Utilizing the Concerns-Based Adoption Model to Assess the Integration of Science, Technology, Engineering, and Mathematics (STEM) in Secondary Introductory Agricultural Mechanics Courses: A Descriptive Study of Idaho Secondary Agricultural Educators

A Dissertation

Presented in Partial Fulfillment of the Requirements for the

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University of Idaho

by

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June 2015

Authorization to Submit Dissertation

This dissertation of Peter Troy White, submitted for the degree of Doctor of Philosophy with a Major in Education and titled "Utilizing the Concerns-Based Adoption Model to Assess the Integration of Science, Technology, Engineering, and Mathematics (STEM) in Secondary Introductory Agricultural Mechanics Courses: A Descriptive Study of Idaho Secondary Agricultural Educators," has been reviewed in final form. Permission, as indicated by the signatures and dates below, is now granted to submit final copies to the College of Graduate Studies for approval.

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Abstract

Science, technology, engineering, and mathematics (STEM) careers experienced a growing deficit in the number of qualified replacements for an aging population of workers. Introductory Agricultural Mechanics (IAM) courses as part of Secondary Agricultural Education Programs provide foundational skills students build upon throughout their agricultural mechanics careers. The purpose of this study was to utilize the Concerns-Based Adoption Model to describe the integration of STEM into the Idaho IAM curriculum, including the units of instruction taught in those courses and teachers' concerns relating to STEM integration into their IAM courses. Utilizing a survey of Idaho Agricultural Science and Technology Instructors, 19 units of instruction were identified as the core of IAM courses in Idaho. Teachers' Stages of Concern relating to the integration of STEM into IAM courses revealed teachers were interested non-users who may have competing ideas relating to the integration of STEM. Comparisons on demographic variables of years of experience teaching IAM courses, gender, certification pathway, and holding an additional science certification yielded few differences in teachers' importance ratings or time spent teaching the units, indicating Idaho teachers hold similar views relating to IAM and STEM integration. Stages of Concern Profiles for Idaho Agricultural Science and Technology Teachers with six to 10 years of experience teaching IAM and female teachers suggest they are less likely to have competing ideas in relation to integrating STEM into IAM courses than other groups. Targeted in-service activities focusing on these two groups may lead to faster integration of STEM. Recommendations include creating a cooperatively defined vision for what a STEM-integrated IAM course looks like utilizing Innovation Configuration Maps and active monitoring of the utilization of STEM integration based on the developed Innovation Configuration Maps. Clinical assessments of the methods teachers utilize to improve student learning utilizing active learning and STEM best practices are needed to improve IAM courses. Modification of IAM laboratory teaching strategies utilizing teachers as researchers was recommended. National replication of this study could improve the infusion of STEM principles in IAM courses.

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White, P.T., & Wolf, K. (2014, May). *Agricultural mechanics as agriscience: Secondary teacher perceptions in Idaho.* Paper presented at the National Agricultural Education Research Conference, Salt Lake City, UT.

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White, P.T., & Wolf, K. (2014, May). *The effect of a three-day professional development on climate science on teacher attitudes towards teaching climate science in the classroom.* Paper presented at the National Agricultural Education Research Conference, Salt Lake City, UT.

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Wolf, K., Velez, J., Johnson-Maynard, J., Eigenbrode, S., **White, P. T.**, Swan, B. G., & Blickenstaff, S. M. (2013). Elementary teacher's perceptions of agriculture and their integration of agricultural topics. *Proceedings of the 40th Annual National Agricultural Education Research Conference, 40, 280-293.*

White, P. T., & Pals, D. A. (2004). The current status of supervised agricultural experience programs (SAE) in the Inland Pacific Northwest. *Proceeding of the 31st Annual National Agricultural Education Research Conference, 31, 103-115*.

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Dedication

Dedicated to my wife Caitrin, and my children, on whom much of the true weight of this effort fell. I could not have succeeded without your constant support and encouragement.

Table of Contents

List of Figures

List of Tables

Chapter 1:
Introduction

This chapter includes a brief review of changes in education and a description of agricultural education. The chapter begins with literature related to change in education and moves into changes relating to agricultural education, including the incorporation of science, technology, engineering, and mathematics (STEM). The chapter concludes with an introduction to the problem under consideration, namely the incorporation of STEM into introductory agricultural mechanics (IAM) courses, and concludes with the operational definitions of terms relevant to this study.

Innovation & Change

Educational innovations hit teachers like waves on the sea, each one nullifying the effects of the previous and creating its own new educational landscape (Goodson, Moore, & Hargreaves, 2006). Each successive wave can cause teachers to build resistance to the next and in the seemingly endless sea of educational change, teachers soon ignore new waves of change, conditioned that they too will pass (Hargreaves & Goodson, 2006). Getting teachers to move beyond their conditioned response of hunkering down, ignoring innovation, and instead accepting and implementing change takes time. Fullan (2007), a university researcher with international experience implementing change in education, emphasized that successful change requires sustained efforts over a number of years, ensuring that "factors sustaining the status quo are systemic," and changing schools means changing cultures (2007, p. 7). In order for changes to rise above the tide and become a part of the positive culture of schools, long-term support and interventions need to be provided at the classroom level (Fullan, 2007).

The 1960s and 1970s were when many of the more prominent theories related to the study of innovation emerged to explain the phenomenon of change in relation to education and agents of change. Change agents are those individuals responsible for the implementation or origination of an innovation; they can be teachers, administrators, policy makers, or researchers. Building on the experiences of the first half of the 20th century, change agents knew that simply having a good innovation did not guarantee its diffusion throughout the educational community (Fullan, 2007). The 1980s marked an increase in accountability as countries worldwide tried to increase competitiveness; yet, Fullan found that little improvement could be documented as a result of this increased scrutiny. Fullan stated that despite the best of intentions:

> Neglect of the phenomenology of change—that is, how people actually experience change as distinct from how it might have been intended—is at the heart of the spectacular lack of success of most social reforms…The problem of meaning is one of how those involved in change can come to understand what it is that should change, and how it can be best accomplished, while realizing that the what and how constantly interact with and reshape each other…The interface between individual and collective meaning and action in every-day situations is where change stands or fails. (2007, p. 8-9)

Theoretical Foundation

Change implementation requires working with both innovators and educators to build consensus, understanding what the change will look like in the classroom, and offering longitudinal support for those implementing the innovations. One model incorporates all three of these components of change: the Concerns Based Adoption

Model, and serves as the theoretical foundation for this study (Hall, Wallace, & Dossett, 1973). The CBAM was "The most robust and empirically grounded theoretical model for the implementation of educational innovations" originating in the 1980s (Anderson, 1997, p. 331). The first step in the Concerns Based Adoption Model (CBAM) is to evaluate teachers' Stages of Concern profiles to determine where their most intense concerns are, relating to a particular innovation. Measuring seven Stages of Concern, 35 statements are used to assess a continuum of change facing those implementing an innovation. Along with this assessment, a detailed consensus of what the change will actually look like in the classroom is completed, as a collaborative effort of the change agent and the teachers, in a document termed an Innovation Configuration Map. The Stages of Concern and Innovation Configurations provide facilitators with guidance, providing interventions and determining the actual Levels of Use of the innovation, using the collaboratively created Innovation Configuration documents.

Change in Education

Change is a delicate and complex proposition. Fullan (2007) found that change inevitably involves loss, fear, and uncertainty. He has concluded that, in the end; "Real change, then, whether desired or not, represents a serious personal and collective experience characterized by ambivalence and uncertainty; and if the change works out, it can result in a sense of mastery, accomplishment, and professional growth" (Fullan, 2007, p. 23).

Sequential studies, specified goals, and longitudinal commitment to the innovation have been shown to be tenants of successful change implementation efforts. Fullan (2007) called it a problem of meaning. He stated:

> To achieve greater meaning, we must come to understand both the small and big pictures. The small picture concerns the subjective meaning or lack of meaning for individuals at all levels of the education system. Neglect of the phenomenology of change—that is, how people actually experience change as distinct from how it might have been intended—is at the heart of the spectacular lack of success of most school reforms. (Fullan, 2007, p. 8)

To help navigate this complex process, the Concerns Based Adoption Model (CBAM) utilizes a three-part process, which helps teachers learn the innovation, resolve their concerns, and measure the levels of use of the innovation. The CBAM's three primary components – Stages of Concern, Levels of Use, and Innovation Configurations – work together to focus the innovation, build buy-in with teachers, and ultimately measure actual levels of implementation (Hall & Hord, 2014). The Stages of Concern instrument – measured using a 35-statement, Likert-type questionnaire – consisted of seven, 5-statement constructs. The constructs are used to measure concerns along a spectrum from unconcerned through concerned stages, labeled informational, personal, management, consequence, collaboration, and finally refocusing concerns. The relative intensities of each of the Stages of Concern provide change agents with information they can use to provide interventions and help teachers learn about the innovation and progress to higher-level concerns.

Agricultural Education

Industry leaders and politicians alike have demanded a more science-literate workforce (The White House, 2009). Science as an integrated component of agricultural education has received continued support since the call for integration was issued by the National Research Council (1988). Agricultural education has faced its share of innovation and is no different in its need for longitudinal understanding and continued support than any other field of education. Understanding the need and potential for change in agricultural education requires historical understanding of the culture of the teachers, the profession, and the students they serve. In the mid to late 1800s, agricultural education began as a science course, then turned solely vocational, and currently is once again taught as an integrated science course (Hillison, 1996). Educational leaders envision our nation producing science, technology, engineering, and mathematics (STEM) educated students, ready to fill the growing societal need for a more scientifically-literate workforce.

Agricultural education has been a part of the American system of education for over a hundred years. It began as a scientific exercise taught from a book, however, the scientific and book-centric approach to teaching agriculture did not resonate with farm students (White, Connors, & Wolf, 2014). Reform efforts eventually led to the creation of vocational agriculture courses, courses designed to train students through hands-on experiences how to return to the farm. Today, those courses cater to a different clientele; one not from a farm, but still interested in agriculture and its application across a myriad of support industries, all relating to the production and distribution of food, fiber, and natural resources for a growing population.

Agricultural education espouses a three-component model of instruction. The three components are FFA, the student leadership organization; Supervised Agricultural Experience (SAE) programs; and classroom/laboratory instruction. The model utilizes SAE to provide work experiences directly related to an agricultural career. SAE experiences also provide relevance to units of instruction occurring in the classroom and laboratory. In turn, classroom and laboratory instruction improves skills and provides technical and scientific background for career-related processes. FFA provides the leadership and teamwork students need to be successful in the workplace. In addition to leadership, FFA provides opportunities for students to measure their skills against students from other schools through Career and Leadership Development Events. In turn, the experiences occurring through the FFA improve students' employability and leads to improved SAE projects.

Agricultural mechanics instruction began as an extension of the farm shop. Boys would construct projects needed on the farm as part of their vocational program at school (Schmidt, Ross, & Sharp, 1927). The instruction included fence building, concrete work, woodworking, home building, equipment maintenance, and a myriad of other skills, all directly targeted at providing the enterprise skills the boys would need to be self-sufficient production agriculturalists. Schmidt et al. (1927) endorsed a progressive four year high school program that began with elementary farm projects in year one and progressed through farm building projects, farm machinery projects, and, in year four, farm power and transportation projects. The current approved curriculum for introductory agricultural mechanics in Idaho is included in Appendix 8 (Idaho Division of Professional Technical Education, 2013). These wide ranging units provide foundational skills to students pursuing agricultural careers.

Physical science as a component of agricultural education is infused across the agricultural mechanics laboratory portion of agricultural education programs (Buriak, 1992; E. Osborne, 1992). Lawver and Fraze (1992, p. 11) insisted that, "With a little creativity and ingenuity, one can identify scientific principles in each of the units of instruction which are taught in the agricultural mechanics curriculum." The current study focused on STEM integration into introductory agricultural mechanics (IAM) courses and an evaluation of the current IAM curriculum to produce a more STEM literate and trained workforce, capable of meeting the needs of the 21st century. Utilizing the Concerns Based Adoption Model, the first step required evaluating teachers Stages of Concern to determine where their most intense concerns were in relation to the integration of STEM into the IAM curriculum.

Background of Agricultural Science

At its inception in the mid-1800s, secondary agricultural education was an applied science (Hillison, 1996). Agriculture courses focused on bookwork of a scientific nature, were taught by those with little practical agricultural experience, and held little appeal for boys of farming backgrounds (White et al., 2014). Shepardson (1929) explained the dynamic relationship between the sciences and agricultural education:

> Agriculture is a meeting ground of the sciences. Physics and chemistry lie at its base. To these elements biology adds its conception of organism. Mathematics is their common instrument. On the way to the application of these basic sciences to practical agricultural problems stand physiology, genetics, nutrition, pathology, entomology, parasitology and the sciences of the soil—derivative subjects which deal with plant and animal life in health and disease. (p. 69)

Few of these courses appeared to give farm students practical experiences that could be directly applied back to the students' farmsteads. After the passage of the Smith-Hughes Act in 1917, agricultural education's focus became vocational, shifting from the science of agriculture to the practice of agriculture (Hillison, 1996). The focus on production-related skills moved the scientific basis for these processes to a less prominent or non-existent role in the curriculum. Early vocational agricultural mechanics courses focused on the ability to create tools and equipment, which were then utilized on the students' farmsteads (Buris, Robinson, & Terry, 2005).

At the turn of the 21st century, national calls for STEM instruction in career and technology education (CTE) led to the re-integration of science into the agricultural curriculum (Hillison, 1996; The White House, 2009). Initial implementation efforts focused on the integration of biological processes into production courses, thus creating plant and animal science courses. More than 20 studies have evaluated the effort to integrate biological sciences into agricultural education between 1990 and 2013; however, STEM is more than biology. STEM education includes physical science, engineering, mathematics, and technology. While biological science integration has proven successful, the other areas requiring true STEM integration need developed as well.

The decade of the 1980s marked a turning point for agricultural education. National enrollments declined at a rate of 1-3% annually, from a high of 697,500 students in 1976 to a low of 525,000 students in 1986. Fewer students with farm backgrounds led to an opportunity to redefine the relevance of agricultural education and how it was taught in America (National Research Council, 1988). The National Research Council, an independent non-profit scientific advisory institute, reported on agricultural education in the United States and concluded that agricultural education needed to add more science and focus more on agricultural literacy. Recommendations included making agricultural education more than vocational agriculture, creating new ways to deliver agricultural education to a wider audience; and working with cooperative extension to develop locally-applied research. Also mentioned were K-12 agricultural literacy and career exploration, emphasizing the connection "between college preparation and agricultural leadership, business and scientific occupations" (National Research Council, 1988, p. 24). Teaching science concepts through agricultural content was prominent in the National Research Council's 1988 report:

> All students need an understanding of basic science concepts. Teaching science through agriculture would incorporate more agriculture into curricula, while more effectively teaching science. There are many opportunities to teach science through agriculture. A common way to capture student interest in science is often by reference to examples in the real world. Teachers can illustrate these examples by bringing an aspect of a living, natural system into the classroom for experimentation and observation. (p. 11)

Following the call for increased science integration, secondary agriculture programs faced pressure to abandon production-oriented curricula and adopt more science-oriented options for students not interested in vocational or production-oriented courses (Shelley-Tobert, Conroy, & Dailey, 2000). Beginning in the late 1980s and continuing for more than 30 years, increased science integration in secondary agricultural education has occurred. Researchers and agriculture teachers have cycled through different methods of incorporating more science, looking for best practices the profession could implement to improve student learning, and stabilize enrollment.

The Idaho Model for Agricultural Education

In Idaho, a new curriculum gradually replaced the existing four-year sequential production agriculture curriculum in the early 1990s. The open-entry curricula utilized an introductory course in agricultural education, followed by specialized courses in an individual pathway (Idaho Division of Professional Technical Education, 2013). Idaho Division of Professional-Technical Education (PTE) utilizes Programs of Study, which provide students with a sequence of specialized courses leading to related post-secondary opportunities as their pathway equivalent. A Program of Study consists of a gateway course followed by additional sequential courses, culminating with a capstone course. Students complete a minimum of four credits, one from each semester course taken, to complete a pathway. Agricultural education has eight recognized pathways: Agribusiness Systems, Animal Systems, Environmental Service Systems, Food Products and Processing Systems, Natural Resource Systems, Plant Systems, Power, Structural, and Technical Systems, and Agricultural Welding. Introduction to Agricultural Mechanics (Ag 130) courses serve as the recommended gateway course for both the Power, Structural, and Technology Systems pathway and the Agriculture Welding Systems Pathway. The Power, Structural and Technical Systems Pathway has 10 approved courses:

AG 0130 Introduction to Ag Mechanics
AG 0210 Agricultural Welding
AG 0211 Advanced Agricultural Welding
AG 0220 Agricultural Power Technology
AG 0221 Small Gasoline Engines

*AG 0222 Agricultural Power Technology/Large Engines
AG 0225 Agricultural Systems/Electricity and Hydraulics
AG 0227 Agricultural Machinery
AG 0230 Agricultural Structures
*AG 0240 Agricultural Fabrication

Courses marked with an asterisk are suggested capstone courses. From this list, Ag 130, 210, 211, 227, and 240 comprise the Ag Welding pathway. The pathway movement began to establish "a coherent, articulated sequence of rigorous academic and career/technical courses, commencing in the ninth grade and leading to an associate degree, baccalaureate degree and beyond, an industry recognized certificate, and/or licensure" (National Career Pathways Network, 2012). The introductory agricultural mechanics (IAM) course serves as the gateway and foundational course for both the Agricultural Welding and Power, Structural, and Technical Systems Pathway and as such needs to include those skills necessary for success in advanced pathway courses. Students who move schools within the state and bring with them credit for completing an IAM course are expected to have a similar skill set as students at their new school. Due to the crucial role IAM plays in student success, the necessity of unification of curriculum, and the many STEM related concepts covered in the Power, Structural, and Technical Systems and Agricultural Welding Pathways, IAM was chosen as the focus of this study.

In Idaho, the Division of PTE approves curriculum for use in the classroom and provides curriculum guides for teachers to tailor to their individual districts' needs (Idaho Division of Vocational Education, 1999). Many of these curriculum guides, written between 1980 and 1998, led to Idaho's 47 semester-based course outlines, covering a diverse array of agricultural disciplines. However, the STEM movement – championed by the White House and echoed by business and industry leaders in need of more STEM-literate employees has not led to the revision of the Ag 130 (Introduction to Agricultural Mechanics) curriculum in Idaho to include ties to STEM concepts, nor has STEM been added to any of the existing curriculum guides.

Idaho high school agricultural education is funded primarily through direct allocations from Idaho PTE to local school districts' agriculture departments. Districts receive reimbursements for approved expenditures, a funding process referred to as added cost funding due to its function of providing funding for expenses above those incurred in typical, non-PTE classes. Added cost funding levels are decided annually and provide the majority of funding to local agriculture programs. In 2014, a grassroots initiative passed the Idaho Legislature as Senate Bill 1416. This initiative provided an increase in added cost funding of approximately $5,000 a year for full-time teachers of agriculture, raising added cost funding from $10,260 to $15,000 a year. This funding model is unique in the Northwest as funds are not allocated from school district funds like they are in Oregon and Washington.

Agriscience

The National Council for Agricultural Education, a stakeholder leadership organization, reported national enrollment in agricultural education (see Figure 1) increased from approximately 525,000 students in 1986 (National Research Council, 1988) to The National Council for Agricultural Education's 2013 estimate of 1.1 million students (M. Honeycutt, personal communication, August 11, 2014).

