizational context, which results in

both greater self-awareness and self-regulated positive behaviors on the part of leaders" (p. 243). Begley (2004) described authentic leadership as "a function of self-knowledge, sensitivity to the orientation of others, and a technical sophistication that leads to a synergy of leadership action" (p. 5). Each definition contains similar language and components, yet they are stated in slightly different perspectives. Through the authentic leadership research agenda and Gallup Leadership Institute associates, Avolio et al. worked on a more refined definition (Garner, et al., 2011). "Authentic leadership is a pattern of leader behavior that draws upon and promotes both positive psychological capacities and a positive ethical climate, to foster greater self-awareness, an internalized moral perspective, balanced processing of information, and relational transparency on the part of leaders working with followers, fostering positive self-development" (Walumbwa et al., 2008, p. 94). Across these variances in interpretation of authentic leadership, one component has been widely agreed upon as the beginning of authentic leadership development, a leader's self-awareness (Steffens et al., 2021; Avolio & Gardner, 2005).

Wisner (2011) outlined how authentic leadership development is a theory that promotes the development of strengths and is rooted in positive psychology. She goes on to discuss that even though further research is needed to fully understand the impact of strengths ownership on leadership effectiveness, indications exist that effective leadership behaviors in her college student sample may be increased through the development of psychological strengths (Wisner, 2011). Avolio & Gardner's (2005) key distinction of authentic leaders was "anchored by their own deep sense of self" (p. 329) and that "authentic leadership can help develop and shape a strength-based organization" (p. 334).

Purpose and Objectives

State FFA officers have the opportunity to complete a rigorous training and curriculum program offered by the National FFA Organization as part of the state FFA officer continuum. Some states actively utilize the strengths concepts and resources throughout the year of office (Mills, et al., 2023), while others do not utilize the Clifton StrengthsFinder® program at all, or beyond utilization of just the initial assessment. The data from the state officers who have completed the assessment provided by the National FFA Organization hasbeen collected since 2006, yet little analysis has been completed for student development information and insights.

As outlined by Roberts et al. (2016) in the Agricultural Education Research Agenda in Priority Area 3, Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century, the need to investigate soft skill development and preparedness, as well as, agricultural recruitment and retention, is necessary to address this priority. The existing body of research specific to agricultural education leadership settings is growing. Analysis of state FFA officer data could provide foundational information in student leadership insight into soft skill development, as well as student recruitment and retention to leadership programs, and potentially the FFA. The strengths revolution is focused on utilizing differences in each person and building the organization around those differences (Buckingham & Clifton, 2001).

The purpose of this study was to analyze and examine self-identified talents among state FFA officers spanning nearly a decade of student leaders *(N=3,283)* with data collected from the National FFA Organization. This will be accomplished through the following objective. Examine diversity of the top five talents of state FFA officers as talent is identified by the Clifton StrengthsFinder® assessment.

Methodology

The focus of this study was to identify and explore self-identified talents among state FFA officers spanning nearly a decade of student leader data collected by the National FFA Organization. A convenience sample of state FFA officers who participated in the Clifton StrengthsFinder® assessment tool who chose to participate. Unfortunately, the exact number of state FFA officers was not collected each year, as the number is not static. In some state associations, regional officers or presidents are considered state FFA officers who thus train together. Since this total number of officers is not consistently reported the exact percentage of the total population is not available. The structure of the National FFA Organization's state officer leadership resources, specifically the utilization of the Clifton StrengthsFinder® assessment, is the basis of this research. All states' FFA associations are provided, free of charge, the opportunity and information to distribute an access code to state FFA officers in order to utilize the Clifton StrengthsFinder® assessment. Once a student completes the assessment, the signature, top five themes of talent are recorded and available to the National FFA Organization. Resources are available to assist the officer and association with further development and information in regards to each officer's talents. According to Clifton et al. (2006) in *StrengthsQuest*, the Clifton StrengthsFinder® is a "Web-based talent assessment consisting of 180 item-pairs (with five response options), presented to the user over a secure connection." Clifton et al. (2006) further states that,

> The participant is then asked to choose from that pair the statement that best describes him or her, and to the extent to which that chosen option is descriptive of him or her. The participant is given 20 seconds to respond to each pair of items before the system moves on to the next item-pair. Upon completion, the respondent receives feedback including his or her top five themes and related action items (p. 301).