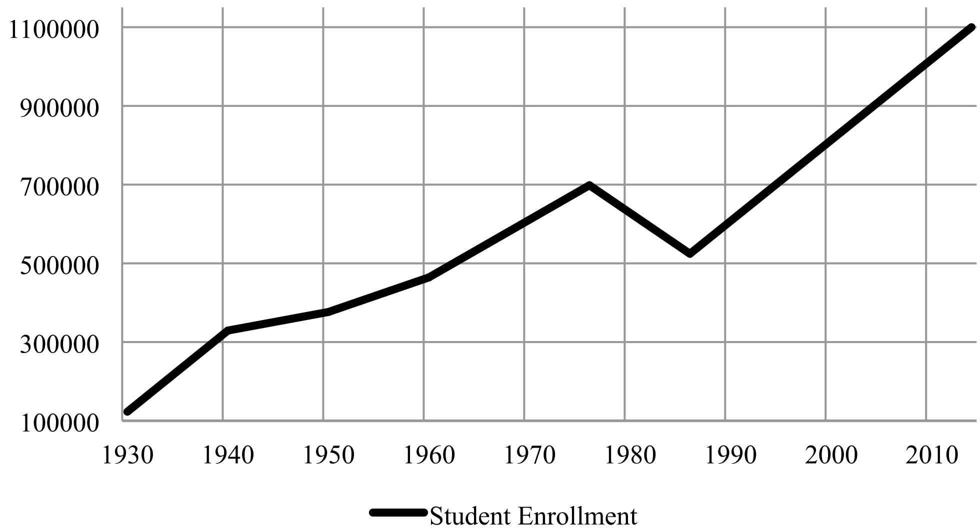

Figure 1. Total national agricultural education enrollment 1930-2013.

The growth in enrollment between 1986 and 2013 coincided with national education efforts, led by The White House, which called for more integration of STEM topics across the curriculum (Kuenzi, 2008; The White House, 2009). The Committee on Integrated STEM Education (Honey, Pearson, & Schweingruber, 2014) reported:

> The case rests on the idea that a STEM education can lead to productive employment and is critical to the nation's innovation capacity. And many employers and public officials have come to believe that all people, particularly young people, needs *[sic]* to have some degree of scientific and technological literacy in order to lead productive lives as citizens, whether or not they ever work in a STEM-related field. (p. 13)

The White House's call for innovation in the teaching of STEM does not represent a reiteration of the 1988 call for science integration in agriculture; it encompasses an even broader emphasis among all disciplines founded on STEM principles, as well as integration throughout areas not considered part of the 1988 call: language arts, social studies, and engineering.

Secondary engineering standards on the national level are a relatively new concept. In 2013, the Next Generation Science Standards (NGSS) were released; and, for the first time, engineering was integrated into the science standards with specific focus on design, iteration, reflection, and testing of student solutions to modern problems (NGSS Lead States, 2013). The NGSS utilized a three-stage approach for STEM education: science and engineering practices, disciplinary core ideas, and crosscutting concepts. The three-stage process of the NGSS focuses student attention on science and engineering as they are practiced. This approach provides a solid foundation of core concepts, extends the singular disciplinary focus out across the entire STEM domain using cross-cutting concepts, and links knowledge in one discipline to knowledge in other STEM disciplines.

Agricultural education's integrated nature and scientific base solidifies its potential to be one of the leaders in the effort to connect STEM across disciplines utilizing crosscutting themes, science and engineering practices, and practical applications. Despite this potential, agricultural mechanics courses largely appear to have missed the integration movement of the 1990s. While there were several issues of the *Agricultural Education Magazine* devoted to the *New Ag Mechanics* (Lawver & Fraze, 1992; E. Osborne, 1992) – and one edition of a text, *Physical Science Applications in Agriculture,* was published – little research following the initial push is available to connect science integration and the agricultural mechanics classroom. Localized efforts to incorporate STEM in the agricultural mechanics curriculum occurred in Illinois; however, the change efforts did not ultimately lead to its sustained integration (E. Osborne, personal communication, May 19, 2014).

Exploratory Evaluation of Teacher Perceptions

The exploratory study of science certified agricultural educators in Idaho, focusing on physical science as a component of agricultural mechanics, was conducted by White and Wolf (2014). They surveyed 64 science certified Idaho Agricultural Science and Technology Teachers and found they were willing to teach a physical science-integrated agricultural mechanics course; however, improving their confidence in and understanding of some of the key physical science concepts was warranted. In the evaluation of the perceptions of teachers relating to physical science integration, White and Wolf found overall agreement relating to the ability of science certified Agricultural Science and Technology Teachers to teach integrated physical science concepts in their agricultural mechanics courses. However, they focused on science certified Agricultural Science and Technology Teachers and excluded those not holding science certification. The current study takes a comprehensive approach and includes all agricultural mechanics teachers, regardless of their science certification status.

STEM Integration

An opportunity to renew the push for a new type of agricultural mechanics instruction in Idaho exists, in part, due to the current state and national focus on STEM education, coupled with the willingness of current science certified Agricultural Science and Technology Teachers to incorporate physical science in their mechanics courses. The CBAM has shown assessment of teachers' Stages of Concern and related interventions can lead to higher adoption rates (Hall & Hord, 2014). Determining teachers' concerns relating to the use of STEM in the introductory agricultural mechanics curriculum will improve the ability of teacher educators to address those concerns and increase the teachers' understandings of STEM integration efforts.

STEM is a broad initiative and assumes a need for science literacy across all student populations (The White House, 2009). All Agricultural Science and Technology Teachers in Idaho are included in this study, due to a need to integrate STEM concepts regardless of endorsement or certification. Inclusion of all individual teacher opinions reflects a more complete view of what is occurring in Idaho; furthermore, they can produce an inclusive description of all Idaho agricultural educators. STEM integration requires teachers to change their methods in order to provide clearer connections between agricultural mechanics content and its underlying STEM processes. Additional change is necessary because the movement in the 1990s to include science in agricultural mechanics laboratories (Krueger & Johnson, 1992; Lawver & Fraze, 1992; E. Osborne, 1992) did not lead to national adoption or integration into the Idaho curriculum guides or approved course lists.

A focus on STEM integration in agricultural mechanics may be considered change by Idaho Agricultural Science and Technology Teachers. Change and innovation implementation often leads to feelings of loss, anxiety, and struggle (Fullan, 2007). Teachers reported sequential concerns relating to themselves, the management of the innovation, and ultimately its impact on students as they implement innovations (Hall & Hord, 2014). To assess the impact of this proposed change, the teachers' Stages of Concerns must be identified to allow change agents to provide the interventions teachers need to further integrate STEM into agricultural mechanics instruction in Idaho. While Idaho teachers expressed willingness to incorporate change related to physical science in their agricultural mechanics courses, White and Wolf (2014) reported no assessment of the current level of STEM integration in the Idaho agricultural mechanics curricula.

Newcomb, McCracken, Warmbrod, and Whittington (2004), university teacher educators and authors of the only agricultural education methods textbook, posit agricultural laboratories represent the applied component of agricultural education. Newcomb et al. (2004, p. 214) note, "The teacher of agriculture must realize that laboratories for agricultural instruction do not exist based on tradition. Rather, laboratories are a crucial component of the teaching-learning program for education in agriculture." They emphasized that the role of the laboratory was not for the construction of projects in isolation, rather, it offers a location where students can apply practical solutions to actual problems. Laboratories not using a "great deal of what is learned," fall "short of being career oriented" (Newcomb et al., 2004, p. 215). Additionally, while STEM content may be included in agricultural mechanics courses, no assessment of this inclusion, or its degree of integration, has been found.

The methodological approach put forth by Newcomb et al. prepares students for both career and college readiness through project-based instruction (Hess, Livings-Eassa, & Green, 2012). To meet the expectations of both college preparation and career readiness, schools have increased rigorous requirements for instruction, and exemplary programs nationwide have increased their interconnectedness by infusing more STEM and Common Core standards into CTE programs (Hess et al., 2012; Kreamer & Derner, 2012). The Career Pathways model for CTE separates STEM out as a separate pathway from the agricultural pathway; however as evidenced herein, many opportunities exist where the two pathways overlap.

Increasing accountability through standards-based instruction requires CTE programs to both increase in rigor and interconnectedness with other subjects taught in their schools (Kreamer & Derner, 2012). Agriculture programs have an opportunity to modify pedagogy to align to the new standards-based approach to education and the concepts of the STEM movement. Engineering education, the sometimes forgotten "E" in the STEM initiative (Brophy, Klein, Portsmore, & Rogers, 2008; Honey et al., 2014) is one area where a modification of pedagogy could increase agricultural education's interconnectedness with both scientific content and engineering practices.

Standards for engineering education are included in the Next Generation Science Standards (NGSS Lead States, 2013). Felder and Silverman (1988, 2002) assessed engineering education and came to many of the same recommendations for engineering that Newcomb et al. came to for laboratory instruction in agricultural education. Felder and Silverman (1988, 2002) recommended the following:

- Relate instruction to what has been covered and will be covered
- Balance concrete and abstract ideas
- Balance practical problem solving with fundamental understanding
- Use pictures, schematics, and graphs
- Utilize film and hands-on demonstrations
- Use computer-assisted instruction
- Provide opportunities for active learning
- Provide opportunities for group work
- Applaud creative solutions, even if the solution is incorrect

This list of best practices, particularly suited to engineering education, is also suited to agricultural education and parallels the pedagogical approach set forth by Newcomb et al. (2004). Brophy et al. (2008, p. 371) explained that "Engineering requires applying content knowledge and cognitive processes to design, analyze, and troubleshoot complex systems in order to meet society's needs." Brophy et al. emphasized how design and troubleshooting are the types of problems engineers thrive upon, two concepts particularly suited to the agricultural laboratory and learning techniques supported by Newcomb et al. (2004). With the connections between agricultural education and engineering education, the question emerges: How many of these best practices in engineering and agricultural education are utilized in the agricultural mechanics curriculum of Idaho; and to what extent has their utility pervaded the secondary programs across the state?

Statement of the Problem

STEM integration across the curriculum is necessary for students to succeed in STEM careers. In Idaho, science certified Agricultural Science and Technology Teachers must meet similar credit requirements as any other science teacher seeking biological or natural science certification, and they must have the same minimum content knowledge exam scores required of all science-endorsed secondary educators (Idaho, 2013). In their survey of 64 Idaho Agricultural Science and Technology Teachers holding science endorsements, White and Wolf (2014) found that teachers were willing to teach an agricultural mechanics course infused with physical science concepts for science credit. White and Wolf also found teachers felt some level of comfort with 18 physical science concepts, including electricity, simple tools, heat transfer, models, and general scientific processes. Missing from their study was an examination of the pedagogical approach taken to teach agricultural mechanics, and an assessment of its compatibility with best practices for science, engineering, and agriculture. Assessment of both the "*what*" and the "*how*" of instruction in agricultural mechanics will allow teacher educators to focus professional development and pre-service courses on those STEM-related pedagogical practices that will directly impact the rigor and quality of agricultural mechanics instruction in Idaho. Despite calls for STEM and physical science integration into the agricultural mechanics laboratory (Buriak, 1992; Krueger & Johnson, 1992; Lawver & Fraze, 1992; E. Osborne, 1992), little research on the topic is available. Determining the most intense concerns relating to the STEM integration process and assessing how agricultural mechanics in Idaho was taught were crucial first steps in improving the STEM content in the agricultural mechanics curriculum of Idaho and preparing agricultural education students for STEM careers.

Purpose of the Study

The intent of this study was to describe STEM integration, particularly the disciplines of physical science and engineering, into the introductory agricultural mechanics curriculum of Idaho through the Concerns-Based Adoption Model's Stages of Concern. An evaluation of what is being taught in the introductory agricultural mechanics courses of the state was also conducted to assess what was being taught and where STEM integration efforts should focus. Specifically, the purpose of this study was to utilize the Concerns-Based Adoption Model to describe the integration of STEM into the Idaho introductory agricultural mechanics curriculum.

Research Questions

The following research questions guided this study:

1. How much time do teachers report spending on units in their introductory agricultural mechanics curriculum?
2. How important do Idaho Agricultural Science and Technology Teachers rate the individual agricultural mechanics units in their introductory agricultural mechanics curriculum?
3. What are teachers' perceptions of STEM integration into the introductory agricultural mechanics curriculum?
4. To what extent do Idaho Agricultural Science and Technology Teachers integrate STEM into their introductory agricultural mechanics courses?
5. What are the Stages of Concern for Idaho agricultural educators relating to STEM integration in agricultural mechanics?
6. What are the relationships between teacher characteristics and their Stages of Concern?

Significance of the Study

Assessing the teachers' Stages of Concern and assessment of the agricultural mechanics curriculum in Idaho are necessary first steps in improving STEM education in agricultural mechanics curricula. As the national demand for a more STEM-literate population increases, researchers can build upon this study and use the CBAM to better facilitate the change process. The other two components of CBAM call for assessment of the innovation through creating Innovation Configuration Maps. Maps teachers and change agents collaboratively configure to identify what the best practices look like and identify those practices that fall outside STEM integration. As teachers implement the change as described in the Innovation Configuration Maps into their curriculum, repeated use of the Stages of Concern questionnaire will aid researchers in measuring changes in teachers' concerns and determine necessary changes in interventions. Conducting Levels of Use assessments will determine how STEM is being implemented and measured against the IC Maps the teachers and change agents collaboratively created. Ultimately, Hall and Hord (2014) reported that this structured and focused approach increases the quality of innovation implementation in schools; in this case, STEM integration in agricultural mechanics courses. Since no record of what is being taught in Idaho Introductory Agricultural Mechanics courses exists, the curriculum must first be assessed to identify which units are being taught amongst those included in the approved framework.

Priority 3 and Priority 4 of the *National Research Agenda for Agricultural Education* align with this research study. Priority 3 calls for a "sufficient scientific and professional workforce that addresses the challenges of the 21st century" (Doerfert, 2011, p. 18). Priority 4 calls for meaningful and engaged learners who, "will be actively and emotionally engaged in learning, leading to high levels of achievement, life and career readiness, and professional success" (Doerfert, 2011, p. 21).While this study utilizes Idaho as the population of focus, understanding how this population was integrating STEM into IAM courses provided data which may be utilized by change agents in similar populations, to provide further insight into how IAM teachers feel about STEM integration, and how it may impact professional development offerings in regions sharing similar demographic characteristics.

A scientific and professional workforce, as described in the national agenda, is a call for a more diverse agricultural workforce that has an increased capacity over current and past workforces. Specifically, "These individuals must be well prepared for discovery science, teaching and learning, science, technology, engineering, and mathematics (STEM) integration, and application of innovation for public, private, and academic settings" (Doerfert, 2011, p. 19).

As a key component of achieving the goals of Priority 3, Priority 4 calls for meaningful, engaged instruction. This type of instruction requires students:

> Go beyond a rote memorization of facts to the ability to interpret the interconnectedness of facts or material, regulate their understanding, transfer the understanding of concepts to new situations, and think creatively … Meaningful learning occurs when the learning environment is multi-disciplinary in nature or illustrates the interconnectedness of subject matter" (Doerfert, 2011, p. 21).

The combination of meaningful learning, applied in the agricultural laboratory, to produce a more scientifically-literate and engaged student embodies the essence of why this study is being conducted.

Limitations of the Study

The study is restricted to Idaho secondary Agricultural Science and Technology Teachers and caution is advised when generalizing the findings to other populations. While many states may appear similar to Idaho, the individual uniqueness of each state may create circumstances not addressed in this study. Due to the financial restrictions of conducting physical observations of the entire agricultural mechanics curriculum, at all the locations teaching this curriculum, survey methodology was utilized to conduct this study. This may have introduced bias through the operational definition of engineering best practices and individual teachers' interpretation of the level of utilization of scientific concepts and engineering practices.

Delimitations or Reasonable Assumptions

This study was a descriptive study of Idaho secondary Agricultural Science and Technology Teachers. As a descriptive study, inferential statistics are not utilized. A census was conducted, however with less than a 100% response rate, statistical symbols and nomenclature reflect a sample, and do not utilize population parameters. To enhance the description of the population, sub-groups based on demographic characteristics were utilized. As a descriptive study, hypotheses relating to the differences between groups were not utilized. Descriptions of the groups occurred to add to the depth of the description, but no hypothetical differences were assumed or tested.

Definition of Terms

NGSS—Next Generation Science Standards outline new national standards for science education. These standards include standards for engineering as well as biological and physical science. Written by a partnership of 26 states, these standards are voluntary for state-level adoption. Standards are arranged by disciplinary core ideas and utilize cross-cutting themes as well as science and engineering practices to address the depth and breadth of the science principles students need to know (NGSS Lead States, 2013).

STEM Integration—the enhancement of science, technology, mathematics, and engineering (STEM) connections through problem solving activities, which specifically pull out and explain STEM concepts in the context of agricultural settings using the correct STEM vocabulary and mathematical formulas to present solutions to problems (Honey et al., 2014)

Common Core State Standards—developed by the National Governors Association Center for Best Practices (NGA) and the Council of Chief State School Officers (CCSSO), these standards provide mathematics and language arts standards by grade level and set end-of-year guidelines for what students should know and be able to do. These standards have been voluntarily adopted by 45 states (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

Perkins IV—Carl D. Perkins Career and Technical Education Act of 2006, this is the latest re-authorization of the original 1998 Carl D. Perkins Act. It provides federal guidelines and funding for career and technology education in the United States ("Carl D. Perkins Career and Technical Education Act," 2006).

Career Pathways—"A coherent, articulated sequence of rigorous academic and career/technical courses, commencing in the ninth grade and leading to an associate degree, baccalaureate degree and beyond, an industry recognized certificate, and/or licensure" (National Career Pathways Network, 2012).

Career Clusters—16 groups of career areas, organized around programs of study that link students to careers and college degrees related to their fields of interest. (Center for Occupational Research and Development & National Association of State Directors of Career Technical Education Consortium, 2012)

Levels of Use—“The various behaviors of the innovation user through various stages—from spending most efforts in orienting, to managing, and finally to integrating use of the innovation” (Hall, Loucks, Rutherford, & Newlove, 1975, p. 52).

Innovation Configuration—A clarification process that clearly delineates what the innovation is and what it is not. IC helps teachers and change facilitators to collaboratively define the innovation and what its implementation looks like in the classroom (Hall & Hord, 2014).

Innovation Configuration Map—A technical document matrix that clarifies what the ideal looks like and what degrees of implementation are acceptable and which are not (Hall & Hord, 2014).

Adoption—“The multitude of activities, decisions, and evaluations that encompass the broad effort to successfully integrate an innovation into … a school” (Hall et al., 1973, p. 5).

Intervention—“An action or event that is planned or unplanned and that influences individuals (either positively or negatively) in the process of change” (Hall & Hord, 2014, p. 27).

Stages of Concern Profile—A composite graphical representation of the seven stages of concern (0-6) scores, converted to percentile scores and listed sequentially (George, Hall, & Stiegelbauer, 2006).

Unconcerned Stage—Stage 0, the stage representing the level of concern the innovation of question holds for the user. Scores can range between zero and 35 for each respondent. Low scores represent innovations of higher importance than high scores. “I think I heard something about it, but I'm too busy right now with other priorities to be concerned about it” (George et al., 2006; Southwest Educational Development Laboratory, 2015, p. 1).

Informational Stage—Stage 1, represents the need for knowledge about the innovation. Scores can range between zero and 35 for each respondent. Higher scores are indicative of teachers who want more information about the innovation, what it is and how it is going to work. “This seems interesting, and I would like to know more about it” (George et al., 2006; Southwest Educational Development Laboratory, 2015, p. 1).

Personal Stage—Stage 2, represents concerns about how the innovation will impact the teacher personally. Scores can range between zero and 35 for each respondent. High scores represent “ego-oriented questions and uncertainties” (George et al., 2006, p. 33). “I'm concerned about the changes I'll need to make in my routines” (Southwest Educational Development Laboratory, 2015, p. 1).

Management Stage—Stage 3, represents concerns about the logistics of the innovation. Scores can range between zero and 35 for each respondent. High scores indicate “intense concern about management, time and logistical aspects of the innovation” (George et al., 2006, p. 33). “I'm concerned about how much time it takes to get ready to teach with this new approach” (Southwest Educational Development Laboratory, 2015, p. 1).

Consequence Stage—Stage 4, represents the level of concern shown over the innovation’s impact on students. Scores can range between zero and 35 for each respondent. “Considerations include the relevance of the innovation for students; the evaluation of student outcomes…; and the changes needed to improve student outcomes” (George et al., 2006, p. 8). “How will this new approach affect my students?” (Southwest Educational Development Laboratory, 2015, p. 1).

Collaboration Stage—Stage 5, represents the level of interest in cooperating with other teachers about the innovation (George et al., 2006). Scores can range between zero and 35 for each respondent. “I'm looking forward to sharing some ideas about it with other teachers” (Southwest Educational Development Laboratory, 2015, p. 1).

Refocusing Stage—Stage 6, represents the teacher’s focus on changing or improving the innovation to get more benefit from the change (George et al., 2006). Scores can range between zero and 35 for each respondent. “I have some ideas about something that would work even better” (Southwest Educational Development Laboratory, 2015, p. 1).

Chapter 2:
Review of Related Literature

This section contains a review of the literature related to the purpose of this study, to describe the integration of STEM into the Idaho introductory agricultural mechanics curriculum utilizing the theoretical lens of the Concerns-Based Adoption Model. The review starts with the theoretical foundations, which are grounded in the change literature, with specific emphasis on the Concerns Based Adoption Model. Following the change literature, the review progresses to the learning of science, science laboratories, and the STEM movement. The chapter concludes with a review of agricultural mechanics education and the relationship between agricultural mechanics and STEM education.

Theoretical Foundations

The theoretical foundations of this study were grounded in two change theories, the concerns based adoption model (Anderson, 1997; Hall, George, & Rutherford, 1977; Hall & Hord, 1987, 2014) and the meaning of educational change (Fullan, 2007). The focus of this study, integration of STEM processes in introductory agricultural mechanics (IAM) courses, led to the integration of Fullan's interactive factors affecting implementation (see *Figure 2*), and the Concerns Based Adoption Models' (see *Figure 3*) Stages of Concern (Hord, Roussin, & Hall, 2013) to examine the integration of STEM topics and pedagogy into introductory agricultural mechanics courses in Idaho.

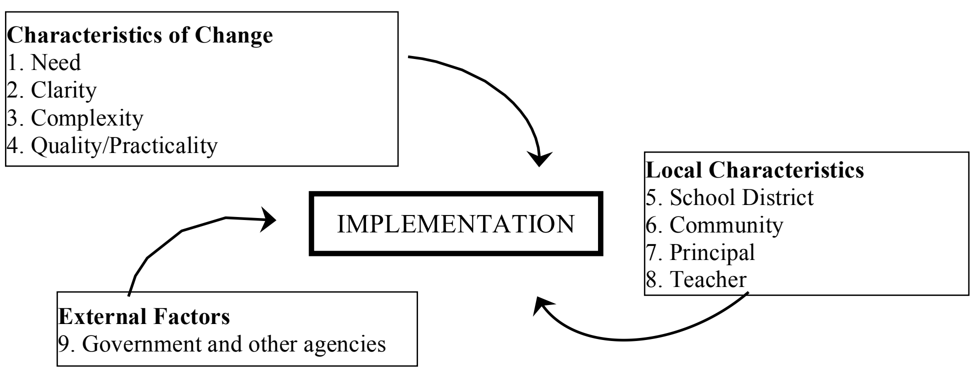

Figure 2. Interactive factors affecting implementation (Fullan, 2007)

The Concerns Based Adoption Model (CBAM).

Researchers at the Research and Development Center for Teacher Education developed a model for studying change in educational settings (Hall & Hord, 2014). Francis Fuller (1969), a teacher educator and researcher on whose work the CBAM was built, focused on the concerns of pre-service teachers. Fuller (1969) identified, through a psychological counseling program with pre-service teachers, three groups of concerns expressed from the student-teaching experience through the first year of teaching. Fuller classified the concerns as non-concerns, concerns with self, and concerns with pupils. Fuller also conducted a meta-analysis of other studies to determine the generalizability of the initial results. This led Fuller to conclude that the concerns occurred consistently across multiple settings in a variety of states and through time, they did not change from study to study. The results of Fuller's work led Hall, Hord, and their University of Texas colleagues to advance the theory and develop a model which identified concerns and provided avenues for targeted interventions (Hall & Hord, 1987).

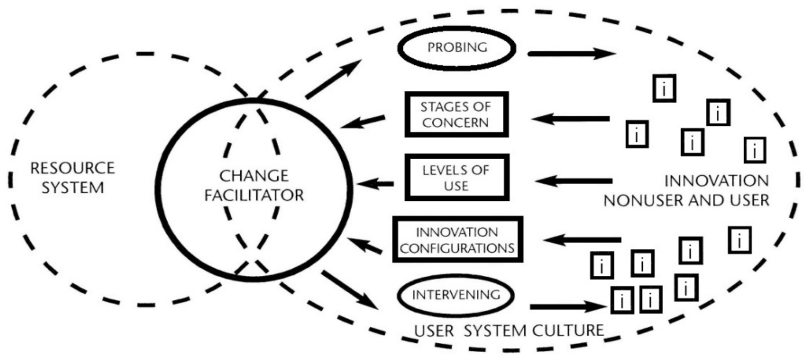

Figure 3. The Concerns Based Adoption Model (George, Hall, & Stiegelbauer, 2006). Copyright © 2006. Permission to reprint found in Appendix 5: Copyright Permissions.

Since the original work of Hall and Hord in the 1970s, this three-part model has been refined and tested in multiple educational settings, time frames, and across grade levels. The models' three primary components (see *Figure 3)*; Stages of Concern, Levels of Use, and Innovation Configurations comprise an iterative system of probing, assessment, and interventions designed to help teachers implement changes (George et al., 2006). Further, "the manager of a specified change could then use these diagnostic data in developing a prescription for needed interventions to facilitate the change effort" (Hall et al., 1977, p. 13).

Anderson (1997) outlined the assumptions of the CBAM theory of educational change:

> Several assumptions about classroom change in curriculum and instruction underpin CBAM: (1) change is a process, not an event; (2) change is accomplished by individuals; (3) change is a highly personal experience; (4) change involves developmental growth in feelings and skills; and (5) change can be facilitated by interventions directed toward the individuals, innovations, and contexts involved. (p. 333)

A graphic description of how the three components of the Concerns Based Adoption Model interact is included in Figure 4. The figure depicts the relationship between the Stages of Concern, Levels of Use, and Innovation Configurations and the role of each in describing the innovation, the users' beliefs, and practices. All three components combined provide a data source for making decisions as well as evidence to improve implementation. The focus of this study is using the Stages of Concern Profile to determine teachers' attitudes and beliefs. The Stages of Concern was the initial step, and it is expected that Innovation Configuration Maps and Levels of Use will be utilized in the future and as such both are described in more detail in the sections to follow.

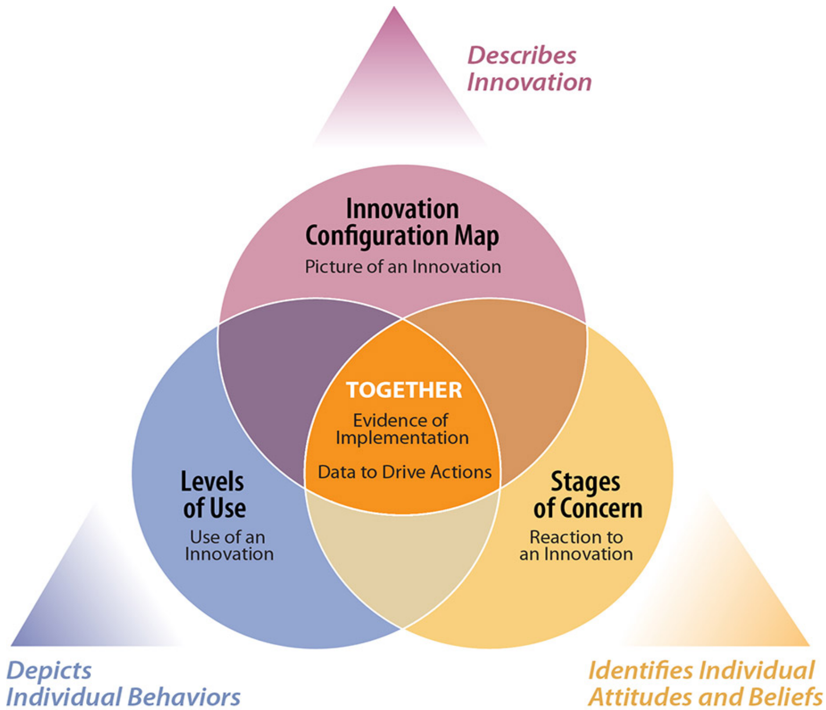

Figure 4. The Concerns Based Adoption Model's Diagnostic Dimensions. Copyright © 2014, SEDL. Permission to use found in Appendix 6.

First, facilitators probe (questionnaires and/or observations) the group to determine both their individual stages of concern, and to discover how the individuals and the group are feeling about a specified change. Hall and Hord (1987) described the role of the facilitator as, "using informal and systematic ways to *probe* individuals and groups to understand them" (p. 13, emphasis in the original). The data collected is analyzed to provide timely interventions and innovation clarifications to help the group learn more about and improve their competence in their use of the innovation. While the general trend resulting from this process is typically a linear progression from lower concerns to higher concerns, George et al. (2006) cautioned, "merely acquiring more knowledge about or experience with an innovation does not guarantee that an individual will resolve earlier concerns and have later concerns emerge" (p. 9).

CBAM: Stages of Concern.

A team of researchers, led by Gene Hall and Shirley Hord, concluded that the change process must be considered and planned systematically (Hall & Hord, 2014). Change is "highly complex, multivariate, and dynamic" (Hall & Hord, 2014, p. 8). Hall and Hord (2014) maintained that while every situation is unique, there will be a consistent pattern of principles that hold true in every innovation implantation process. Hord and Hall provided the following list of 12 principles of educational change:

1. Change is learning—it's as simple and complicated as that
2. Change is a process, not an event
3. The school is the primary organizational unit for change

4. Organizations adopt change—individuals implement change
5. Interventions are key to the success of the change process
6. Appropriate interventions reduce resistance to change
7. District- and school-based leadership is essential to long-term change success
8. Facilitating change is a team effort
9. Mandates can work
10. Both internal and external factors greatly influence implementation success
11. Adopting, implementing and sustaining are different phases of the change process
12. Focus, focus, focus (2104, p. 9-22)

These 12 principles provide the foundation for the CBAM. The Stages of Concern Questionnaire, when used longitudinally, provides continuous assessments of where teachers' concerns are – how intense they are in comparison to other concerns – and allows change agents to provide interventions directed at those concerns. They also provide guidance for change agents as they holistically assess the school system when change efforts are not succeeding.

Building upon the work of Frances Fuller in the late 1960s, the Stages of Concern questionnaire was developed to assess the current concerns expressed by an individual or group (Hall et al., 1977). The concerns identified by Fullar were expanded through subsequent research and led to the research group establishing seven Stages of Concern, which most users move through sequentially (Hall & Hord, 2014). The seven stages are: Stage 0: Unconcerned, Stage 1: Informational, Stage 2: Personal, Stage 3: Management, Stage 4: Consequence, Stage 5: Collaboration, and finally, Stage 6: Refocusing. A 35-statement questionnaire is used to collect data, which are graphed to compare groups and resolve individual teachers concerns (see Figure 5). The first three stages represent self-concerns, concerns internal to the user. The fictional individual represented in Figure 5 would be expressing peak concerns in Stage 6: Refocusing, followed by Stage 3: Management. This combination could indicate that the user has begun adapting the innovation and because of those adaptions is experiencing some concern related to the management of those changes. Similar analysis can be conducted for groups of individuals and should be interpreted utilizing *Measuring Implementation in Schools: The Stages of Concern Questionnaire* (George et al., 2006).

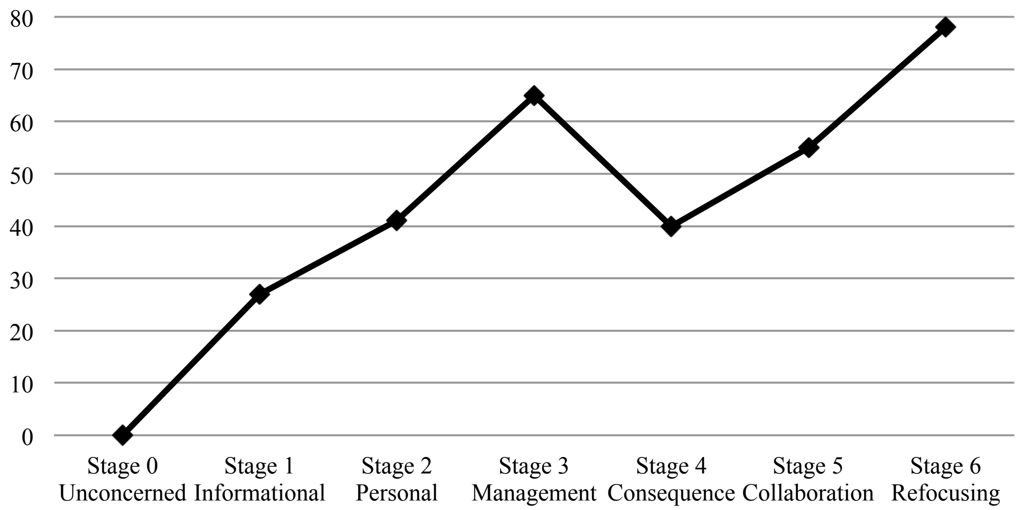

Figure 5. Sample Stages of Concern profile with fictional data

Stage 0: Unconcerned, is indicative of individuals who have little involvement with or concern over the innovation (George et al., 2006). Individuals move to Stage 1: Informational, when they become aware of the innovation and express some interest in learning more. Stage 2: Personal, is indicative of individuals who are weighing the personal costs of the innovation against their perceived returns. Once this level has been resolved and the users have resolved their personal concerns, they leave self-focused concerns and move to task-oriented concerns in Stage 3: Management. These concerns focus on the task: how the innovation works; how to teach it; and other, general management-based concerns (George et al., 2006).

Individuals who progress beyond Stage 3 concerns begin to focus on the impact to the students in their own classes, and the impact on the students' performance under the innovation, two key indicators they are in Stage 4: Consequence. Once individuals move from focusing on their own students and begin to collaborate with other teachers around the innovation for the betterment of a broader base of students, they have progressed to Stage 5: Collaboration. Movement to Stage 6: Refocusing, occurs when the individual's focus shifts to improving the innovation. This may entail cessation of use and the adoption of a different innovation entirely. While movement from lower stages to higher stages is not automatic, "the emergence and resolution of concerns about innovations appear to be developmental, in that earlier concerns must first be resolved (lowered in intensity) before later concerns can emerge (increase in intensity)" (George et al., 2006, p. 8). While the CBAM includes the use of Innovation Configurations and Levels of Use, these components of the model follow an assessment of the Stages of Concern. As integral components of the model, they are explained herein but fall outside the focus of this initial study.

CBAM: Innovation Configurations.

Previous success or failure and the degree of teacher involvement in creating and understanding the purpose of the proposed change may lead to increased expectations for success as teacher dignity is preserved and utilized as a component of lasting educational change (Fullan, 2007). Central to CBAM is the use of Innovation Configuration Maps to define and clarify change as well as establish a professional learning community focused on the innovation (Hall & Hord, 2014). The purpose of the IC practice and IC maps is best described by Hall and Hord (2014, pp. 53-54):

> For teachers and others who are expected to implement new practices, all too frequently a problem is lack of clarity about what they are being asked to do. Even when training and materials are provided, there is a big leap from preparing to do something to actually doing it. In the end, what teachers do in the classroom may bear little resemblance to what the creator(s) of the change had in mind originally. All of the teachers may call it the same thing, but in practice what they do may look very different.

One key to the CBAM is a focus on exactly what the innovation looks like. Ideally, a change is defined and teachers understand how that change will impact their pedagogy. While increasing science content in agriculture courses and STEM content in all courses has received media and research attention, clear expectations on a course-by-course level have not been found in the literature. Innovation Configuration mapping is a process of defining the boundaries for what the change looks like and, just as importantly, what it does not look like (Hall & Hord, 2014). Fullan (2007) noted that lasting educational change occurs when teachers feel they are a part of the process. CBAM, and particularly the Innovation Configuration mapping process, is an opportunity for teachers and change facilitators to discuss the proposed change together and work out what it will look like in the classroom and how it will impact student learning. End-user adaptation of curriculum is part of the change process; and in every change, a continuum of adaptation will occur.

Innovation Configuration mapping defines when an adaptation meets the intent of the change and when an adaptation no longer qualifies as acceptable (Hall & Hord, 2014). Innovation Configuration Maps provide visual and action-oriented descriptions of the components of the innovation. Variation descriptions cover the array of acceptable actions and their application in the classroom or laboratory setting. Increasing the visual descriptors and the level of detail helps teachers know when they are and are not utilizing the innovation. Innovation Configuration Maps define, through detailed descriptions, the range of quality, fidelity, and adaptation occurring with the innovation, as well as provide teachers with descriptions of what the ideal looks like (Hall & Hord, 2014). Hall and Hord found Innovation Configuration Maps were more useful to teachers when a group works together to define the levels, variations, and the ideal. Aligning with Fullan's recommendations for involvement, Hall and Hord (2014, p. 70) stated:

> Through the process and dialogue, clarity increases about what use of the innovation looks like and how they are to use it. This results in participants developing precise expectations, a feeling of contributing to the innovation that they will use, and commitment to the innovation's implementation. In other words, the participants will have "buy-in."

The creation of Innovation Configuration Maps requires first assessing what is currently taught. This allows the change agents to work with administrators, policy makers, and teachers to identify what the change will look like. Following this evaluation and an assessment of the teachers' Stages of Concern, creating an Innovation Configuration Map in cohort with teachers and administrators would allow change agents to improve the STEM integration in agricultural mechanics through the use of the clear expectations and the specific examples an Innovation Configuration Map provides.

CBAM: Levels of Use.

Assessment of the Level of Use of an innovation requires that an Innovation Configuration Map was created, and teachers and change agents agreed upon what the proposed change will look like in the classroom. Use of Innovation Configuration Maps helps participants realize Fullan's (2007) characteristics of change, awareness, need, clarity, complexity, quality/practicality, and allows one to move onto assessing the Levels of Use as defined by the Concerns Based Adoption Model. Each of the eight levels represents a progression in the adoption and implementation of educational changes. While changes are either implemented or not implemented, Hord et al. developed a continuum of use based on the degree to which an innovation is interwoven into the system. Levels of Use analysis is conducted at the individual user level, and not at the systems level, because often system-based evaluation includes both those who have adopted the innovation as well as those who have not, creating the opportunity for misinterpretation of the results (Ellsworth, 2000). Hall and Hord recommend conducting an interview on Levels of Use or collecting the data through classroom observations (2014). While studies often find some alignment between Stages of Concern and Levels of Use, these two assessments do not have a defined relationship, and Hall and Hord report that disjunction between higher level concerns and higher uses does occur. In describing the Stages of Concern and Levels of Use, Hall and Hord (2014) stated:

> The terms have a deceptively similar ring. However, we are about to make a significant conceptual switch, for whereas Stages of Concern addresses the *affective* side of change—people's reactions, feelings, perceptions, and attitudes—Levels of Use has to do with *behaviors* and portrays *how* people are acting with respect to a specified change. (p. 107)

The nine Levels of Use are divided into three levels of non-use and five levels of use (see Table 1); they are typically progressed through sequentially.

Table 1

Levels of Use of an Innovation an Individual Progresses Through When Experiencing a New Innovation and the Accompanying User Classification

Level of Use	Name of Level	User
Level 0	Nonuse	No
Level I	Orientation	No
Level II	Preparation	No
Level III	Mechanical Use	Yes
Level IV A	Routine	Yes
Level IV B	Refinement	Yes
Level V	Integration	Yes
Level VI	Renewal	Yes

Level 0: Nonuse represents those who have neither knowledge of, nor involvement with, the innovation. They leave this Levels of Use when they "take action to learn more detailed information about the innovation" (Hall & Hord, 2014, p. 113). The next Level of Use, Level I: Orientation, encompasses teachers who are acquiring

information about the innovation. This is an evaluative level, and teachers leave this level when they "make a decision to use the innovation by establishing a time to begin" (p. 113). This decision marks entrance into the last non-user Levels of Use, Level II: Preparation, where teachers are actively preparing to use the innovation for the first time. Teachers leave this last level of non-use when they begin to make "user-oriented changes" to utilize the innovation (p. 113).

Users of the innovation begin at Level III: Mechanical Use, where they focus on the basics and do things day to day. The focus is on the teachers' individual needs and changes to their behaviors. Mechanical users have little time for reflection since they spend their time trying to master the innovation (Hall & Hord, 204). Users leave this Level of Use when they have developed a routine and their use of the innovation is no longer characterized as "disjointed and inefficient" (p. 110).