Using Microsoft® Excel to organize the themes, and when present, attaching the state association demographic, the data was then analyzed using JMP for frequency and percent.

Helping individuals identify natural positive talents, the Clifton StrengthsFinder® assessment was built on the concept of positive psychology, and has been vetted through aspects of validity, reliability, consistency, and utility. Content validity has shown evidence of strength in its results, as well as, deeper exploration into construct validity has shown no problem with multicollinearity (Asplund et.al, 2009). Criterion-related validity studies have shown positive results in comparison to other well-validated personality instruments similar to the Clifton StrengthsFinder® (Gallup Strengths Center, 2016; Schreiner, 2006). Schreiner (2006) conducted a study across 14 colleges and universities with N=438 usable sample and measured construct validity in two ways, comparing Clifton StrengthsFinder® student results to the same students taking two similar inventories, the California Psychological Inventory (Gough & Bradley, 1996) and the 16PF (Cattell, 1993). "93.4% of these predictions were confirmed by significant correlation coefficients", as well as the "average item clustering percentage across all possible theme pairs was 90%" (Schreiner, 2006, p.7). A number of studies exist that have shown such evidence to strongly support positive utility and are easily found across a number of outlets (Schreiner, 2006; Bayer, 2012; Lane & Chapman, 2011; Stebleton, et al. 2012; Wisner, 2011; Gillum, 2005; Lehnert, 2009).

Two types of reliability estimates were used to examine the Clifton StrengthsFinder®, internal consistency using Cronbach's alpha, as well as test-retest reliability (Asplund, et. al, 2009). Test-retest correlations were generally consistent; however, the reliability of the score profile is also critical, and a Chi-Square test of independence was conducted on each theme. (Asplund, et.al, 2009). Evidence of stability for 33 of the 34 themes had significant results; however, one theme, self-assurance, was less stable over time (Asplund et.al., 2009). The test-retest reliability was also examined and deemed appropriate by Schreiner (2006) by taking the assessment a second time 8-12 weeks after the first, and after not receiving their results, the mean score was .70, an acceptable measure.

StrengthsFinder® data has shown benefits to teachers in effective teaching and responding to youth (Educational Horizons, 2006). Research has revealed the idea of three possible stages of strengths development: talent identification, integration and acceptance of one's talents followed with changed behaviors (Hodges & Harter, 2005). Exploration of leadership development from a strengths perspective serves as an alternative path to evaluate leadership development practices. Interviews administered by Gallup analysts to more than two-million individuals were reviewed and generated into data that was used to capitalize on the accumulated knowledge and experience of strengths-based practice (Asplund, et al., 2009). Currently, the assessment is available in over 20 different languages, and after a revision in 2006, these 180 items were reduced to 177. These items are grouped into 34 themes, which are listed in Table 4.1 (Clifton et. al. 2006).

Results

This study sought to analyze the talent diversity among the sample of state FFA officers as identified by the Clifton StrengthsFinder® assessment. Table 1 displays the frequencies and percentages of all 34 talent themes across the sample state officer population throughout the entire data collection period. Achiever and Responsibility were the two most frequently shared talents across state FFA officers. Achiever occurred 1,209 times in 3,283 state FFA officers at a frequency of 36.83 percent. Responsibility occurred 1,056 times in 3,283 state FFA officers at a frequency of 32.17 percent. Command and Intellection were located at the bottom of the talent frequencies, occurring 162 times at 4.93% and 137 times at 4.17% respectively. Achiever, Responsibility, Restorative, Includer, and Learner were the most frequently shared talents among state FFA officers from. However, across all years, eight of the ten most commonly shared talents were consistently ranked in the top ten of each data collection year. Achiever, Responsibility, Restorative, Includer, Belief, Positivity, WOO and Learner are of the most consistently shared in the top ten each year among state FFA officers. It should also be noted that all 34 talent themes occurred in the sample population of officers.

Table 1
Frequency of strengths in top 5 themes

Strength	*f*	%
Achiever	1209	36.83
Responsibility	1056	32.17
Restorative	963	29.33
Includer	948	28.88
Learner	836	25.46
Belief	788	24.00
WOO	772	23.52
Positivity	751	22.86
Input	648	19.74
Communication	630	19.19
Strategic	607	18.49
Adaptability	557	16.97
Futuristic	534	16.27
Relator	502	15.29
Harmony	494	15.05
Arranger	475	14.47
Developer	474	14.44
Competition	457	13.92
Individualization	367	11.18
Context	362	11.03
Focus	314	9.56
Ideation	281	8.56
Significance	270	8.22
Activator	250	7.61
Empathy	228	6.94
Discipline	219	6.67
Maximizer	202	6.15
Consistency	194	5.91
Self-Assurance	192	5.85
Analytical	182	5.54
Connectedness	177	5.39
Deliberative	177	5.39
Command	162	4.93
Intellection	137	4.17

Table 2 outlines the top ten most frequently shared talents each data collection year. In 2006, *N=398* state FFA officers, outlining the top two themes, 131 have Achiever in their top five talents which is 32.91%, followed closely by Responsibility with 120 occurrences at 30.15%. In 2007, *N=390* state FFA officers, outlining the top two themes, Achiever occurred 149 times at 38.21%, followed by Responsibility at 117 instances and 30.00%. In 2008, *N=338* state FFA officers, the top two themes, Achiever occurred 135 times at 39.94% and Responsibility occurred

112 times at 33.14%. In 2009, *N=381* state FFA officers who took the assessment, and this year's data showed Responsibility as the most commonly shared talent, occurring 133 times at 34.91%, while Achiever occurred 129 times at 33.86%.
In 2010, Achiever edged back to the most commonly shared talent of the *N=372* state FFA officers. Achiever occurred 142 times at 38.17% while Responsibility was shared 139 times at 37.37%. Interestingly in 2012, of the *N=354* state FFA officers who took the assessment, Achiever still tops the list, which occurred 130 times at 36.72%, while Responsibility fell to third most commonly shared. Includer became the second on the list, which occurred 124 times at 35.03%. Responsibility still held on to a 31.92% shared trait among the state FFA officers in the 2012 data.

In 2013, Achiever still continued to be the most commonly shared talent of the *N=328* state FFA officers, 121 had Achiever in their top five occurring at 36.89%. Responsibility measured in at the second most commonly shared among the 2013 officers, occurring 102 times at 31.10%. Includer and Restorative measured in at third at 30.18%. The *N=372* state FFA officers who participated in the assessment in 2014, shared Achiever as their most commonly shared talent, occurring 148 times at 39.78% and Restorative as the second most common at 118 times and 31.72%. Responsibility stayed just above 30% as third most commonly shared. In 2015, of the *N=350* state FFA officers who took the assessment, surprisingly Restorative reigned in as the most commonly shared talent, 130 shared at 37.14%. While Achiever became the second most commonly shared in 124 officers at 35.43%. Responsibility still occurred at 30.86% in 108 students.

Table 2

Top 10 Most Frequently Shared Strengths Among State FFA Officers

	2006	2007	2008	2009	2010	2012	2013	2014	2015
	f (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)
Achiever	131 (32.91)	149 (38.21)	135 (39.94)	129 (33.86)	142 (38.17	130 (36.72)	121 (36.89)	148 (39.78)	124 (35.43)
Adaptability			66 (19.23)	66 (17.32)					
Belief	96 (24.12)	91 (23.33)	85 (25.15)	82 (21.52)	89 (23.92)	91 (25.71)	78 (23.78)	80 (21.51)	96 (27.43)
Communication			74 (21.89)	91 (23.88)	69 (18.56)	75 (21.19)	64 (19.51)		
Developer						68 (19.21)	60 (18.29)		
Futuristic					70 (18.82)			69 (18.55)	67 (19.14)
Includer	102 (25.63)	105 (26.92)	109 (32.25)	98 (25.72)	114 (30.65)	124 (35.03)	99 (30.18)	106 (28.49)	91 (26.00)
Input		84 (21.54)	69 (20.41)	82 (21.52)	70 (18.81)		59 (17.99)	79 (21.24)	74 (21.14)
Learner	98 (24.62)	80 (20.51)	80 (20.51)	80 (20.51)	80 (20.51)	80 (20.51)	80 (20.51)	80 (20.51)	80 (20.51)
Positivity	78 (19.60)	78 (19.60)	78 (19.60)	78 (19.60)	78 (19.60)	78 (19.60)	78 (19.60)	78 (19.60)	78 (19.60)