Level IV A: Routine was summarized by Ellsworth (2000, p. 149) as, the "crisis has passed: use of the innovation has stabilized, but little thought is being given to improve its effectiveness yet." Here the teacher is utilizing the innovation, but puts little thought into the advanced merits of the changes they have implemented. A teacher in this stage would download a new curriculum, or teach via a new pedagogy, and follow the prescribed methodology without really trying to make the innovation truly theirs. Users move from this Level of Use when they make changes to their use of the innovation to increase student outcomes (Hall & Hord, 2014).

Level IV B: Refinement begins when, "the individual begins to adapt the innovation to enhance its short- and long-term benefits to those within their immediate sphere of influence" (Ellsworth, 2000, p. 149). Teachers in the refinement stage see results and believe in the innovation. They are past routinely following the prescribed methods and are now actively adapting the innovation to their classroom. Users leave this Level of Use when they begin to make changes to benefit students based on "input from and in coordination with colleagues" (Hall & Hord, 2014, p. 113).

Level V: Integration represents a collective effort. Ellsworth (2000, p. 149) stated, "This adaptation begins to mass and the effects of the individual's own use with the efforts of colleagues, to improve outcomes for those in their combined spheres of influence." Teachers in this stage now reach out to others who have adopted the innovation to discuss and collaborate to find better ways of using the innovation. Teachers see application outside the set parameters, and actively seek better ways to implement the innovation. Once a teacher has begun "exploring alternatives to or major modification of the innovation," they move to the final Level of Use (Hall & Hord, 2014, p. 113).

Level VI: Renewal is the stage wherein re-evaluation and reflection upon the innovation allows adopters to contemplate the modification and enhancements they have made, allowing the process to begin anew (Ellsworth, 2000; Hord et al., 2013). Teachers in the renewal stage have concluded the innovation is better for students and worthy of utilization across their curriculum. They seek ways to either further adapt the innovation or implement the innovation in even more areas. This renewed awareness provides the start of additional innovation, feeding the cycle as new opportunities arise.

While the above scenarios and descriptions focus on best-case scenarios, it is important to note that at any time the decision to stop the innovation completely may occur. As individual teachers move through the Levels of Use, they may decide that the innovation no longer holds the value it purports, or externally-driven changes may lead to the innovation becoming obsolete before it reaches levels of integration and renewal (Ellsworth, 2000).

Fullan's New Meaning of Educational Change.

Fullan (2007) posited that the most important consideration in the study of educational change and factors impacting change is the teacher. Teachers rarely feel they drive educational changes, and some even relay feelings of being a puppet on a string (Fullan, 2007). Successful change efforts reverse this practice of marginalizing teachers' voices and their collective wisdom and make them an integral part of the change efforts. Fullan (2007, p. 129) simplified the change process; "Educational change depends on what teachers do and think—it's as simple and as complex as that." A teacher's actual level of control is an important consideration in educational change, due to the impact typically exerted on teachers through external initiatives, a factor they seldom control.

Change is never an easy proposition. Fullan's (2007) evaluation of change as a process typically involving loss, anxiety, and struggle further expands the emotions measured with the CBAM. Additionally, change in education has devolved to the point of being a cliché. Ellsworth (2000, p. xiii) reported that educational change now occurs at a "rate never before seen," due in part because of the "information-based society" in which we now reside. Studies relating to educational change have proposed many models to try and understand this process from a myriad of stakeholder perspectives (Ellsworth, 2000). Understanding the change process is important in secondary education due to the fact "that school is, for each teacher, a place of 'quiet isolation'" where many teachers view their classrooms as isolated and disconnected from the school as a whole (Ellsworth, 2000, p. 105). While many changes occur as top-down edicts, resulting from national movements or legislation tied to funding, Fullan (2007) found that successful educational change only occurs through cooperative efforts wherein teachers play an active role. Fullan proposed that successful models for change in education hold the dignity of those affected, teachers and students alike, as paramount in executing a successful transition. Those impacted by change tend to rely on their individual paradigm of reality; therefore, successful change can only occur through "shared meaning," or as Fullan (2007) describes it:

> Real change, then, whether desired or not, represents a serious personal and collective experience characterized by ambivalence and uncertainty; and if the change works out, it can result in a sense of mastery, accomplishment, and professional growth. The anxieties of uncertainty and the joys of mastery are central to the subjective meaning of educational change and to the success or failure thereof—facts that have not been recognized or appreciated in most attempts at reform. (p. 23)

Factors affecting implementation.

To understand why teachers do not move through the change process toward the higher Stages of Concern and Levels of Use, further focus on Fullan's (2007) four factors affecting implementation – need, clarity, complexity, and quality and practicality – are required. Fullan (2007) proposed a theory of educational change dependent upon understanding local or school-based factors and external factors, like government policies and educational standards. The factors Fullan delineated are interactive in nature, none occur in isolation, nor can one change without impacting another. The first, need, was split into awareness of the need for change and interest in the change. Relating to awareness of the need, Fullan (2007, p. 88) stated, “Many innovations are attempted without a careful examination of whether or not they address what are perceived to be priority needs.” This becomes increasingly important as more frequent and larger reform efforts are undertaken. Given the frequency of changes in education, focusing on priorities becomes an essential first step in the change process.

The focus on priorities leads to the second part of the need continuum: interest in the change practice, or the change practice being of enough importance to warrant the time necessary to implement the change. While many needs can be identified in any given education setting, for teachers, the level of interest in a particular change practice comes as a “question not only of whether a given need is important, but also of how important it is relative to other needs” (Fullan, 2007, p. 88). Adding to the complexity of the need stage is the fact that many practices have an emergent need that may not be as evident at the initiation of a change practice (Fullan, 2007). Fullan (2007) emphasized that to move beyond the need phase, there must be some degree of visible progress being made toward meeting the needs of the impacted group.

The need phase traditionally gives way to the clarity phase. Clarity, or the ability of the change agent to articulate their innovation, requires specific interventions, or practices, and conveyance of them across all stages of the change effort. Fullan (2007) related many failed change efforts, where those trying to implement a change could not articulate the teachers’ actual practices or the intended impact of the innovation. False clarity is often the result when a focus on clarity is not a systemic effort. Fullan (2007, p. 89) stated, “new or revised …guidelines have been dismissed by some teachers on the grounds that ‘we are already doing that,’” when in fact, the use of the new curriculum or guidelines were implemented before the teachers fully understood the underlying strategies necessary to effectively implement the new change practice. In addition to ineffective implementation, “unclear and unspecified changes can cause great anxiety and frustration” (Fullan, 2007, p. 90).

Fullan defined complexity as, “the difficulty and extent of change required of the individuals responsible for implementation” (2007, p. 90). This complexity can be measured as a function of “difficulty, skill required, and extent of alterations of beliefs, teaching strategies, and use of materials” (Fullan, 2007, p. 90). Increasing complexity can lead to decreased adoption, and Fullan (2007, p. 91) cautioned, “Simple changes may be easier to carry out, but they may not make much of a difference.”

Fullan (2007) expressed that a quality product should be of primary concern in change efforts. Without quality materials that have practical importance to the proposed change, the change will not be as effective (Fullan, 2007). Many large change efforts focus on implementation to the detriment of the development of quality resources. “When adoption is more important than implementation, decisions frequently are made without the follow-up or preparation time necessary to generate adequate materials” (Fullan, 2007, p. 91).

Understanding and implementing effective educational change requires time (Fullan, 2007). Fullan theorized, “The goal, then, is to attempt substantial reform and do it by persistently working on multilevel meaning across the system over time" (p. 92). Once change starts to take hold, adoption will occur at varying degrees, or as CBAM labels them, Levels of Use (Hord et al., 2013). Caution is warranted when assessment of an innovation occurs in the first year. Hall and Hord (2014) suggest a timeline of three to five years for any innovation implementation and the conducting of an accurate assessment of the innovation's impact. Assessment of innovations may occur after one semester or one year; and without giving the innovation enough time for change agents to know its actual value, teachers, change agents, or researchers may discard the innovation as a failure.

Theories of Learning Science

A basic understanding of the way in which we learn science is required for full implementation of changes in the Level of Use that science integration and STEM processes experience in agricultural mechanics laboratories. Starting with Greek philosophers and extending to the present day, many theories relating to understanding science have been proposed. Frequently cited in both agricultural and science education research and pedagogy, three philosophers and their philosophies merit further exploration: Immanuel Kant, Lev Vygotsky, and John Dewey. While it has been proposed that Dewey's influence was a product of chance (Moore & Moore, 1984), his influence is no less prevalent than the others mentioned, regardless of its origination.

The nature of science, or the way we gain scientific knowledge, is a difficult process for students to understand (McComas, Almazroa, & Clough, 1998). McComas et al. (1998) described scientific knowledge as "durable" and "tentative," and they explained there is "no one way to do science," whose history they describe as being both "evolutionary and revolutionary" (p. 513). They further described secondary science teachers' beliefs as "inductivist-empiricist" (p. 516) and dependent upon a positivist view of science. Crotty explained this positivist position as a "conviction that scientific knowledge is both accurate and certain" (Crotty, 1998, p. 27). Crotty explained that the positivist scientific "world of regularities, consistencies, uniformity's common ironclad laws, [and] absolute principles" was inconsistent with the real world (Crotty, 1998, p. 28). McComas et al. (1998) "are confident that science education will be a richer discipline and our students will be more adequately prepared for their lives as citizens when they are afforded a fuller understanding of the nature of this thing called science" (p. 527-528).

Constructivism holds that "reality is constructed through the interaction of the creative and interpretive work of the mind with the physical/temporal world" (Paul, 2005, p. 46). In this epistemology, "knowledge is a dynamic product of the interactive work of the mind made manifest in social practices and institutions" (Paul, 2005, p. 46). Several constructivist philosophers have played a key role in the development of both agricultural education and science education. Their philosophical views combine to influence the way science teaching occurs in secondary classrooms.

Immanuel Kant (1724-1804).

> Reason in a creature is a faculty for extending the rules and purposes of the exercise of all its powers far beyond natural instinct, and it is illimitable in its plans. It works however not instinctively, but stands in need of trials—of practice—and of instruction in order to ascend gradually from one degree of illumination to another. (Kant, 1824, p. 386)

Rationalism in science, or the epistemology that knowledge was formed in the mind through reason, existed before Kant; however, he is credited as one of the originators of the positivist philosophy that *a priori* knowledge plays a role in interpreting experience (Slife & Williams, 1995).

Kant held that at least some human knowledge results from mental activity that is *a priori*:

> Our minds are naturally prepared to organize and give meaning and interpretation to the sensations we experience. Indeed, if the mind were not so prepared, the many sensations of our world would overwhelm and confuse us. We are not overwhelmed and confused, because we selectively attend to some sensations, organize them, and thus endow our experience with meaning. (Slife & Williams, 1995, p. 74)

Slife and Williams explained Kant's philosophy: "Our experience is always a combination of the *a priori* organization and the world itself, without our necessarily recognizing which is which" (1995, p. 75). The idea that new knowledge builds upon prior knowledge is consistent with human cognitive theories on how our brain organizes and relates new information to existing information (Kirschner, Sweller, & Clark, 2006). Kirschner et al. (2006) explained that long-term memory is central to understanding what we "see, hear, and think" and is the "central, dominant structure of human cognition" (p. 76). Kirschner et al. (2006) reasoned that working memory, where processing occurs, was limited in its capacity to store knowledge; however, by interacting with long-term memory, or Kant's *a priori* knowledge, many of these limitations can be mitigated.

Science education represents one embodiment of reasoning connecting *a priori* knowledge through reasoning to new knowledge. The scientific method applied in secondary laboratory settings requires one to first hypothesize what will happen in a given situation. Based on prior knowledge of relevant related information, the hypothesis is then formally tested to determine if the reasoning proved true, or if some flaw in the reasoning led to the experiment creating an alternative outcome.

John Dewey (1859-1952).

"It is either celebrated or conceded that John Dewey is the most influential American philosopher of the 20th century" (Diggins, 1989, p. 76). From Dewey comes the problem solving approach to teaching. McLellan, a Canadian contemporary of John Dewey, stated in the preface to his work *Applied Psychology*, that every student of psychology should read Dewey's work, and that he was indebted to Dewey's work in preparation of his manuscript (McLellan, 1889). McLellan would eventually add Dewey as coauthor of his work in later printings. *Applied Psychology*, emphasized instruction based on activity, practical applications, ideas leading to action, and action leading to ideas (Dykhuizen, 1962). The subtitle to *Applied Psychology:* "Learn to Do by Knowing and to Know by Doing" may sound very familiar to those in agricultural education due to its similarity to the beginning of the FFA motto; Learning to Do, Doing to Learn.

Dewey believed in what he called warranted assertions. Warranted assertions were a cyclical process that involved action, reflection, wisdom (not knowledge), and new action (Dykhuizen, 1962). Science as a logical process occupied much of Dewey's research focus at the University of Chicago, where he ran an experimental school and frequently used his own children as test subjects (Dykhuizen, 1962).

Dewey did not believe in spectator-based knowledge (Kulp, 1992). For Dewey, “knowledge is what results when we, through intelligently directed activity, achieve successful integration with our environment” (Kulp, 1992, p. 8). The learning process defined by Dewey, as summarized by Newcomb et al. (2004, p. 74) includes:

1. Experiencing a provocative situation
2. Defining the problem—clarifying questions to be answered
3. Seeking data and information
4. Formulating possible solutions
5. Testing proposed solutions
6. Evaluating the results

The reflex arc, problem solving, and reflection have become integral to agricultural education (Newcomb et al., 2004; Parr & Edwards, 2004; Thoron, 2012) and science education (C. Anderson, 2007; R. D. Anderson, 2007; Weiland, 2012) through a process today called inquiry based learning. However, some propose the union happened by chance:

> Adoption of the problem-solving approach to teaching and vocational agriculture occurred primarily as a historical accident. If vocational agriculture had not come into existence during the peak of Dewey’s career our profession would probably not have embraced problem-solving so readily. (Moore & Moore, 1984, p. 5)

Lev Vygotsky (1896-1934).

> Pedagogy must be oriented not to the yesterday, but to the tomorrow of the child’s development. Only then can it call to life in the process of education those processes of development which now lie in the zone of proximal development. (Vygotsky, 1993, pp. 251-252)

Sociocultural learning, attributed to the philosophies of Lev Vygotsky, plays a key role in teaching both teamwork and stretching students beyond their comfort zone into what Vygotsky calls the zone of proximal development (Schunk, 2012). “Vygotsky considered the social environment critical for learning and thought that social interactions transformed learning experiences” (Schunk, 2012, p. 242). Schunk (2012) explained that Vygotsky’s philosophy held that students independently solving problems could enhance their understanding through collaboration with more capable peers. In this learning theory, “learners bring their own understandings to social interactions and construct meanings by integrating those understandings with their experiences in the construct” (Schunk, 2012, p. 244). Much as Socrates and Plato utilized social interactions to deepen understanding, today’s science classrooms utilize collaborative interactions in a social setting to help students reason together. This methodology, credited to the work of Vygotsky, allows students and teachers to interact and collaboratively expand their knowledge base.

Vygotsky is also credited with the pedagogical practice of scaffolding (Puntambekar & Hubscher, 2005). Originally this approach provided both instructional support and limited external factors to enhance learning in the specified context (Puntambekar & Hubscher, 2005; Schunk, 2012). Today, “the scaffolding construct is being applied more broadly, to include the support provided in technology tools, peer interactions, and discussions aimed at the whole class" (Puntambekar & Hubscher, 2005, p. 1). These new meanings for the term scaffolding do not always correlate with the original meaning of scaffolding and individualized instruction, which allow each student to maximize their learning and is difficult with today's larger class sizes (Puntambekar & Hubscher, 2005). Despite these restrictions for STEM courses, "techniques such as scaffolding and peer collaboration can help students be successful with challenging tasks and move beyond their current state of knowledge" (Honey et al., 2014, p. 4).

Sociocultural theory also addresses the fact that science is increasingly a dialogue with people of diverse backgrounds and cultural identities. "Students learn science when they are able to adopt scientific language, values, and social norms for the purpose of participating in scientific practices, such as inquiry and application of scientific concepts" (C. Anderson, 2007, p. 18). However, understanding sociocultural diversity in science classrooms is difficult. "Science educators must struggle to see hidden sociocultural conflicts and to make use of the cultural resources that children bring to science learning" (C. Anderson, 2007, p. 19). Vygotsky's sociocultural theories may have been more concerned with the internal social interaction of students and peers, but cultural differences and understandings of science, what is truth, and cultural incompatibilities must be considered in the multicultural classroom of the 21st century (Schunk, 2012). "Though fundamental to all learning experiences, social and cultural experiences such as those which require students to work with each other and actively engage in discussion, joint decision making, and collaborative problem solving may be particularly important in integrated learning" (Honey et al., 2014, p. 4).

Science, Engineering, and Integration

Integrated science education does not eliminate the need for discipline-specific instruction. "Students' knowledge in individual disciplines must be supported. Connecting ideas across disciplines is challenging when students have little or no understanding of the relevant ideas in the individual disciplines" (Honey et al., 2014, p. 5). Instead, integration in agricultural education, as defined for this study, was the enhancement of science, mathematics, and engineering connections through problem-solving activities, which specifically pull out and explain STEM concepts in the context of agricultural settings, using the correct STEM vocabulary and mathematical formulas to present solutions to problems. Honey et al. (2014, p. 21) point out that advocates of STEM integration contend: "Teaching STEM in the context of real-world issues and challenges—and hence, in an integrated fashion—can make the subjects more relevant to students and teachers, thereby enhancing motivation for learning and improving student achievement and persistence.

Problem solving and inquiry based instructions are key tenants of both agricultural and science education (Parr & Edwards, 2004). These student-centered approaches to learning utilize social interaction (Vygotsky) and a constructivist pedagogy (Dewey) to engage students actively in the learning and exploring process. "Students will thus need support to elicit the relevant scientific or mathematical ideas in an engineering or technological design context, to connect those ideas productively, and to reorganize their own ideas in ways that come to reflect normative, scientific ideas and practices" (Honey et al., 2014, p. 5).

The engineering process.

In Career and Technology Education (CTE), engineering has its own recognized career pathway (Center for Occupational Research and Development & National Association of State Directors of Career Technical Education Consortium, 2012). The recognition of an engineering pathway does not remove the need for educators across the secondary curriculum to incorporate STEM concepts into their individual disciplines. In fact, "CTE programs offer an important instructional approach that strengthens students' understanding of STEM content and helps attract more individuals into STEM career pathways" (The Association for Career and Technical Education, 2009, p. 1). More than half of all STEM jobs require less than a bachelor's degree and pay an average salary of $53,000 (Rothwell, 2013). The need for students able to think as engineers and utilize the design process is crucial for success in STEM careers (International Technology Education Association, 2002). Their standards emphasized the role of design:

> Design is regarded by many as the core problem-solving process of technological development. It is as fundamental to technology as inquiry is to science and reading is to language arts. To become literate in the design process requires acquiring the cognitive and procedural knowledge needed to create a design and familiarity with the processes by which a design will be carried out to make a product or system. (International Technology Education Association, 2002, p. 90)

The Technological Literacy Standards were cross-disciplinary by nature:

> By practicing these problem-solving methods, students acquire a number of other viable skills—performing measurements, making estimates and doing calculations—using a variety of tools, working with two and three-dimensional models, presenting complex ideas clearly, and devising workable solutions to problems. (International Technology Education Association, 2002, p. 90)

Many variations of the actual design process exist; and, "There is no formal agreement on what constitutes engineering knowledge and skills at the K–12 level, but there is growing recognition of the importance of the engineering design process" (Honey et al., 2014, p.19). However, international standards for technology include, among other skills, the following components in the design process: (1) identify a need, (2) define the problem/ how to solve the need, (3) define constraints (money, time, resources), (4) generate ideas, (5) analyze and choose an idea, (6) build a model or prototype, and (7) test and evaluate the results (International Technology Education Association, 2002). This process is similar to the process described by both Dewey and Newcomb et al. for gaining knowledge or wisdom. Honey et al. (2014, p. 51) emphasized, it was "through iterative design cycles the students would engage in planning, creating, testing, and improving their inventions." Iteration and reflection as stages of the learning process further connect current thinking in STEM education with the constructivist philosophies of Kant, Dewey, and Vygotsky.