Relator	99 (24.87)	99 (24.87)							
Responsibility	120 (30.15)	120 (30.15)	120 (30.15)	120 (30.15)	120 (30.15)	120 (30.15)	120 (30.15)	120 (30.15)	120 (30.15)
Restorative	105 (26.38)	105 (26.38)	105 (26.38)	105 (26.38)	105 (26.38)	105 (26.38)	105 (26.38)	105 (26.38)	105 (26.38)
Strategic	84 (21.11)	84 (21.11)			73 (19.62)	73 (19.62)	73 (19.62)	73 (19.62)	
WOO	100 (25.13)	100 (25.13)	100 (25.13)	100 (25.13)	100 (25.13)	100 (25.13)	100 (25.13)	100 (25.13)	100 (25.13)

Conclusions and Discussion

State FFA officers are members who have sought out the opportunity to serve the organization in the capacity of a student leader. The sample population of state FFA officers shows a diversity of all represented talent themes. With Achiever and Responsibility as two of the most frequently occurring themes in the sample, as a majority, state FFA officers are driven and highly accountable students. With Command and Intellection as the two least occurring in the sample, this population less frequently takes charge of situations or quietly thinks to themselves.

Looking deeper into the definitions of Achiever and Responsibility in the context of the Clifton StrengthsFinder® assessment, even more insight can be gained. An Achiever is driven by accomplishment, and therefore keeps very busy and productive (Buckingham & Clifton, 2001). Students in the organization, specifically state FFA officers, are generally seen as driven individuals, diligently working to accomplish the next task at hand. The organization is saturated with opportunities for student achievement, officer positions, competitions, scholarships and awards, which all appeal to students high in the talent of Achiever. An individual with the Achiever talent finds a reoccurring drive to accomplish, consistently pushing for more each day. A state officer with this talent will relentlessly seek accomplishments, facing challenge after challenge. Balance for the Achiever theme is important to encourage those with this talent to not take on too much or be driven to accomplish things without it being purposed. Embracing the drive among state officers with this talent could find a positive impact in the organization, the agricultural classroom, and society.

The Responsibility theme stirs the need to take ownership over everything said, done or committed to doing (Buckingham & Clifton, 2001). This sense of ownership marries quite well with the Achiever theme and further leads to the reputation of state FFA officers that not only are driven to accomplish whatever is at hand, but also have the sense of responsibility to see that it is done. The FFA touts the need for a high sense of responsibility in young people throughout agriculture, attracting a high number of state FFA officers with a natural talent of Responsibility. Balancing the talent of Responsibility is necessary, it can also overwhelm individuals into taking on more than realistically can be accomplished. Young people in agriculture that are high in the theme of Responsibility are vitally necessary as continued misinformation floods media outlets, confusing and misleading consumers and the public about food and agriculture.

The Restorative talent speaks to problem solvers, who are energized by identifying and examining symptoms and solutions (Buckingham & Clifton, 2001). Restorative state FFA officers can find potential impact when examining challenges and seeking solutions for these

challenges, whether in the organization, the classroom, in relationships or in agriculture. Seeking balance for the Restorative talent is necessary to ensure the drive for solutions doesn't overtake the bigger picture. Many agricultural courses have become more focused on problem-based learning. Is this drawing a stronger contingency of naturally Restorative talented young people to the FFA? The potential challenges that lie ahead in food and agriculture can be overwhelming at times. This surprising number of Restorative young people, ready to take on the challenges of any type of problem, is comforting to see in these young agriculturalists.

Being an Includer provides for the desire to make others feel included and part of the group (Buckingham & Clifton, 2001). State FFA officers can utilize this talent to support and encourage younger members in the organization and draw new ones to the table. Inclusiveness can promote a welcoming environment that nurtures participation and engagement. A relationship to the official dress of the organization, something as simple as the unity of the FFA jacket, may potentially be appealing to this high number of students who are naturally talented and drawn to inclusion. As demographics of the nation continue to change, appreciation for the talent of Includer in the National FFA Organization among student leaders will potentially have an impact on current members, as well as those that may be considering joining the organization.

Learners, quite simply, love to learn and are drawn to the process of learning (Clifton et. al., 2006). As agriculture is an ever-evolving field, those with the natural talent of a Learner would tend to be drawn to it by the nature of learning. Serving as a state FFA officer can offer a large learning curve to many, finding a large component of state FFA officers naturally talented in this ability could support this relationship. This love of learning will potentially transcend future endeavors, a continued desire to learn more, in career skills and technical training, in post-secondary education, graduate courses and adult education programs. This constantly changing field of agriculture will require those with this drive to not just sustain that need, but also to exceed that expectation.

A strong Belief theme indicates that an individual holds certain core values that are enduring (Buckingham & Clifton, 2001). These values shape everything one does, and quite frankly, why they do it. The FFA has strong traditions and foundations, is it really a surprise that student leaders strong in the Belief talent are found in this organization? Those high in the Belief theme find a demand to have meaning behind what one does and meaning that meshes with those core values (Buckingham & Clifton, 2001).

Always looking on the positive side of any situation is what the talent theme of Positivity is simply all about (Clifton et. al., 2006). Positiveness can be contagious, and state FFA officers with this talent can impact a number of other members they encounter throughout their experience. Recognizing students with this talent and approaching experiences in school and in life can be impacted with a positive perspective.

WOO stands for winning others over and embraces the challenge of meeting new people and getting them to like you (Clifton et. al., 2006). In fact, people strong in this talent are energized from this process, continually seeking opportunities to do it over and over again. This is a useful talent to have as a state FFA officer, since a large part of their responsibilities include meeting new people both in and out of the organization.

Looking at the less common strengths shared among state FFA officers in their top 5 themes is also revealing. The five least commonly occurring strengths in state FFA officers across this data period were Deliberative, Analytical, Connectedness, Command and Intellection. The Deliberative talent is expressed as a careful, vigilant, private person that carefully assesses each decision (Buckingham & Clifton, 2001). As one considers this nature described in a person with the talent of Deliberative, questions arise that if the instant access and gratification rich in today's world has impacted this talent, is it not as prevalent in young people? Or, is it not as prevalent among state FFA officers? The Analytical theme shows an appreciation of data while being objective and dispassionate (Buckingham & Clifton, 2001). This theme provides a necessary challenge at times to question ideas and look deeper past emotions to proof. Someone that can provide this talent, and naturally have the ability to look deeper beyond emotions of situations, may have a profound impact on any challenge encountered. Consider the high number of controversial issues involved in agriculture, someone that has the natural ability to wade through these types of challenges and evaluate evidence in light of varying emotions may be necessary to advancing the organization and the industry. The Connectedness talent allows someone to see the relationships and connections among all things, embracing that everything happens for a reason (Buckingham & Clifton, 2001). The natural talent of seeing connections among things could be of value to the FFA and agriculture, allowing a perspective that may provide others with a sense of being part of something bigger.

Command and Intellection weigh in at less than five percent of the time occurring in state FFA officers' top signature themes. Individuals high in the talent of Command have a desire and need to take charge and share their opinions with others (Buckingham & Clifton, 2001). Confrontation is accepted as part of the process towards resolution and is not avoided by most individuals high in the talent of Command (Buckingham & Clifton, 2001). State FFA officers high in Command may find this talent a natural fit for seeking opportunities, which allow them to exercise this sense of authority. The talent of Intellection is about liking to think and enjoying mental activity, even in multiple directions (Buckingham & Clifton, 2001). This introspective nature tends to be noted as someone who likes time alone or time to think. Nurturing this talent in state FFA officers can provide a valuable resource to a group or team as someone who has taken some time to think about situations, solutions and questions. Why are these strengths are found less frequently among state FFA officers? Serving as a state FFA officer does present as a team experience. Do individuals strong in the talent of Intellection and Command feel less embraced to serve on a team of officers? Do FFA programs and opportunities discourage these abilities from flourishing in students? Does FFA not attract students with these talents, or are these talents simply not as prevalent across young people taking the assessment or in today's youth?