Integration efforts do not need to focus solely on STEM content knowledge. Honey et al. pointed out:

> A STEM education can lead to productive employment and is critical to the nation's innovation capacity. And many employers and public officials have come to believe that all people, particularly young people, need to have some degree of scientific and technological literacy in order to lead productive lives as citizens, whether or not they ever work in a STEM-related field. (2014, p. 13)

Literacy, or familiarity with STEM processes, creates a competent 21st century workforce. Honey et al. described the literacy movement as including:

> Some combination of (1) awareness of the roles of science, technology, engineering, and mathematics in modern society, (2) familiarity with at least some of the fundamental concepts from each area, and (3) a basic level of application fluency (e.g., the ability to critically evaluate the science or engineering content in a news report, conduct basic troubleshooting of common technologies, and perform basic mathematical operations relevant to daily life). (2014, p. 34)

Similar to agricultural literacy (National Research Council, 1988), STEM literacy is now considered an essential component of students' secondary instruction (Honey et al., 2014). Also similar to agricultural education are engineering education's best teaching practices, which include:

- Motivate learning. As much as possible, relate the material being presented to what has come before and what is still to come in the same course, to material in other courses, and particularly to the student's personal experience *(inductive/global)*.
- Provide a balance of concrete information (facts, data, real or hypothetical experiments and their results) *(sensing)* and abstract concepts (principles, theories, mathematical models) *(intuitive)*.
- Balance material that emphasizes practical problem-solving methods *(sensing/active)* with material that emphasizes fundamental understanding *(intuitive/reflective).*
- Provide explicit illustrations of intuitive patterns (logical inference, pattern recognition, generalization) and sensing patterns (observation of surroundings, empirical experimentation, attention to detail), and encourage all students to exercise both patterns *(sensing/intuitive)*. Do not expect either group to be able to exercise the other group's processes immediately.
- Follow the scientific method in presenting theoretical material. Provide concrete examples of the phenomena the theory describes or predicts (sensing/ inductive); then develop the theory or formulate the mod *(intuitive/inductive/ sequential)*; show how the theory or mod can [*sic*] be validated and deduce its consequences *(deductive/sequential)*; and present applications *(sensing/deductive/sequential).*
- Use pictures, schematics, graphs, and simple sketches liberally before, during, and after the presentation of verbal material *(sensing/visual*). Show films (sensing/visual.) Provide demonstrations *(sensing/visual)*, hands-on, if possible *(active)*.
- Use computer-assisted instruction—sensors respond very well to it *(sensing/active)*.
- Do not fill every minute of class time lecturing and writing on the board. Provide intervals—however brief—for students to think about what they have been told *(reflective).*
- Provide opportunities for students to do something active besides transcribing notes. Small-group brainstorming activities that take no more than five minutes are extremely effective for this purpose *(active).*
- Assign some drill exercises to provide practice in the basic methods being taught *(sensing/active/sequential)* but do not overdo them *(intuitive/reflective/ global).* Also provide some open-ended problems and exercises that call for analysis and synthesis *(intuitive/reflective/global).*
- Give students the option of cooperating on homework assignments to the greatest possible extent *(active).* Active learners generally learn best when they interact with others; if they are denied the opportunity to do so, they are being deprived of their most effective learning tool.
- Applaud creative solutions, even incorrect ones *(intuitive/global).*

- Talk to students about learning styles, both in advising and in classes. Students are reassured to find their academic difficulties may not all be due to personal inadequacies. Explaining to struggling sensors or active or global learners how they learn most efficiently may be an important step in helping them reshape their learning experiences so that they can be successful *(all types)*. (Felder & Silverman, 1988, 2002, p. 680)

Utilization of best teaching practices increases a teacher's impact on student learning. These practices called for more teamwork, exploration, design, discussion, reflection, creativity, and career applications. The level and extent of implementation of these practices in the introductory agricultural mechanics curriculum of Idaho was unknown.

Student motivation and interest in science.

Student motivation to learn is always a concern teachers must address. In science and other STEM-related classes, the motivation of students is decided early in the elementary and middle school grades (Blank, 2012). Prior to secondary STEM educators helping students develop literacy in their content area, re-ignition of the student's interest must occur (Bathgate, Schunn, & Correnti, 2014). Bathgate et al. (2014, p. 190) concluded, "Reductions in openness and curiosity toward science experiences may prevent many children from fully developing scientific literacy, reducing what they can understand about technology, medical issues, and environment concerns as adults." This makes increasing motivation to learn in secondary classrooms essential for those trying to ignite an interest in the STEM fields. Changing attitudes and increasing motivation to learn science is a complex proposition:

> "In learning science, it is important to recognize that attitudes influence motivation, which in turn influences learning, and ultimately behavior. This sequence is relevant to investigating learning in many science contexts, although the relationships among these variables can be more complex and interactive than this basic sequence suggests." (Koballa & Glynn, 2007, p. 85)

Active learning and inquiry-based approaches may be a tool that reignites this interest in STEM (Hampden-Thompson & Bennett, 2011; Koballa & Glynn, 2007; J. Osborne, Simon, & Collins, 2003; Vedder-Weiss & Fortus, 2011, 2012). Active, inquiry-based learning in STEM is associated with school laboratories as one location where active and engaged learning occurs. Tobin (1990) debated the value of the science laboratory from the perspective of teaching the scientific process as it occurs beyond the structured school setting and concluded that the science lab was not as effective as has been suggested in the past. Indeed, while some may question the value of laboratories to teach science discovery, student motivation toward science, and interest in scientific fields of study, increased when students actively engaged with science through laboratory learning experiences (Tobin, 1990).

The agricultural education teaching laboratory.

The laboratory is a "space for individual or group student experiments, projects, or practice" (Talbert, Vaughn, Croom, & Lee, 2007, p. 396). In agricultural education, these spaces vary widely in size and type of equipment available from school to school, and provide space for activities in "agriscience, agricultural mechanics, horticulture, plant and soil science, animal science, and natural resources" (Talbert et al., 2007, p. 396). The level of use is often determined by a combination of both teacher comfort and facility condition (Talbert et al., 2007).

Talbert et al. explained that these spaces allowed students to learn, use equipment, and develop skills that enhanced their classroom instruction and built interest in the subject matter.

The science laboratory is similar in function to the agriculture laboratory. Here students conduct "learning experiences in which students interact with materials or secondary sources of data to observe and understand the natural world" (Lunetta, Hofstein, & Clough, 2007, p. 394). However, "rapid developments in science, technology, and cognitive research have made the traditional definition of science laboratories—only as rooms where students use special equipment to carry out well-defined procedures—obsolete" (Singer, Hilton, & Schweingruber, 2005, p. 2). In science learning, Singer et al. (2005, p. 3) posit the laboratory can be used for, "enhancing mastery of subject matter; developing scientific reasoning; understanding the complexity and ambiguity of empirical work; developing practical skills; understanding the nature of science; cultivating interest in science and interest in learning science; and developing teamwork abilities." While the value of the experiences in the laboratory to teach science as scientists practice it is still unclear (Tobin, 1990);

> The school science laboratory is a unique resource that can enhance students' interest, knowledge of science concepts and procedures, and knowledge of important tools and skills that can develop new understanding. Experiences in the school laboratory can also help students glimpse ideas about the nature of science that are crucial for their understanding of scientific knowledge. These are among the reasons the laboratory activities have had a prominent place in the science curriculum since early in the 19th century. (Lunetta et al., 2007, p. 394)

Science and agriscience laboratories provide places for students to explore and work as teams to accomplish tasks. The great variety of laboratories in use in both science (Singer et al., 2005) and agriculture (Phipps, Osborne, Dyer, & Ball, 2008; Talbert et al., 2007) classrooms speaks to their ability to be customized to meet the needs of the schools in which they are utilized. Best practices in agricultural education espouse the agriscience laboratories as one of the best locations to teach hands-on science to students (Phipps et al., 2008; Talbert et al., 2007).

Historical perspectives of agriscience in Idaho

Scientifically-based agricultural production helped enable the American farmer to feed the world (Brown, Collins, Robinson, & Seeger, 2012). Science inclusion in secondary agricultural education has followed a circuitous path, sometimes in favor and sometimes forgotten (Hillison, 1996). Agricultural literacy (National Research Council, 1988) and science literacy (Hurd, 1998) presented opportunities for both agriculture and science to aid each other in the improvement of instruction in both fields of study.

Agricultural education in the public schools began in the late 1790s with the idea of using the common school as a place to train the farmer in the arts of agriculture (Stimson & Lathrop, 1942). This effort led to Justin Morrill sponsoring the bills leading to the establishment of land-grant colleges in 1862 and 1890 (Stimson & Lathrop, 1942). The University of Idaho, established in 1889, began courses for students of less-than-college grade in 1893, with short courses in agriculture designed as block courses students could take during the winter while they were not farming (Lattig, 1939). The School of Practical Agriculture at the University of Idaho prepared students in scientific agricultural production and was meant to be a preparation school to help rural farm students become college ready (Lattig, 1939). High schools across Idaho began to include agriculture in their course offerings as a special focus of the State Board of Education to stimulate development of vocational education in the areas of agriculture and education (Idaho State Board of Education, Idaho State Superintendent of Public Instruction, & Board of Regents, 1915; Lattig, 1939). Early secondary agricultural education was of two types: the bookish type, which included little practical application of agriculture due to the limited training of the teachers; or scientific application of agriculture, using the extension service and its agents to deliver what the Hatch Act called agricultural science (Gibson, 1941; Hillison, 1996). In Idaho, agriculture courses at the local level were primarily "lessons from a book, often given by a teacher who has never held plow handles or milked a cow" (Idaho State Board of Education et al., 1915, p. 28).

The Smith-Hughes Act of 1917 made federal funds available for vocational training in high schools nationally. Hillison (1996) described the program as a cooperative venture between the United States Department of Agriculture and the Federal Board for Vocational Education (1996). The Smith-Hughes Act established high standards for program quality and instructor qualifications, and only five of Idaho's 73 schools were able to meet them (Idaho State Board of Education, Idaho State Superintendent of Public Instruction, & Board of Regents, 1919). The focus of the Smith-Hughes courses was strictly vocational, and Hillison stated; "Obviously the Smith-Hughes Act shifted the definition of agricultural education from being science-based and academic-oriented to a strictly vocational definition" (1996, p. 10). With the passage of the Smith-Hughes Act in 1917, agricultural education became fully vested in the business of producing technically skilled agricultural workers.

Agricultural Mechanics

Agricultural mechanics courses evolved out of a need to prepare boys or "future farmers … to carry on efficiently all the other numerous mechanical activities farmers commonly engage in" (Schmidt et al., 1927, p. v). Agricultural education programs in Idaho, and throughout the country, developed competency profiles of technical skills needed by agriculturalists in their states, and teachers utilized methodologies focused on students obtaining competence in the identified skill areas. As previously noted, early agricultural mechanics courses were focused on the farm enterprise and training boys with the skills needed to be proficient and self-reliant in the mechanical operations of their own farm. Technical skills instruction ranged from building cabinets to wiring home and shops, from building livestock equipment to repairing tractors and other farm power systems. The guiding principles of agricultural mechanics, according to Schmidt et al. (1927), were generally "those farm mechanical activities in which a farmer usually engages, and which he cannot perform efficiently without some training, [that] offer a most fruitful source of teaching objectives for instruction in farm mechanics" (p. 15).

The focus in agricultural mechanics has slowly changed and continues to evolve with the needs of today's diverse student body and employers' changing needs. Rosencrans and Martin (1997), in their study of over 200 agriculture teachers in 12 mid-western states, found over 85.6% of teachers felt agricultural mechanics instruction needed to focus on general transferable skills that would make students employable in a wide range of careers over the job-specific skill instruction they had been utilizing. Other key findings by Rosencrans and Martin included nearly 50% of teachers reporting pressure to reduce the emphasis on agricultural mechanics. In addition, 69% of the teachers in their study reported that stand-alone courses in agricultural mechanics were still a critical component of agricultural education programs. Rather than a focus on specific skills for specialized occupations, the diverse needs of today's workforce have been recognized by agricultural educators, and they continually adapt to meet those needs.

Agricultural mechanics content.

Heimgartner and Foster (1981) evaluated the importance of agricultural mechanics units in the Northwest in a study involving a sample of 119 instructors from the states of Washington, Oregon, Idaho, Montana, and Utah. Instructors in the study reported that agricultural mechanics courses accounted for 39.0% of all agriculture courses in the region, nearly double the next highest instructional area; and 46.4% of courses in Idaho, over twice the next highest area (Heimgartner & Foster, 1981). Heimgartner and Foster also asked instructors to assess the importance of the units utilized in agricultural mechanics programs across the region. Instructors reported the lowest importance in the historical production-oriented skill areas of glazing and rope work, and they recommended the discontinuation of these units in the curriculum of the region. Other units receiving below average importance ratings included metal lathe work, fence building, and masonry. No studies of agricultural mechanics content have been found for Idaho or the Northwest since 1981.

Preparation of teachers in agricultural mechanics.

Heimgartner and Foster (1981) asked instructors the source of their agricultural mechanics experience. Regionally, instructors reported that 28.4% of their experience came from their college preparation programs, and 30.9% of their experience came from previous farm backgrounds. Idaho instructors reported 33.1% of their experience came from their college preparation programs, and 26.2% came from previous farm experience. Instructors reported their highest experience in the areas of arc welding, oxy-acetylene welding, and small gas engines, all areas they also reported as being high in importance.

Buris et al. (2005) studied the preparation trends of pre-service teacher education programs in the area of agricultural mechanics, an area they described as a "cornerstone in the secondary program" (p. 23). Burris et al. asked the 69 study participants, each representing a different preparation program, to rate 53 competencies in nine agricultural mechanics areas of instruction. Teacher education programs in their study reported the highest importance in the areas of hand/power tools followed by agricultural power and electricity. The bottom three areas in importance reported by their respondents were the areas of plumbing, machinery and equipment, and concrete. Respondents also rated these 53 competencies in the perceived level of their graduates' preparation. The top and bottom three exchanged ranks, however, only electricity fell from the top three and was replaced by metal fabrication. The final component of the Burris et al. study was to determine the number of credits of agricultural mechanics required at the responding institutions. The highest percentage of programs (38.69%) required five to eight credits, followed by 33.34% of programs requiring nine to 12 credits and 20.3% requiring more than 13 credits of agricultural mechanics. Buris et al. (2005) reported that, "while the competency approach to teaching agricultural mechanics in secondary programs has drawn criticism as an instructional methodology, the competency of the instructor in those mechanical skills remains important" (p. 25). Burris et al. concluded that "pre-service teachers will benefit from programs that offer experiences in a wide range of agricultural mechanics content areas," and that teacher preparation programs should continue to provide competencies in agricultural mechanics to their graduates (p. 32). Additionally, Burris et al. concluded that the importance of agricultural mechanics units to secondary programs should continually be evaluated, as should the content of agricultural mechanics preparation programs to ensure important competencies were being taught in the teacher preparation programs and to avoid discrepancies between importance to secondary programs and time devoted at the university level.

The most recent study of agricultural mechanics skills occurred in Missouri (Saucier, McKim, & Tummons, 2012). Saucier et al. (2012) utilized Delphi methodology with 18 Missouri agriculture teachers to determine which agricultural mechanics skills beginning teachers most needed. Following a four-round Delphi, their panel of experts agreed upon 23 competencies beginning Missouri agriculture teachers needed to be successful:

Table 2
Essential Skills Needed to Teach Agricultural Mechanics

Overall Rank	Skill Area(s)
1	Laboratory safety
2	Methods used to teach agricultural mechanics
3	Laboratory management
4	Measurement tools
5	Project management
6	Shielded metal arc welding
7	Handheld power tools
8	Oxygen/acetylene cutting
9	Stationary power tools
10	Gas metal arc welding
11	Building material management
12	Carpentry
13	Hand tools
14	Electricity
15	Plasma arc cutting
16	Oxygen/acetylene welding
17	Cold metalwork
18	Small gas engines
19	Concrete
20	Plumbing
21	Gas tungsten arc welding
22	Surveying
23	Soldering

Note. Adapted from Saucier, R., McKim, B., & Tummons, J. (2012). A delphi approach to the preparation of early–career agricultural educators in the curriculum area of agricultural mechanics: Fully qualified and highly motivated or status quo? *Journal of Agricultural Education, 53*(1), 136-149. doi: 10.5032/jae.2012.01136

Conceptual Agriculture to Contextual Agriculture

Following the 1988 call for increased focus on agricultural literacy, due in part to a changing student demographic, agricultural mechanics relevance to the overall agricultural education program was questioned, and concern arose that perhaps agricultural mechanics had been lost in the agriscience transition (Buriak, 1992; E. Osborne, 1992). As the importance of teaching students production agriculture practices decreased following the 1988 call, the value of agriculture as a context for teaching science, life skills, and cross-disciplinary thinking increased (Mark A. Balschweid, 2002; Conroy, Trumbull, & Johnson, 1999; Dailey, Conroy, & Shelley-Tolbert, 2001). Changing the focus of agricultural education more toward science principles brought about questions relating to the scientific rigor of agricultural classes, staying true to agricultural education's roots, and meeting the demands of increasing standards (Scales, Terry, & Torres, 2009). In the move to a more scientific agricultural education, where would agricultural mechanics instruction end up, or would it be dropped all together?

Science preparation in agricultural education.

The question; "Are agriculture teachers prepared to teach science concepts?" emerges from the literature regularly (Mark A. Balschweid, 2002; Mark A. Balschweid & Thompson, 2002; Johnson & Newman, 1993; Ricketts, Duncan, & Peake, 2006; Scales et al., 2009; Thompson & Balschweid, 1999). The concerns focus on an array of issues from the perceptions of other teachers (Warnick, Thompson, & Gummer, 2004) to the actual amount of science being learned (Connors & Elliot, 1995; Ricketts et al., 2006). Connors and Elliot found Michigan students in agricultural education courses achieved as well as their traditional science counterparts on a standardized science test. Rickets et al. found Georgia students who completed a sequence of four agriculture courses enhanced with science actually achieved higher than their non-CTE counterparts did on their state standardized exam for science. Scales et al. (2009) questioned the teachers' knowledge about science topics, and thus their ability to teach the science content, and found Missouri agriculture teachers did not achieve passing scores on a biology certification exam; however, no comparison to current science teachers was made in this study. Studies directly comparing agriculture and science teacher knowledge levels were not found. Combined, the results of these studies provide researchers and policy makers alike confirmation of the benefits of a science enhanced agriculture curriculum and the need for continued professional-development in agriscience.

Baker, Bunch, and Kelsey (2012) posed a related concern, "What is lost when integration occurs?" A question Scales et al. (2009, p. 109) share when they concluded:

> The conventional wisdom of integrating more science, mathematics and reading into the secondary agriculture curriculum must be carefully considered. Leaders and stakeholders of secondary agricultural education must recognize that such a change will likely alter the very purpose of the program.

Baker et al. utilized a qualitative approach to analyze the agriculture program of an Agriscience Teacher of the Year Award winner from Oklahoma, Mr. Lee. Through their qualitative interviews and observations, they concluded that the program was successfully integrating science. They noted Mr. Lee would have liked to have more knowledge of "abstract science concepts" (Baker et al., 2012, p. 54), but they provided no explanation by what was meant by this phrase. The program under study was a two-teacher program, and only Mr. Lee held a science endorsement; however, they described a collegial relationship between the teachers, and both focused on different aspects of the curriculum. They reported no negative aspects resulting from the increased incorporation of science into the curriculum. They also reported that while Mr. Lee was uncomfortable in some aspects of teaching the science component, Mr. Lee reported he was actively learning the concepts with the students.

The new agricultural mechanics.

Originally, agricultural mechanics was a course used to teach carpentry skills and furniture making (Humphreys, 1965) as well as basic construction and repair of farm equipment (Buris et al., 2005). As farming became more mechanized, secondary instruction adapted to meet the new, more mechanized agricultural mechanics (Humphreys, 1965). Today, the agricultural education laboratory can be utilized for a myriad of instructional objectives relating to horticulture, agricultural mechanics, animal science, specialty labs (forestry, aquaculture, etc.), and agriscience (Phipps et al., 2008). The laboratory setting this study focuses on is the agricultural mechanics laboratory, which is used as an instructional component in teaching about power and machinery, construction, structures, electrical, metals fabrication, welding, soil and water, and food processing (Phipps et al., 2008).

Following the release of *Understanding Agriculture: New Directions for Education,* a movement to reinvent the focus of agricultural mechanics emerged (E. Osborne, 1992). E. Osborne (1992) cites a growing concern that agricultural mechanics instruction was lost in the reform movement underway in agriscience. His position was that agricultural mechanics instruction "should undergo the same science-based reforms that other parts of the curriculum have experienced" (E. Osborne, 1992, p. 3). He presented two possibilities for the revision of the curriculum, either blending science into the existing curriculum or "offering new courses that primarily focus upon science applications in agricultural mechanics" (E. Osborne, 1992, p. 3). E. Osborne provided detailed descriptions for a science-enhanced agricultural mechanics course offered in Illinois. This course was designed with algebra and physical science as prerequisites, had both math and science objectives along with agricultural mechanics objectives, and had an associated textbook, *Physical Science Applications in Agriculture*. E. Osborne posited, "The Ag Mech of today must be reshaped into a more scientifically sound enterprise that focuses less on skill development and more on basic understanding of *the way things work*" (E. Osborne, 1992, p. 3).

The agricultural mechanics laboratory setting allows for psychomotor skill development, the blending of mind and muscle control, the acquisition of career-specific skills, and the creation of conceptual knowledge, which can be transferred across disciplines and specific settings (Phipps et al., 2008). The agricultural mechanics pedagogy utilizes a hands-on approach, which includes the use of competency-based instruction, demonstrations, and questioning (Phipps et al., 2008) to focus student interest in the application of knowledge obtained in the classroom (Newcomb et al., 2004). These approaches to instruction aligned closely with those proposed as best practices in the field of engineering education (Felder & Silverman, 1988, 2002).

Comfort in physical science.

Several studies over the past 20 years have asked agriculture teachers about their level of comfort teaching physical science concepts (Thompson, 1998; Washburn & Myers, 2010; White & Wolf, 2014). The studies by Thompson (1998) and Washburn and Meyers (2010) included only a single Likert-type statement, "I feel prepared to teach integrated physical science concepts." Thompson (1998), in his survey of Agriscience Teacher of the Year Award winners, found a mean of 3.89 (SD = .83) on a 5-point Likert-type scale, or they slightly agreed they were prepared to teach integrated physical science. Washburn and Meyers (2010), in their study of all Florida agriculture teachers, reported 71.4% of their respondents agreed at some level that they were prepared to teach integrated physical science.

White and Wolf (2014), in their study of Idaho Agricultural Science and Technology Teachers, found a similar level of agreement related to comfort teaching integrated physical science, with a mean of 4.35 (SD = 1.18) as measured on a 6-point Likert-type scale. White and Wolf went on to assess other aspects of infusing physical science concepts into agricultural mechanics courses. Teachers in their study reported agreement at some level on a physical science five statement construct describing physical science integration (M = 4.78, SD = 0.94). Teachers in the study reported lowest agreement on the statement, "I feel prepared to teach integrated physical science concepts" (M = 4.35, SD = 1.18), and highest agreement with the statement, "Physical science courses are enhanced by agriscience mechanics examples" (M = 5.16, SD = 1.18). Teachers in all three studies reported some degree of comfort with physical science concepts; however, none of the three studies reported explanations regarding why integration was not occurring.

Next generation science standards.

Following more than a decade of research into science education, the Committee on Conceptual Framework for the New K-12 Science Education Standards released, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (National Research Council, 2012). This publication addressed the growing deficit of scientific knowledge and interest in STEM careers occurring in the United States. The report recommended increasing science graduation requirements; the utilization of cross-cutting concepts to teach science with broader application; and, for the first time, recommended the inclusion of engineering standards alongside the science standards. Released in 2013, the Next Generation Science Standards (NGSS Lead States, 2013) were developed from the Committee on Conceptual Framework for the New K-12 Science Education Standards recommendations and were adopted by more than half the states at their release. The cross-cutting themes, engineering concepts, and the need for a more scientifically-literate workforce lend themselves to applied applications, such as those existing in agricultural mechanics courses.

Summary

Science and agricultural education rely on a constructivist approach for building student knowledge. Efforts to update national science standards have led to the publication of a new type of science standard, one that focuses on cross-cutting concepts, is interdisciplinary, includes engineering principles and processes, and has real-world application through applied instruction. Agricultural mechanics courses can be applied physical science courses and offer an opportunity for students to learn science contextually through instruction of agricultural mechanics content. The iterative methods used in engineering are also used in the project-based instructional practices of agricultural mechanics.

Change is never an easy prospect; however, agricultural mechanics instruction must remain relevant, and it must adapt to do so (Rosencrans & Martin, 1997). Agriculture students no longer come from predominantly production agriculture backgrounds, nor do many students get the chance to return there. Agricultural mechanics instruction allowing students to explore how things work, and how to design better tools and systems, will make graduates both career and college ready. Infusion of physical science and engineering processes is a win-win situation for students, teachers, and industry employers. Establishing the baseline for where Idaho agricultural mechanics programs are; what units they teach; and at what level science, technology, engineering and mathematics concepts are utilized will enable change facilitators to understand the type of support needed for the agricultural mechanics curriculum to be relevant to both career and college track students of the future.

Chapter 3:
Methods

This section describes the type of research, the population of interest, and the analysis procedures used in conducting this study. Instrument design and general research procedures are addressed, followed by analysis procedures broken down by research questions. The purpose of this study was to utilize the Concerns-Based Adoption Model to describe the integration of STEM into the Idaho introductory agricultural mechanics curriculum.

Research Questions

The following research questions guided this study:

1. How much time do teachers report spending on units in their introductory agricultural mechanics curriculum?
2. How important do Idaho Agricultural Science and Technology Teachers rate the individual agricultural mechanics units in their introductory agricultural mechanics curriculum?
3. What are teachers' perceptions of STEM integration into the introductory agricultural mechanics curriculum?
4. To what extent do Idaho Agricultural Science and Technology Teachers integrate STEM into their introductory agricultural mechanics courses?
5. What are the Stages of Concern for Idaho agricultural educators relating to STEM integration in agricultural mechanics?
6. What are the relationships between teacher characteristics and their Stages of Concern?

Type of Research

This descriptive study utilized a web-based survey instrument to collect data. Survey methodology was used to "produce statistics, that is, quantitative or numerical descriptions about some aspects of the study population" (Fowler, 2009, p. 1). Dillman, Smyth, and Christian (2009) stated that electronic questionnaires face many difficulties with the general population, but they are well suited to targeted groups with "high internet access rates and skill levels, such as members of professional associations" (p. 9). Agricultural Science and Technology Teachers in Idaho regularly correspond electronically and utilize the internet for a myriad of activities, including filing state reports, communicating with parents, accessing Idaho's state-approved curriculum, and as a result have high internet access and skill levels. Prior to collecting data, the University of Idaho Institutional Review Board certified this study (14-203) as exempt (see Appendix 1: IRB Exemption).

Population and Selection

This study was a census of all Agricultural Science and Technology Teachers in Idaho (N = 124). All Agricultural Science and Technology Teachers were invited to participate in this study, and were included in the frame; however, many of the questions were specific to instruction in agricultural mechanics, and not all teachers participated in the study. One of the early questions on the questionnaire distinguished between those who were teaching agricultural mechanics, and those who were not teaching agricultural mechanics courses.

Instrument Design

Data collection occurred using a researcher-developed instrument. The instrument consists of the CBAM Stages of Concern instrument; Likert-type and open-ended questions with statements related to the change literature (Ellsworth, 2000; Fullan, 2007; Hord et al., 2013); and the relevant science and engineering education literature. Individual summated rating scale constructs augmented the Stages of Concern statements in areas relating to STEM pedagogy. Boone and Boone (2012) stated that a minimum of four Likert-type statements compose a Likert scale; and the data is treated as interval data and can be analyzed using measures of central tendency, correlations, and inferential statistics. Statements in this questionnaire formed scales with at least a minimum of four statements.

Descriptive teacher and school information was collected to describe the population and the schools in which they teach (see Table 3). A review of the literature provided the characteristics of importance. Subject-matter expert interviews with two teachers who each had more than ten years agricultural mechanics teaching experience, at schools of differing size and with diverse student backgrounds, were used to confirm face and content validity for urban and rural schools with single and multiple teacher agriculture programs. Teacher characteristics were utilized to create groupings among respondents, which were then compared to determine the application of the Stages of Concern among the groups of the overall population. A complete questionnaire is located in Appendix 2.

Table 3

Data Collected on Teacher Characteristics

Teacher Descriptive Characteristics	Scale of Measure
Student Enrollment	Ratio
Minutes of Instruction	Ratio
Number of Students in Largest Section of Intro to Ag Mech each Year	Ratio
Number of Years Teaching	Ratio
Number of Years Teaching Agricultural Mechanics	Ratio
Number of Agricultural Mechanics Courses in Preparation Program	Ratio
Square Feet of Lab Space for Intro to Ag Mech	Ratio
Gender	Nominal
Science Certification	Nominal
Certification Method	Nominal
Currently an Agricultural Mechanics Teacher	Nominal
Student Background in Agricultural Mechanics	Nominal

One section of the questionnaire consisted of the 35 Stages of Concern statements. For more than 35 years, change agents have been utilizing the CBAM to address concerns and improve the implementation of change across educational settings (Hall & Hord, 2014). The 35 statements were subdivided into seven constructs of five questions each, corresponding to the seven Stages of Concern. Table 4 shows alignment between question number and construct. In accordance with Stages of Concern Questionnaire protocol, the complete introductory letter was inserted as part of the question header on the electronic questionnaire (George et al., 2006). Respondents were asked to rate statements on an eight-point anchored scale with, 0 = *Irrelevant to me*, 1 = *Not at all true of me at this time*, 4 = *Somewhat true of me at this time*, and 7 = *Very true of me at this time*.

Table 4

Stages of Concern Statements and Associated Construct Groupings

Construct	Question Numbers
Stage 0	3, 12, 21, 23, 30
Stage 1	6, 14, 15, 26, 35
Stage 2	7, 13, 17, 28, 33
Stage 3	4, 8, 16, 25, 34
Stage 4	1, 11, 19, 24, 32
Stage 5	5, 10, 18, 27, 29
Stage 6	2, 9, 20, 22, 31

Another section of the questionnaire listed 39 possible units of instruction and requested teachers rate them on a 10-point semantic differential scale with anchors of 1 = *Little importance*, and 10 = *Great deal of importance*. Teachers were also asked how many hours they spent instructing on each of the listed units.

To determine STEM perceptions and utilization, the final section of the questionnaire consisted of ten Likert-type statements that made up the STEM methods in agricultural mechanics construct. These statements related student employability to STEM through the processes of exploration, design, teamwork, reflection, real world application, mathematics, technology, and science. To provide additional information about the STEM methods utilized in the curriculum, two questions asked about the frequency of utilizing STEM best practices, and the facilities available to teach integrated STEM content. Three open-ended statements were provided asking teachers to provide additional information on STEM, their concerns, and their opinions about related issues not included on the questionnaire.

Instrument Reliability

Reliability is the consistency of a measure from one use to the next (Vogt & Johnson, 2011). Reliability of the internal consistency of scalar items is “concerned with the homogeneity of the item within a scale” (DeVellis, 2012, p. 35). Internal consistency is commonly measured using Cronbach’s alpha and is defined as “the proportion of a scale’s total variance that is attributable to a common source, presumably the true score of a latent variable underlying the items” (DeVellis, 2012, p. 37).The *a priori* reliability threshold for this study was set at 0.6. Reliability estimates were calculated (see Table 5) for each construct of the researcher-developed instrument based on pilot data, and they were recalculated *post-hoc* using respondent data. Each of the Stages of Concern scales consist of five statements, and reported reliabilities are found in Table 5.

Following the pilot study, reliability estimates were lower than the predetermined 0.6 level of reliability in some areas of the instrument. Respondent comments helped to clarify several statements in the SOC prior to distribution to the population of interest. Specifically, the word innovation was changed to “*integrating STEM in* *ag mechanics*" and any statement that did not include the word innovation had "*In relation to integrating STEM in ag mechanics"* added to it to serve as a reminder of the instructions at the beginning of the statements. Complete questionnaire statements as sent to the population of interest are located in Appendix 2.

Table 5

Cronbach's Alpha Reliabilities of Constructs Utilized in this Study

Construct	Reported Reliabilities*	Pilot Reliability	Study Reliability
Sample Size	830.00	26.00	98.00
Stages of Concern Stage 0	.64	.56	.77
Stages of Concern Stage 1	.78	.61	.89
Stages of Concern Stage 2	.83	.84	.94
Stages of Concern Stage 3	.75	.55	.84
Stages of Concern Stage 4	.76	.86	.83
Stages of Concern Stage 5	.82	.80	.90
Stages of Concern Stage 6	.71	.50	.86
STEM Methodology	-	.88	.91
STEM Facilities	-	.80	.91
Ag Mechanics Context	-	.81	.82

Note. *George et al, 2006

Validity

External validity is the ability to generalize results to the population from which a sample was drawn. As a census, external validity as a threat to this study results from less than a 100 percent response rate. External validity concerns are addressed in the section covering threats inherent in survey methodology. Internal validity refers to the "adequacy of a scale as a measure of a specific variable" (DeVellis, 2012, p. 59). DeVellis (2012) identified three types of validity that need to be addressed in scale development, its predictive ability, and its relationship to measures of other constructs. These three types of validity are content validity, criterion-related validity, and construct validity. Criterion-related validity was not a concern in this study, due to its not conducting predictions to external criteria.

Content validity.

Content validity is a measure of how accurately an item represents what it is meant to represent (Vogt & Johnson, 2011). "Content validity is not a statistical property; it is a matter of expert judgment" (Vogt & Johnson, 2011, p. 72). Content validity was assessed by the use of experts familiar with agricultural education, specifically agricultural mechanics, that instruct undergraduate agricultural education and agricultural mechanics courses at the University of Idaho. A list of experts utilized in this study is found in the appendices. Dillman et al. (2009, p. 220) recommended the use of a small group of individuals with "specialized knowledge of some aspect of the questionnaire quality." These experts look at the questions to provide feedback on (p. 220):

- Whether questions measure the concepts that the surveyor intends to measure
- The potential for unintended question order effects

- Questions that should be asked but weren't
- Question structure and inappropriate response categories

This group of experts should represent a variety of people from fields of significantly different expertise (Dillman et al., 2009). This study utilized the expertise of two faculty in the Agricultural Education department, two faculty in the Biological and Agricultural Engineering Department at the University of Idaho, and a current Washington agriculture teacher with more than ten years of experience teaching agricultural mechanics courses (see Appendix 2: Questionnaire & Expert Reviewers).

Construct validity.

Construct validity refers to the ability of a construct to measure what is purported to measure (DeVellis, 2012). Trochim and Donnelly (2008) proposed an expanded definition of construct validity, positing it is a function of the operationalization of the constructs under consideration, evidence that the operationalization is controlled, and providing data that the operationalized constructs correlate more highly with measures they are theorized to than those they should not correlate as highly among. Two measures typically associated with this type of validity are convergent and divergent validity. Convergent validity refers to "evidence of similarity between measures of theoretically related constructs" and divergent or discriminant validity refers to the "absence of correlation between measures of unrelated constructs" (DeVellis, 2012, p. 69). Because of the small size of the population, factor analysis was not conducted (DeVellis, 2012).

In this study, operationalization of constructs resulted from the literature cited herein, Pearson-Product Moment Correlation Coefficients between construct statements correlated significantly ($p < .05$) with other statements within the construct. Moderate to substantial relationships were found for all but two correlations, each on a different construct, which both had low strength in relation to one other statement on their constructs, but moderate to substantial correlations to the other statements in their respective constructs. As external constructs measuring STEM in agricultural mechanics were not available, correlations to known constructs were not conducted.

Threats Inherent in Survey Methodology

Dillman et al. (2009) list four types of survey error which must be addressed to achieve accurate information; coverage or frame, sampling, nonresponse, and measurement error. Of the four, sampling error is not addressed as this study utilized a census and did not employ sampling techniques. The small size of the population ($N = 124$) of interest led to the use of a census in this study. Coverage error, or the error resulting from not all members of the population having an equal chance to respond, can occur when, "the list from which the sample is drawn does not include the everyone in the population" (Dillman et al., 2009, p. 17). To reduce the possibility of error from missing some of the population, the frame was created using the directory of Idaho Agricultural Science and Technology Teachers as complied by the Agricultural and Extension Department at the University of Idaho. The pre-notice individual e-mails also ensured all listed e-mails were valid and accepting mail, and led to the correction of three e-mail addresses.

Nonresponse error, a threat to external validity, is the result of not receiving a response from all individuals who were sent a survey. The error emerges when "those who do not respond are different from those who do respond in a way that is important to the study" (Dillman et al., 2009, p. 17). To minimize non-response, all contacts were personalized as much as possible, multiple contacts were made with a different cover letter each time, pre-notification was sent from a private e-mail account, e-mails were timed strategically to maximize their visibility, directions were clarified through the use of subject matter experts and a pilot study, and non-respondents were contacted to try and elicit their response and increase response rates (Dillman et al., 2009). Those completing their questionnaire in the first two rounds of reminders were considered early responders. Early responders (n = 52) were compared to both late responders and those personally contacted (n = 48) on all three constructs to determine if any significant differences exist between the two groups, early vs. late and non-respondents (Lindner, Murphy, & Briers, 2001). No significant differences existed between the two groups based on comparisons of all constructs ($p > .05$).

The final type of error, measurement error, a threat to internal validity, occurs when the respondent's answers are imprecise, or inaccurate, and "is often the result of poor question wording" or difficulty working their way through the survey (Dillman et al., 2009, p. 18). To reduce this type of error, subject matter experts from the University of Idaho Agricultural and Extension Education Department and one teacher from outside the study area examined the question wording to enhance clarity and readability. To improve flow through the survey, long questions were split so headings could be visible through the entire question, and where possible, multiple choices were provided rather than leaving open-ended boxes for the respondents to fill in.

Piloting the Instrument

The questionnaire was piloted to a similar population in the neighboring state of Oregon (Fowler, 2009). Oregon has a similar number of programs and teachers as Idaho. Once the recommended minimum of 20 responses were collected, the data were analyzed for reliability (Fowler, 2009). Dillman et al. (2009) recommend administration to a subsample of the population a few days ahead of the entire group. This allows time to fix any problems in the delivery and response formatting prior to the instrument going out to the larger sample of the population. Pilot studies also allow for identification of "item nonresponse problems and steps that may be taken to reduce them" (Dillman et al., 2009, pp. 228-229). In this study, the pilot group performed both these tasks, so that the small number of Idaho Agricultural Science and Technology Teachers was not further reduced. Following the pilot study the 35 Stages of Concern statements were modified so every statement included a reference to the innovation under consideration. The instrument utilized in the pilot had only replaced the word innovation with the phrase "*integration of STEM in Introductory Agricultural Mechanics*." Comments and data from the pilot were analyzed and "*In relation to your Introductory Agricultural Mechanics Course*" was added to statements that did not include any specific reference to the innovation, a modification that was determined to fit within the published administration guidelines (George et al., 2006).

Implementing the Questionnaire

Questionnaire implementation followed the Tailored Design Method outlined by Dillman et al. (2009). All pre-survey notification contacts were sent as individual e-mails from the researchers' university-sponsored account (January 22nd) and were personalized to invite each teacher to participate in the survey. The second emailed invitation was sent through Qualtrics® (January 26th) and included a web-link to the questionnaire that respondents could click on or insert into their web browser to complete the questionnaire. Following the initial e-mail invitations, reminders were sent out starting the following Monday (Feb 2nd, 9th, & 16th). All reminder e-mails were sent out early in the morning, so that they arrived in the teachers' inboxes before most of them arrived at work but were recent enough to be near the top of their e-mail inbox. Dillman et al. have not defined a rule for timing reminders on e-mail based questionnaires, but they do recommend the reminder go out prior to the recipient forgetting about the questionnaire. To maintain this level of awareness of the questionnaire, reminders will go out each week following the initial e-mail until substantial increases in responses no longer occur. This resulted in a total collection time of five weeks, with the survey ending on February 23rd.

Following collection of data, the final response rate for the questionnaire was 89.5% (n = 111). An *a priori* decision to not utilize responses that did not complete at least 80% of one of the three sections of the questionnaire further reduced the usable responses. Following the removal of unusable responses from those who did not complete at least 80% of one of the three sections, 100 responses remained for a useable response rate of 80.6%.