Notably, all 34 themes of talent are represented across the 3,283 state FFA officers represented in this data, ranging from 4.17% to 36.83% in the top 5 themes. Diversity among state FFA officers is quite visible with this array of talents while common themes also bring these students together. Strong representation and shared talents of Achiever and Responsibility fuel this collective group to 'do' much with this broad representation of student talents.
Embracing the complex facets of each talent encountered could be a huge step in embracing greater self-awareness. Authentic leadership promotes a nurturing environment towards greater self-awareness, internalization of moral perspectives, balanced processing and relational transparency, ultimately advancing positive self-development (Walumbwa et al., 2008).

Furthermore, objectively considering how talents can grow into strengths and honestly recognizing non-strengths could be considered a component of internalization and balanced processing. Relational transparency can build from learning about teammates' strengths and considering other's thoughts, feelings, and behaviors about these strengths as well as their own. Potentially each of these steps in authentic leadership development could find a parallel in state FFA officer strengths development.

Authentic leadership connects back to the intentional purpose of the Clifton StrengthsFinder® assessment, which is to nurture personal growth and be utilized as a tool for self-awareness (Asplund et al., 2009). What will a greater number of self-aware students in FFA and agricultural education truly mean? What impact can a greater number of self-aware students with the talent of Achiever have on the agricultural education world? Are those students aware of their talents in Responsibility? Restorative? Inclusion? Learners? Although true strengths development takes the ability to hone and develop natural talents, so they can be harnessed for best benefits, do opportunities in the FFA organization encourage students with any talent to join the organization? Does the opportunity to serve as a state FFA officer attract all facets of FFA members, at least in the context of talent diversity? Does this state FFA officer population data also represent the talent statistics across the general membership of the National FFA Organization? Are some talents more or less common among the general student population? What about just agricultural education students? Furthermore, do the programs and opportunities in the National FFA Organization nurture all students with a variety of talents, or does the organization attract certain students with specific natural abilities more readily?

Implications and Recommendations

Positive psychology applied in modern views of leadership are more positioned around the concept of authenticity, simply stating that the most effective leaders are being themselves and being true to themselves (Linley et. al, 2007). As noted by the National Research Council (2009) and Quinlan et al. (2022) today's students want careers that will be not only personally and professionally rewarding but are also aligned with their values and interests. Considering this talent information about students may allow these natural abilities to potentially become areas of great strength. Young people at times can be challenged to focus on their ever-changing interests, with heavy weight placed on future decisions, like certifications, schooling and careers.

A strength's focus encourages organizations to become great by utilizing each person's differences, and then build the organization around those differences (Buckingham & Clifton, 2001). Providing programs and opportunities to authentically develop natural talents through leadership development may further pave the way for not only a strong organization, but a strong strengths-based organization. Utilizing strengths has been associated with significantly higher levels of happiness, well-being, and fulfillment leading to a greater degree of authenticity (Linley, et. al., 2007). Strengths-focused programs and classrooms is one way to move towards a student-centered, personal instruction approach.

Furthermore, considerations of this data lead to future research recommendations. Following up with a random selection of state officer teams at the conclusion of their state officer year with reflection on the impact, utility and rigor of strengths and strengths training program may shed valuable insight. Additionally, a one-year, post survey followed by a five-year post survey could also help identify the impact and utility of the strengths component to state FFA officers. The

State and National FFA Organizations should also consider these findings with regard to all leadership development programming. Are students receiving adequate information, opportunities and resources to identify, nurture and grow their talents? As reflected in the data, with over 30% of state FFA officers with talents heavy in the Executing Domain, simply providing the tools and resources for self-exploration and learning may lead to surprising results. Evaluating and realizing the talents of students and the respective domains each are categorized may also be valuable when creating curriculum and content revisions to programs. More content focused on finding solutions (talent of Restorative), exploring new information (talent of Learner), and taking ownership of projects (talent of Responsibility), for example, may actively engage more officers.

Is giving the Clifton StrengthsFinder® assessment a second time, perhaps at the end of the state FFA officer experience, an appropriate suggestion? Indications exist that it is likely the individual's measurements may project accurately for years, as the concept implies, one grows into their talents, developing into strengths (Buckingham & Clifton, 2001). Therefore, a re-test at the end of the state officer experience would most likely not be beneficial in that short timeframe. However, major life experiences may alter the results of the assessment, and some students have noted the heavy impact of the state FFA officer experience. Could this situation be an appropriate exception for a test-retest of the assessment?

Caution should be applied when using these data results to populations differing from state FFA officers. However, a random sampling of FFA members utilizing the Clifton StrengthsFinder®, or similar assessment at large, could be valuable. This research could provide insight and identify if state FFA officers are truly a representative sample of talents comparatively across FFA members nationwide. Additionally, this research may also lay foundations for a greater understanding of whether programs and opportunities are nurturing and attracting a talent-diverse array of students into the organization. A random sampling of agricultural education students not in FFA may also be a valuable comparison of this data, and furthermore lead to an understanding of whether opportunities in FFA are attracting all 34 themes of talent respectively.

Moreover, while there are concerns for equal encouragement for all students, regardless of natural talent, to be involved in agriculture and the FFA, recognizing the diversity of this data sample and the inherit strengths within is impressive. Strengths provide an opportunity to nurture and grow through developing self-awareness and authentic leadership skills that can ultimately fit into the current interests of the student and any future path that student may take. Can it be considered as potentially shedding some light on recruitment and retention throughout agricultural education and the National FFA Organization? Could strengths utilization and subsequent evaluation provide an avenue to develop the necessary soft skills that are required for the 21st Century?

References

Asplund, J., Lopez, S., Hodges, T., & Harter, J. (2009). *The Clifton StrengthsFinder® 2.0 technical report: development and validation.* Omaha, NE. The Gallup Organization.

Avolio, B., & Gardner, W. (2005). Authentic leadership development: Getting to the root forms of leadership. *The Leadership Quarterly, (16),* 315-338. doi: 10.1016/j.leaqua.2005.03.001

Bayer, M. (2012). The effectiveness of student leadership development programs at a midwestern university. Retrieved from ProQuest Dissertations Publishing. (UMI No. 3524436.

Begley, P. (2004). Understanding valuation processes: exploring the linkage between motivation and action. *International Studies in Educational Administration, 32*(2), 4-17.

Buckingham, M., & Clifton, D. (2001). *Now, discover your strengths.* New York: Free Press.

Buzinde, C., Foroughi, B., & Godwyll, J. (2019). Youth leadership programs for community development and social action: a pedagogical approach. *Community Development Journal, 54*(4), 677-694.

Clifton, D., Anderson, E., & Schreiner, L. (2006). *StrengthsQuest: Discover and develop your strengths in academics, career, and beyond, 2nd edition.* Washington, DC: The Gallup Organization.

DeMink-Carthew, J., Netcoh, S., & Farber, K. (2020). Exploring the potential for students to develop self-awareness through personalized learning. The Journal of Educational Research, 113(3), 165-176.Gallup Strengths Center. (2016). Gallup Strengths Resource Center. Retreived from: https://www.gallupstrengthscenter.com/PrivateResources/en-US

Gardner, W. L., Karam, E. P., Alvesson, M., & Einola, K. (2021). Authentic leadership theory: The case for and against. *The Leadership Quarterly, 32*(6), 101495.

Gillum, W. (2005). The effects of strengths instruction on under-performing high school students in mathematics. Retrieved from ProQuest Dissertations Publishing. (UMI No. 3160496).

Goleman, D., Boyatzis, R., & McKee, A. (2002). *Primal Leadership, Realizing the Power of Emotional Intelligence.* Boston, Massachusetts: Harvard Business School Press.