Data Analysis

Data was analyzed using SPSS® 22 and Microsoft Excel®. The study was of a descriptive nature; therefore, means, standard deviations, and frequency tables are the primary statistics utilized. The use of a census, instead of a sample from the population, limited the use of inferential statistics; and caution is advised when generalizing beyond Idaho. Data collected, related research questions, and the associated scales of measurement are located in Table 6.

Table 6

Composite Data Collected and the Associated Scale of Measurement.

Data Set	Research Question	Description	Construct	Scale of Measure
Stages of Concern	4	7, 5 Likert-type statements	7	Interval
Benefits of STEM Integration	3	10 Likert-type statements	1	Interval
STEM Frequency	3	7 statements	No	Interval
STEM Facilities	3	5 statements, 6-point Likert-type scale	1	Interval
Duration of Instruction	1	Days of instruction	No	Ratio
Ag Mechanics Context for STEM	3	6-point Likert-type scale	No	Ordinal

Research Question 1.

The purpose of Research Question 1 was to describe the duration of instruction of the individual agricultural mechanics units. In order to compare instructional time across different teaching arrangements (semester, trimester, and full-year courses), the most common arrangement, a one-semester course, was chosen as the standard for comparison. All trimester courses were multiplied by 1.5, and all full-year courses were multiplied by 0.5 to adjust the reported times to the one-semester equivalent. In the pilot study, the questionnaire asked for the number of days of instruction. To reduce variability on the final instrument, teachers were asked to estimate the total number of hours they spent teaching the specified content rather than the number of days devoted to the unit. In the final questionnaire, total number of hours were multiplied by a conversion factor, so all hours of instruction were comparable on a one-semester course equivalent. Calculations of instructional times utilized teachers who reported currently teaching introductory agricultural mechanics courses (IAM) and a non-zero time on the specific unit of instruction. Descriptive statistics for teachers reporting zero hours of instruction were not used. Means and standard deviations were calculated for each of the 39 units of instruction. Means for duration of instruction were ranked first by the number of teachers reporting teaching the unit, and then by the total hours of instruction. Lastly, the duration of instruction for units selected were totaled to determine what percentage of an 82.5-hour semester-based class they would occupy. This duration was chosen as it represents a 55 minute class taught five days a week for 18 weeks, both typical of secondary schools in Idaho.

Durations of instruction were compared using gender, years teaching an IAM course, certification pathway, and certification in both agriculture and science versus those with only agriculture certification as sub-groups for comparison. Teachers' number of years of experience teaching IAM courses were blocked to aid in analysis. Initial blocking by 10-year groupings created one group with nearly one half of all respondents (1 – 10 years) and one with few respondents (31 – 40 years). To create more balanced groups, the first age group was split in half, and the last age group was combined with the 21 – 30 age group to create a group with 21 or more years of experience.

Research Question 2.

The purpose of Research Question 2 was to determine the importance of units taught in the introductory course. The Idaho Ag 130 Introduction to Agricultural Mechanics curriculum, its associated textbook, and face-to-face interviews with teachers served as the basis for 29 units included on the questionnaire. Face-to-face interviews with two Agricultural Systems Management instructors at the University of Idaho who taught the agricultural mechanics skills to undergraduates led to the addition of four additional units, for a total of 39 units of instruction. Each unit was rated relating to its importance to the IAM curriculum on a 10-point scale, with one equaling *Little Importance* and ten equaling *Great Deal of Importance*. Analysis of the data collected for this research question utilized frequency tables for the importance of the units and mean importance ratings for individual units' overall rating reported by Idaho Agricultural Science and Technology Teachers. The units included in the Idaho curriculum guide are included in Appendix 8. A Kendall Tau Correlation analysis was conducted to describe the relationships between unit importance and the time spent teaching the units. Kendall's tau was chosen over Spearman's rho as the correlation for its improved accuracy in smaller populations and instances when there may be more ties in the data (Field, 2104). Descriptions utilized Davis' (1971) conventions for strength of association. As the intent of the correlation was descriptive and not predictive, no *p-values* are reported (Miller, 1994).

Research Question 3.

The purpose of Research Question 3 was to describe teachers' perceptions of STEM in introductory agricultural mechanics courses. Specific constructs asked how teachers felt about STEM in the *Benefits of STEM construct*; their perceptions of the laboratory capacity of their facilities for STEM teaching in the *STEM Facilities construct;* and their perceptions of IAM as a context for teaching STEM in the *Agricultural Mechanics Context construct.* Each STEM construct used from five to 10 statements, which yielded a composite score for each, which was converted back to a 6-point scale by dividing the response total for each area by the number of statements in the respective constructs. Best practices identified in the literature (Felder & Silverman, 1988, 2002) provided the content for statements in each construct.

Research Question 4.

The purpose of Research Question 4 was to describe the extent of STEM integration in the IAM curriculum as measured by the percentage of time teachers devoted to utilizing the STEM methods of exploration, design, problem solving, teamwork, reflection, mathematics, and technology compiled into the *STEM Frequency construct*. Teachers reported the utilization percentages on a scale from zero to 100 and were told the sum of the various STEM methodologies did not need to total 100%, as several could be utilized simultaneously.

Research Question 5.

The purpose of Research Question 5 was to describe the Stages of Concern Profiles for Idaho agricultural educators relating to STEM integration into introductory agricultural mechanics courses. The complete, 35-statement Stages of Concern questionnaire was used in this study. In accordance with administration guidelines, the complete introduction was included as a preface for the Likert-type statement section (George et al., 2006). Following administration recommendations, two changes were made to statements before final administration: the word innovation was replaced with "*STEM integration in ag mechanics,"* and the phrase "*In relation to my intro to ag mechanics course*" was added to statements not specifically referencing the innovation following the pilot study to remind respondents to what the statements referenced. Dividing the 35 statements on the online instrument ensured the headings were visible to respondents for all statements. Missing scores from respondents were filled in using the average score of the other values for the respective scale from which the missing data came and was decided *a priori* (George et al., 2006). Respondents who left more than 20% of the SOC section of the questionnaire blank were removed from the group of usable respondents. SPSS Syntax computed stage scores and percentiles (see Appendix 7), and group scores were rounded to the nearest integer and converted to percentile scores in Microsoft Excel. Group Stages of Concern profiles were plotted on graphs for interpretation (see Figure 6), and raw scores were analyzed using SPSS.

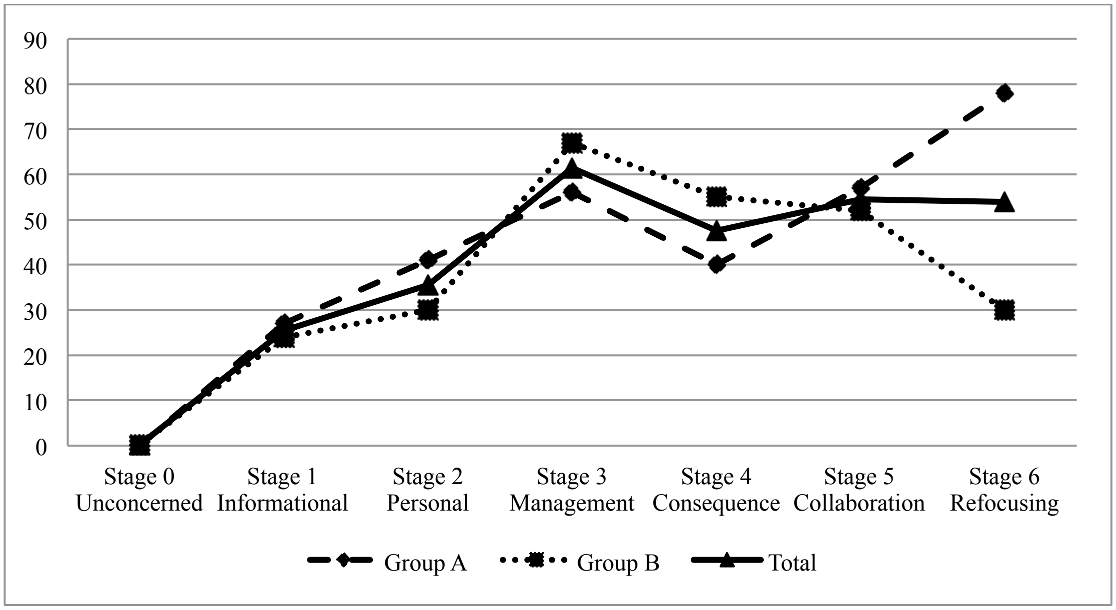

Figure 6. Sample Stages of Concern Profile with fictional data for two sub-groups

Each of the seven constructs in the questionnaire were individually summated, and two numbers were used in analysis: the raw score for comparisons and the converted percentile score for descriptive analysis of relative intensities of respondents peak concerns. Percentile scores were created using the conversion chart found in Table 113 (see Appendix 6) and automated through SPSS and Microsoft Excel. Each stage utilizes a different column on the conversion chart. Using the individual respondent raw score row, moving across to the proper stage associated with the construct raw score yielded seven individual percentile scores for each individual. George et al. (2006, p. 31) explained that, “A rich clinical picture can be developed by examining the percentile scores for all seven stages and interpreting the meaning of the highs and lows and interrelationships,” and then confirming the interpretations individually with respondents, or through the use of open-ended questions. The final two questions on the electronic questionnaire utilized open-ended questions to aid in the confirmation of individual responses.

George et al. (2006) recommended converting summated scale scores to a percentile value using their established conversion table in creating graphs for the Stages of Concern Profiles. These conversion values (see Table 113 in Appendix 6) were created following the administration of the instrument to over 800 individuals (George et al., 2006). SPSS was used to total individual scales and produce percentile conversions. All statistical analysis of the Stages of Concern used raw scores and not percentile scores. Percentile scores “tend to make the distribution rectangular,” which would make statistical results less accurate (George et al., 2006, p. 28).

Once charted, data were visually analyzed for the peak, or most intense and second most intense Stages of Concern. The peak stage indicated the most intense concern teachers were facing, related to the integration of STEM content into their courses, and indicated a place where interventions are needed if complete adoption of the innovation is to succeed. The second highest peak, and its relation to the highest peak or intensity of concern, indicates another area where an intervention is necessary. Using the manual for Stages of Concern questionnaires, *Measuring Implementation in Schools: The Stages of Concern Questionnaire* (George et al., 2006), group analysis was conducted. Interpretation of results relied on the definitions of the peaks. *Measuring Implementation in Schools: The Stages of Concern Questionnaire* aided interpretations of profiles, and the sample graphs included in the manual were compared to respondents' graphs to improve the reliability of interpretations. The open-ended questions at the end of the questionnaire provided additional insight into the analysis of the numerical Stages of Concern and were used to confirm interpretation of individual respondents' profiles.

Research Question 6.

Research Question 6 described the relationships between the Stages of Concern profiles and teacher characteristics (see Table 3). Group scores were calculated utilizing the raw average score, which were then converted to percentile scores using Microsoft Excel. Once group profiles for the Stages of Concern were created, visual analysis and comparison of groups occurred. George et al. (2006, p. 31) stated "A rich clinical picture can be developed by examining the percentile scores for all seven stages and interpreting the meaning of the highs and lows and interrelationships." George et al. (2006, p. 31) continue; "If an open-ended concerns statement has been included on the demographics data sheet, it can provide useful context for SOCQ interpretations." Following the visual analysis and interpretation of complete group profiles, teachers' comments on the open-ended question were utilized to verify that the interpretations were representative of their true concerns.

Chapter 4:
Findings

This chapter includes a brief overview of the studies methodology and response rate and progresses through data collected by research question. Supplemental data tables are found in Appendix 6 from which much of the data presented in this section originated. Demographic data was provided to further describe the population and provide a context for informal comparisons to similar populations. The purpose of this study was to utilize the Concerns-Based Adoption Model to describe the integration of STEM into the Idaho introductory agricultural mechanics curriculum.

Research Questions

The following research questions guided this study:

1. How much time do teachers report spending on units in their introductory agricultural mechanics curriculum?
2. How important do Idaho Agricultural Science and Technology Teachers rate the individual agricultural mechanics units in their introductory agricultural mechanics curriculum?
3. What are teachers' perceptions of STEM integration into the introductory agricultural mechanics curriculum?
4. To what extent do Idaho Agricultural Science and Technology Teachers integrate STEM into their introductory agricultural mechanics courses?
5. What are the Stages of Concern for Idaho agricultural educators relating to STEM integration in agricultural mechanics?
6. What are the relationships between teacher characteristics and their Stages of Concern?

Following data collection, the final response rate was 89.5% (n = 111). Following the removal of unusable responses from those who did not complete at least 80% of one of the three sections, 100 responses remained for a useable response rate of 80.6%. Comparison of early to late responders on all constructs found no significant differences ($p > .05$).

Demographics of the population are included to provide a description of the teachers in the study. Male respondents comprised the majority (76%) of the respondents. Among those reporting currently teaching IAM courses, 83.82% were male. Science certification was reported among 59.76% of traditionally certified teachers and 16.67% of alternatively certified teachers (see Table 7). High school student body populations ranged from 29 to over 5000, with 65 teachers reporting a school student body of less than 667 students and 45 teachers reporting less than 334 students in their high schools. Teachers reported that 18.6% (n = 18) of their school's student residences were primarily urban, 62.9% (n = 61) were primarily rural non-farm, and 18.6% (n=18) were primarily rural farm. Additional information about class sizes, period lengths, and laboratory space is located in Table 7 and Table 8.

Table 7

General Respondent Demographics

	n	*f*	%
University Preparation Program Completers	100	85	85.0
Additional Science Certification	97	51	52.6
School Uses Semester-Based Scheduling	98	74	75.5
Introductory Agriculture Mechanics Course Length			
One Trimester	91	22	24.2
One Semester	91	52	57.1
Two Semesters	91	17	18.7

Table 8

General Demographic Data on Respondents' Schools

	n	Mean	SD	Min	Max
Years Teaching	97	13.92	10.65	1	37
Years Teaching IAM Courses	93	13.44	10.15	1	37
Class period length	98	68.20	15.31	45	97
Laboratory space (ft^2)	98	3316.96	2721.13	0	12,000
High School Enrollment	97	644.71	727.91	29	5000
Largest Student Enrollment in Agricultural Mechanics*	63	20.29	7.83	6	35

Note. *Numbers include only those reporting currently teaching an introductory agricultural mechanics course

Teachers reported on the source of the majority of their agricultural mechanics knowledge as well as their students' prior agricultural mechanics backgrounds. Teachers reported that the majority of their agricultural mechanics knowledge came from prior farm background (44.8%, *n* = 43), followed by their college preparation program (36.5%, *n* = 35), with 18.8% (*n* = 18) reporting that their background came from prior non-farm and other sources. Teachers rated the experience their students brought to their IAM courses. On a 10-point scale from "*No Experience*" to "*Great Deal of Experience*," teachers reported their students brought little experience (*M* = 3.62, *SD* = 1.73) to their IAM course, with no teacher selecting "*great deal of experience*."

Teachers were asked how many courses in agricultural mechanics were taken as part of their preparation programs. Table 9 shows a complete breakdown of the number of courses teachers reported taking. The mean number of courses was 6.47 (*SD* = 4.38), with two teachers reporting taking more than 20 courses in agricultural mechanics and three teachers reporting no agricultural mechanics coursework in their preparation programs.

Table 9

Total Number of Reported Courses in Agricultural Mechanics Taken

Courses	*n*	Percent	Cumulative Percent
0	3	3.2	3.2
1	2	2.2	5.4
2	7	7.5	12.9
3	3	3.2	16.1
4	23	24.7	40.9
5	11	11.8	52.7
6	14	15.1	67.7
7	2	2.2	69.9
8	7	7.5	77.4
9	2	2.2	79.6
10	6	6.5	86.0
12	6	6.5	92.5
15	1	1.1	93.5
17	1	1.1	94.6
18	3	3.2	97.8
20+	2	2.2	100.0

Teachers reported the number of students in their largest section of IAM. Teachers reported between 6 and 35 students in their largest classes (*M* = 20.29, *SD* = 7.83). The complete breakdown is located in Table 10.

Table 10

Largest Student Enrollment in Agricultural Mechanics Reported by Teachers Currently Teaching an Introductory Agricultural Mechanics Course

Students	Frequency	Percent	Cumulative Percent
6	1	1.6	1.6
9	1	1.6	3.2
10	2	3.2	6.3
12	5	7.9	14.3
13	1	1.6	15.9
14	3	4.8	20.6
15	2	3.2	23.8
16	1	1.6	25.4
17	4	6.3	31.7
18	8	12.7	44.4
19	1	1.6	46.0
20	5	7.9	54.0
21	3	4.8	58.7
22	4	6.3	65.1
23	3	4.8	69.8
24	1	1.6	71.4
25	4	6.3	77.8
26	2	3.2	81.0
27	1	1.6	82.5
28	1	1.6	84.1
30	3	4.8	88.9
31	2	3.2	92.1
32	3	4.8	96.8
34	1	1.6	98.4
35	1	1.6	100.0

Research Question 1.

The purpose of Research Question 1 was to describe how much time teachers report teaching specified individual units in their introductory agricultural mechanics curriculum. Table 11 shows the 39 units, ranked by the number of teachers reporting teaching the unit and the standardized number of hours they reported spending on the unit. Unit lengths varied from a tenth of an hour to 125 hours of instruction, with mean hours of instruction ranging from 1.03 hours (*SD* = 0.55) for fence construction to 19.69 hours (*SD* = 20.09) for student projects. Using the mean numbers of hours of instruction, a complete semester (82.5 hours) would be reached with the 15 most reported units of instruction (*Cleaning & Tool Storage* through *SAE* inclusive, see Table 11). Using the median value extends the units that will fit to include the top 21 units (*Cleaning & Tool Storage through Arc Welding*). To include all the units, at least 32 (50% of respondents) respondents reported teaching at the mean number of hours of instruction, would require 126.98 hours of instructional time, the equivalent of 1.54 semesters in duration.

Standardized hours of instruction for males and females varied little for most units of instruction (see Table 12). Mean differences for hours of instruction did not exceed 4.5 hours (approximately one week) between any units when disaggregated by gender. The unit of instruction with the greatest mean difference (4.49) was *student projects*, with male teachers reporting teaching the unit longer (*M* = 20.50, *SD* = 21.62) than female teachers (*M* = 16.00, *SD* = 10.80). Mean differences in instruction of over three hours (approximately 3 days) were also found for *TIG welding* (M_{diff} = -3.44), *computerized plasma or mill work* (M_{diff} = 3.87), and *tool use and identification* (M_{diff} = -3.07). Female respondents did not report teaching the units of *large engines* or *hydraulics*.