Harter, J. & Hodges, T. (2003). *Construct validity study: StrengthsFinder and the five factor model* [technical report]. Omaha, NE: The Gallup Organization.

Hodges, T. & Harter, J. (2005). A review of the theory and research underlying the StrengthQuest program for students. *Educational Horizons 83*(3), 190-201. ISSN: 0013175X

Kouzes, J., & Posner, B. (2007). *The Leadership Challenge, 4th edition.* San Francisco, CA: Jossey-Bass.

Lane, F. & Chapman, N. (2011). The relationship of hope and strength's self-efficacy to the social change model of leadership. *Journal of Leadership Education. 10*(2). 116-137.

Lehnert, A. (2009). *The influence of strengths-based development on leadership practices among undergraduate college students.* Retreived from ProQuest Dissertations Publishing. (UMI No. 3377758)

Linley, P., Govindji, R., West, M. (2007). Positive psychology approaches to public services leadership: An introduction to strengths-based leadership. *The International Journal of Leadership in Public Services, 3*(4), 44-55. doi:10.1108/17479886200700029

Luthans, F., & Avolio, B. (2003). Authentic leadership development. In K.S. Cameron, J.E. Dutton, & R.E. Quinn (Eds.), *Positive organizational scholarship: Foundations of a new discipline* pgs. (241-261). San Francisco: Barrett-Koehler.

Mills, M. D., Anderson, R., & Paulsen, T. H. (2023). Are selection processes allowing Talent diverse members advance through the leadership ranks of FFA?. *CTE Journal, 11(*2).

National FFA Organization. (2023). FFA home page. Retrieved from https://www.ffa.org/home

National Research Council. (2009). *Transforming agricultural education for a changing world.* Washington, DC: National Academies Press.

Quinlan, K. M., & Renninger, K. A. (2022). Rethinking employability: how students build on interest in a subject to plan a career. *Higher Education, 84*(4), 863-883.

Roberts, T., Harder, A., & Brashears, M. (Eds). (2016). *American Association for Agricultural Education national research agenda: 2016-2020.* Gainesville, FL: Department of Agricultural Education and Communication.

Schreiner, L. (2006). A technical report on the Clifton StrengthsFinder® with college students. Omaha, NE: The Gallup Organization. Retreived from: https://www.strengthsquest.com/192485/technical-report-clifton-strengthsfinder-collegestudents.aspx?utm_source=resources&utm_medium=learnmorebutton&utm_campaign=strengthsquest

Soria, K. & Stubblefield, R. (2015). Building a strengths-based campus to support student retention. *Journal of College Student Development, 56*(6), 626-631. doi: 10.1353/csd.2015.0056

Stebleton, M., Soria, K., Albecker, A. (2012). Integrating strength-based education into a first year experience curriculum. *Journal of College and Character, 13.2,*1-8. doi:10.1515/jcc-2012-1877

Steffens, N. K., Wolyniec, N., Okimoto, T. G., Mols, F., Haslam, S. A., & Kay, A. A. (2021). Knowing me, knowing us: Personal and collective self-awareness enhances authentic leadership and leader endorsement. *The Leadership Quarterly*, *32*(6), 101498.

Strong, R., Wynn, J., Irby, T., & Lindner, J. (2013). The relationship between students' leadership style and self-directed learning level. *Journal of Agricultural Education, 54*, 174-185. doi:10.5032/jae.2013.02174

Velez, J., McKim, A., Moore, L., & Stephens, C. (2015). A nationwide assessment of the scope and impact of agricultural leadership education. *Journal of Agricultural Education, (56),* 116-126. doi:10.5032/jae.2015.01116

Walumbwa, F., Avolio, B., Gardner, W., Wernsing, T., & Peterson, S. (2008). Authentic leadership: development and validation of a theory-based measure. *Journal of Management, 34*(1), 89-126. doi: 10.1177/0149206307308913

Wisner, M. (2011). Psychological strengths as predictors of effective student leadership. *Christian Higher Education, 10.* 353-375. doi: 10.1080/15363759.2011.576223

Woolfolk, A. (2010). *Educational psychology* (11th ed.). Columbus, OH: Pearson/Alllyn & Bacon