Table 11

Non-zero Hours of Instruction Reported by Instructors Currently Teaching an Introduction to Agricultural Mechanics Course Ranked by the Total Number of Instructors Teaching the Unit

Unit	*n*	Mean	*SD*	Median	Min	Max
Cleaning & Tool Storage	65	3.38	5.49	2.25	0.1	37.9
Safety Practices	62	8.42	9.39	6.06	1.0	53.0
Stationary Power Tools	59	3.49	3.20	2.25	0.3	15.2
Measuring	58	5.43	8.47	3.03	0.5	60.6
HH Power Tools	57	3.91	6.11	2.27	0.3	45.5
Tool Use & ID	57	5.49	3.75	5.00	0.8	20.0
Tool Reconditioning & Maintenance	56	5.04	4.56	3.03	0.3	20.0
Principles of Electricity	55	3.69	2.69	3.00	0.5	10.0
Hand Tools	55	3.04	4.45	2.00	0.3	30.3
Plumbing and Pipe Fitting	54	5.67	4.14	5.00	1.0	20.0
Electrical Wiring	54	6.34	4.89	5.00	0.5	22.7
Cold Metal Work	52	3.79	2.95	3.00	0.5	12.5
Careers	51	2.05	1.26	1.52	0.1	5.0
Student Projects	50	19.69	20.09	15.15	1.0	125.0
SAE	47	3.04	3.11	2.27	0.5	18.2
Bill of Materials	47	2.39	3.72	1.52	0.5	25.0
Drafting & Sketching	45	3.17	2.44	2.27	0.5	10.0
OA Welding	45	7.30	8.81	5.00	0.1	50.0
FFA	44	2.45	1.47	2.00	0.8	6.0
OA Cutting	42	4.58	5.68	3.03	0.1	30.0
Arc Welding (SMAW)	41	12.40	11.53	9.09	0.1	50.0
Fasteners	40	2.00	1.47	1.52	0.2	6.0
Painting	40	1.70	1.08	1.52	0.2	5.0
Wood Working	37	8.52	7.28	8.00	0.5	35.0
HH Plasma Cutting	31	3.49	3.18	2.00	0.1	12.5
MIG Welding (GMAW)	31	7.09	6.07	5.00	0.1	25.0
Small Gas Engines	30	9.51	20.49	2.50	0.8	106.1
Hot Metal Work	29	3.56	3.24	2.00	0.5	15.2
Carpentry	26	4.68	5.27	2.13	0.8	25.0
Concrete	25	2.68	2.31	2.00	0.2	10.0
Electrical Motors	23	1.90	2.11	1.52	0.1	10.0
Surveying	22	3.12	3.23	2.00	0.3	15.2
TIG Welding (GTAW)	18	4.75	5.16	3.75	0.1	21.2
Computerized Plasma/Mill	13	4.07	3.98	3.03	0.1	14.0
Rope Work	12	1.36	1.34	1.00	0.3	5.0
Metal Lathe Work	10	3.00	2.36	2.76	0.1	7.5
Hydraulics	9	1.29	0.90	1.00	0.1	3.0
Fence Construction	8	1.03	0.55	1.00	0.2	2.0
Large Engines	8	4.08	8.48	1.00	0.1	25.0

Note. All reported times were adjusted to the hour-equivalence of a one-semester course. HH = Hand Held, OA = Oxy-Acetylene

Table 12

Non-zero Standardized Hours of Instruction Reported by Instructors Currently Teaching an Introduction to Agricultural Mechanics Course Split by Gender

	Male				Female			
Unit	*n*	*M*	*SD*	Min/Max	*n*	*M*	*SD*	Min Max
Cleaning & Tool Storage	55	3.62	5.93	0.1/37.9	10	2.08	1.13	0.8/4.0
Safety Practices	52	8.84	10.02	1.0/53.0	10	6.22	4.75	2.0/17.6
Measuring	50	5.62	9.05	0.5/60.6	8	4.22	3.04	1.0/10.0
Stationary Power Tools	50	3.81	3.36	0.3/15.2	9	1.72	0.89	0.8/3.0
Tool Use & ID	48	5.01	3.30	0.8/20.0	9	8.07	5.05	3.0/17.6
HH Power Tools	48	4.13	6.62	0.3/45.5	9	2.75	1.42	1.0/5.0
Tool Reconditioning & Maintenance	47	5.24	4.76	0.3/20.0	9	4.01	3.35	0.6/12.0
Electrical Wiring	46	6.27	5.06	0.5/22.7	8	6.74	3.98	3.0/15.2
Plumbing and Pipe Fitting	46	5.30	3.88	1.0/20.0	8	7.77	5.19	2.0/15.2
Principles of Electricity	46	3.80	2.86	0.5/10.0	9	3.13	1.54	1.0/6.0
Hand Tools	46	3.26	4.82	0.3/30.3	9	1.89	1.12	0.5/4.0
Cold Metal Work	44	4.02	3.09	0.5/12.5	8	2.50	1.55	0.8/5.0
Careers	43	2.01	1.24	0.1/5.0	8	2.22	1.45	0.8/4.5
Student Projects	41	20.50	21.62	1.0/125.0	9	16.00	10.80	1.0/35.3
Bill of Materials	41	2.46	3.97	0.5/25.0	6	1.88	0.77	1.0/3.0
OA Welding	40	7.39	9.28	0.1/50.0	5	6.61	3.76	2.0/12.0
OA Cutting	38	4.60	5.92	0.1/30.0	4	4.38	2.80	1.5/8.0
SAE	38	3.22	3.37	0.5/18.2	9	2.27	1.49	0.5/5.0
Drafting & Sketching	37	3.42	2.55	0.5/10.0	8	2.04	1.48	1.0/5.3
Arc Welding (SMAW)	36	12.27	11.68	0.1/50.0	5	13.36	11.58	2.0/30.3
FFA	36	2.50	1.53	0.8/6.0	8	2.25	1.25	1.0/4.0
Fasteners	36	1.82	1.20	0.2/5.0	4	3.63	2.75	1.0/6.0
Painting	34	1.74	1.14	0.2/5.0	6	1.50	0.63	0.5/2.0
Wood Working	30	8.71	7.72	0.5/35.0	7	7.68	5.40	0.8/15.0
MIG Welding (GMAW)	28	7.35	6.28	0.1/25.0	3	4.68	3.25	1.5/8.0
HH Plasma Cutting	27	3.36	3.26	0.1/12.5	4	4.38	2.81	1.5/8.0
Small Gas Engines	26	9.81	21.95	1.0/106.0	4	7.56	5.86	0.8/15.0
Hot Metal Work	24	3.74	3.46	0.5/15.2	5	2.66	1.88	1.0/5.3
Carpentry	23	4.96	5.52	0.8/25.0	3	2.52	1.83	1.0/4.6
Electrical Motors	22	1.92	2.16	0.1/10.0	1			
Concrete	21	2.56	2.28	0.2/10.0	4	3.26	2.73	1.0/6.5
Surveying	19	3.24	3.47	0.3/15.2	3	2.34	0.59	2.0/3.0
TIG Welding (GTAW)	17	4.56	5.26	0.1/21.2	1			
Computerized Plasma/Mill	12	4.37	4.01	0.1/14.0	1			
Metal Lathe Work	9	3.25	2.36	0.1/7.5	1			
Rope Work	9	1.34	1.41	0.3/5.0	3	1.42	1.38	0.5/3.0
Hydraulics	9	1.29	0.90	0.1/3.0	0			
Large Engines	8	4.08	8.48	0.1/25.0	0			
Fence Construction	7	0.96	0.56	0.2/2.0	1			

Note. HH = Hand Held, OA = Oxy-Acetylene

Teachers who had completed a traditional university based certification pathway and those who were alternatively or industry certified reported little differences in the duration of instruction for the units they teach (see Table 13). Mean differences for hours of instruction exceeded 4.5 hours (approximately one week) in three units, and three hours (approximately three days) in four additional units. University prepared respondents reported teaching *small engines* (M_{diff} = 8.92), *woodworking* (M_{diff} = 5.29), *large engines* (M_{diff} = 4.32), *computerized plasma or mill work* (M_{diff} = 3.59), and *oxy-acetylene welding* (M_{diff} = 3.30) longer than alternatively certified teachers. Alternatively or industry certified teachers reported teaching *hot metal work* (M_{diff} = 4.85) and *arc (SMAW) welding* (M_{diff} = -3.47) more than university certified teachers.

Those teachers with both agriculture and science certification were compared to those who hold only agriculture certification (see Table 14) for differences in standardized hours of instruction. Mean differences for hours of instruction exceeded 4.5 hours in two units, and three hours in three additional units. Science certified respondents reported teaching *computerized plasma or mill work* (M_{diff} = 3.61) and *TIG (GTAW) welding* (M_{diff} = 3.55) longer than teachers without science certification. Teachers without science certification reported teaching *small engines* (M_{diff} = -10.42), *woodworking* (M_{diff} = -5.12), and *large engines* (M_{diff} = -4.10) more than science certified Agricultural Science and Technology Teachers.

Table 13

Non-zero Standardized Hours of Instruction Reported by Instructors Currently Teaching an Introduction to Agricultural Mechanics Course Split by Certification Pathway

	University				Industry/Alt			
Unit	*n*	*M*	*SD*	Min/Max	*n*	*M*	*SD*	Min/Max
Student Projects	43	19.62	20.66	1.0/125.0	4	17.75	15.50	5.0/40.0
Arc Welding (SMAW)	35	12.49	11.40	0.1/50.0	3	15.96	18.98	5.0/37.9
Small Gas Engines	26	10.67	21.83	0.8/106.1	2	1.75	0.35	1.5/2.0
Wood Working	32	8.55	7.65	0.5/35.0	2	3.26	2.46	1.5/5.0
Safety Practices	54	8.47	9.80	1.0/53.0	5	9.43	7.73	2.0/20.0
OA Welding	38	7.94	9.42	0.1/50.0	4	4.64	2.17	3.0/7.6
MIG Welding (GMAW)	27	7.05	6.32	0.1/25.0	1	5.00	0.00	5.0/5.0
Electrical Wiring	47	6.48	5.15	0.5/22.7	4	4.52	2.31	2.5/7.6
Large Engines	5	5.82	10.74	0.1/25.0	2	1.50	0.71	1.0/2.0
Plumbing and Pipe Fitting	47	5.57	4.09	1.0/20.0	4	6.29	6.15	1.0/15.2
Tool Use & ID	50	5.57	3.85	1.0/20.0	5	5.56	3.30	0.8/10.0
Measuring	52	5.19	8.63	0.5/60.6	3	8.17	10.28	1.5/20.0
TIG Welding (GTAW)	14	5.00	5.78	0.1/21.2	1	5.00	0.00	5.0/5.0
Tool Reconditioning & Maintenance	48	4.98	4.12	0.6/16.0	5	7.36	8.43	0.8/20.0
OA Cutting	35	4.66	6.14	0.1/30.0	4	4.64	2.72	1.0/7.6
Computerized Plasma/Mill	10	4.59	4.32	0.1/14.0	1	1.00	0.00	1.0/1.0
HH Power Tools	49	3.97	6.55	0.3/45.5	5	3.51	2.14	0.5/6.0
Carpentry	21	3.80	3.22	1.0/10.0	2	0.88	0.18	0.8/1.0
Principles of Electricity	48	3.70	2.76	0.5/10.0	4	3.77	3.10	1.0/7.6
Surveying	18	3.66	3.34	1.5/15.2	2	0.63	0.53	0.3/1.0
Cold Metal Work	46	3.62	2.71	0.5/12.0	3	4.01	3.60	1.0/8.0
HH Plasma Cutting	27	3.61	3.28	0.1/12.5	2	2.63	3.36	0.3/5.0
Cleaning & Tool Storage	57	3.51	5.83	0.1/37.9	5	3.31	1.30	1.5/5.0
Stationary Power Tools	51	3.42	3.22	0.3/15.2	5	3.11	2.43	0.5/6.0
Hot Metal Work	25	3.22	2.45	0.5/10.0	2	8.08	10.01	1.0/15.2
Drafting & Sketching	39	3.10	2.28	1.0/10.0	4	3.25	4.52	0.5/10.0
SAE	41	3.09	3.20	0.5/18.2	4	2.75	3.17	1.0/7.5
Hand Tools	47	3.07	4.78	0.3/30.3	5	2.91	1.60	0.5/5.0
Concrete	19	2.69	1.83	0.2/6.5	3	0.75	0.43	0.3/1.0
Metal Lathe Work	8	2.68	1.89	0.1/4.6	1	1.00	0.00	1.0/1.0
Bill of Materials	43	2.51	3.86	0.5/25.0	2	0.75	0.35	0.5/1.0
FFA	39	2.47	1.46	0.8/6.0	4	2.63	1.80	1.0/5.0
Careers	44	2.06	1.27	0.1/5.0	4	2.38	1.38	1.0/4.0
Electrical Motors	18	2.05	2.31	0.1/10.0	3	1.76	1.41	0.3/3.0
Fasteners	32	2.00	1.43	0.2/6.0	5	2.51	2.12	1.0/6.0
Painting	32	1.71	1.05	0.2/5.0	5	1.46	1.08	0.3/3.0
Rope Work	9	1.56	1.51	0.3/5.0	2	0.88	0.17	0.8/1.0
Hydraulics	6	1.36	1.02	0.1/3.0	2	1.25	1.06	0.5/2.0
Fence Construction	6	1.04	0.66	0.2/2.0	1	1.00	0.00	1.0/1.0

Note. HH = Hand Held, OA = Oxy-Acetylene

Table 14

Non-zero Standardized Hours of Instruction Reported by Instructors Currently Teaching an Introduction to Agricultural Mechanics Course Split by Agricultural Science and Technology Teachers with and without Science Certification

	Science & Ag Certification				Ag Certification Only			
Unit	*n*	*M*	*SD*	Min/Max	*n*	*M*	*SD*	Min/Max
Cleaning & Tool Storage	36	2.26	1.87	0.1/10.0	28	4.90	7.92	1.0/37.9
Safety Practices	33	7.20	5.70	1.5/30.0	28	10.07	12.45	1.0/53.0
Measuring	31	4.15	4.23	0.5/20.0	26	6.68	11.69	1.0/60.6
Stationary Power Tools	31	2.60	1.84	0.3/9.0	27	4.45	4.11	0.8/15.5
Tool Use & ID	31	5.90	4.47	0.8/20.0	26	5.00	2.64	1.0/10.6
Tool Reconditioning & Maintenance	30	5.13	4.47	0.6/16.0	25	5.13	4.76	1.0/20.0
Plumbing and Pipe Fitting	29	5.24	3.76	1.0/20.0	24	6.21	4.66	1.0/15.2
Principles of Electricity	29	3.19	2.44	0.5/10.0	25	4.21	2.94	0.5/10.0
Electrical Wiring	29	6.00	5.17	0.5/22.7	24	6.82	4.70	0.5/20.0
HH Power Tools	29	2.86	2.20	0.3/10.0	27	5.00	8.53	1.0/45.5
SAE	28	2.78	1.92	0.5/7.5	18	3.56	4.44	0.5/18.2
Cold Metal Work	27	3.44	2.29	0.5/10.6	24	3.82	3.15	0.5/12.0
Careers	27	2.17	1.39	0.8/5.0	23	1.95	1.11	0.1/4.0
Hand Tools	27	2.17	2.12	0.3/10.0	27	3.84	5.92	0.5/30.3
Student Projects	26	18.77	15.23	1.0/60.6	23	21.05	25.10	5.0/125.0
FFA	24	2.41	1.35	0.8/5.0	19	2.59	1.65	1.0/6.0
Bill of Materials	23	1.82	1.77	0.5/9.1	23	3.04	4.98	0.5/25.0
OA Welding	23	7.89	7.66	0.5/30.0	21	6.76	10.26	0.1/50.0
Drafting & Sketching	22	2.37	1.54	0.5/6.0	23	3.94	2.90	1.0/10.0
OA Cutting	21	4.40	6.26	0.5/30.0	20	4.74	5.31	0.1/25.0
Arc Welding (SMAW)	21	11.94	10.35	1.0/40.0	19	12.91	13.25	0.1/50.0
Wood Working	19	5.99	4.70	0.5/20.0	17	11.11	8.88	0.8/35.0
Fasteners	18	2.14	1.51	1.0/6.0	21	1.92	1.49	0.2/6.0
HH Plasma Cutting	18	3.12	2.90	0.3/10.0	13	4.02	3.59	0.1/12.5
Painting	17	1.84	1.20	0.3/5.0	22	1.63	1.01	0.2/4.0
Small Gas Engines	17	5.44	5.16	1.0/15.0	12	15.86	31.52	0.8/106.1
Carpentry	14	3.90	3.70	0.8/10.0	11	5.64	7.05	1.0/25.0
Hot Metal Work	13	3.19	2.41	0.5/7.6	16	3.86	3.84	1.0/15.2
Concrete	13	2.51	1.84	0.3/6.5	11	3.03	2.88	0.2/10.0
MIG Welding (GMAW)	13	7.29	7.01	0.5/25.0	17	6.62	5.49	0.1/21.2
Surveying	11	2.94	2.04	0.3/7.6	10	3.57	4.32	1.0/15.2
Electrical Motors	8	2.22	3.19	0.3/10.0	14	1.82	1.34	0.1/5.0
TIG Welding (GTAW)	8	6.62	6.95	0.5/21.2	9	3.07	2.79	0.1/8.0
Computerized Plasma/Mill	6	5.80	5.17	0.5/14.0	6	2.19	1.81	0.1/5.0
Rope Work	5	1.16	1.07	0.3/3.0	7	1.50	1.57	0.5/5.0
Hydraulics	3	0.83	0.29	0.5/1.0	6	1.52	1.03	0.1/3.0
Metal Lathe Work	3	3.27	2.17	0.8/4.6	7	2.88	2.59	0.1/7.5
Large Engines	2	*			6	5.10	9.78	0.1/25.0
Fence Construction	1	*			7	0.89	0.42	0.2/1.5

Note. HH = Hand Held, OA = Oxy-Acetylene, *Data not reported due to small *n*.

The comparison of the standardized duration of instruction and years of teaching an introductory agricultural mechanics course are located in Table 15. *Cleaning and tool storage, stationary power tools, hand held power tools, tool use and identification, tool reconditioning and maintenance, principles of electricity, hand tools, plumbing and pipe fitting, electrical wiring, cold metal work, careers, SAE, drafting and sketching, FFA,* and *oxy-acetylene cutting*; 15 of the 21 most taught units, (see Table 11) had less than three hours of variability between the four experience groups.

Of the 39 units of instruction, 11 of the mean differences of the groups exceeded 4.5 hours and three additional units' group mean differences exceeded 3 hours. The largest mean difference between groups was for the unit of *student projects* (range = 13.65). Teachers with six to ten years of experience accounted for 11 of the hours of variation by themselves. The second largest mean difference was found in the *large engines* unit (range = 12.95), however only eight teachers reported teaching this unit, one group had only two teachers, and no teacher with more than 20 years experience reported teaching this unit. An 11.19 mean difference between the highest and lowest means for *small gas engines* made it the third largest mean difference among all listed units. Other units with mean differences over three hours included: *oxy-acetylene welding* ($M_{diff} = 7.41$, $n = 45$), *surveying* ($M_{diff} = 7.12$, $n = 22$), *MIG (GMAW) welding* ($M_{diff} = 6.68$, $n = 31$), *computerized plasma or mill work* ($M_{diff} = 6.43$, $n = 13$), *woodworking* ($M_{diff} = 6.28$, $n = 37$), *carpentry* ($M_{diff} = 5.76$, $n = 26$), *measuring* ($M_{diff} = 5.46$, $n = 58$), *arc (SMAW) welding* ($M_{diff} = 4.68$, $n = 41$), *safety* ($M_{diff} = 3.42$, $n = 62$), and *TIG (GTAW) welding* ($M_{diff} = 3.25$, $n = 18$).

Table 15

Non-zero Standardized Hours of Instruction Reported by Instructors Currently Teaching an Introduction to Agricultural Mechanics Course Split by Years Teaching Groups

	1-5 Years		6-10 Years		11-20 Years		Over 20 Years	
Unit	*n*	*M/SD*	*n*	*M/SD*	*n*	*M/SD*	*n*	*M/SD*
Cleaning & Tool Storage	19	4.67/8.36	13	2.75/2.46	17	3.62/5.65	16	2.11/1.32
Safety Practices	18	9.99/11.68	12	9.64/13.37	17	7.53/6.68	15	6.57/4.23
HH Power Tools	18	5.57/10.35	11	2.71/1.67	14	3.42/2.69	14	3.22/2.35
Stationary Power Tools	18	3.94/4.30	11	3.21/2.60	16	2.98/2.31	14	3.71/3.05
Tool Reconditioning & Maintenance	17	5.40/5.52	11	4.24/4.41	13	5.59/4.46	15	4.75/3.87
Hand Tools	17	4.27/7.27	11	2.46/1.36	14	2.56/2.76	13	2.44/2.40
Student Projects	16	18.38/17.15	10	29.44/35.73	13	15.79/12.07	11	17.34/9.46
Measuring	16	8.59/14.66	11	3.13/2.13	16	4.10/4.69	15	5.15/4.21
Plumbing & Pipe Fitting	16	5.80/4.57	10	6.05/5.20	13	5.35/4.74	15	5.55/2.33
Electrical Wiring	16	5.77/3.46	10	7.85/6.04	16	6.13/4.89	12	6.14/5.80
Tool Use & ID	16	4.87/3.57	12	6.64/4.43	16	5.45/4.35	13	5.24/2.46
Principles of Electricity	16	2.85/1.77	11	4.93/3.62	16	3.82/2.98	12	3.50/2.14
Drafting & Sketching	15	3.19/2.59	8	2.73/1.98	13	3.35/2.36	9	3.29/3.00
Cold Metal Work	15	3.06/2.01	9	4.09/2.94	14	3.91/2.75	14	4.26/3.99
SAE	14	3.10/3.15	8	1.71/1.00	13	2.66/1.34	12	4.28/4.80
Careers	14	1.83/1.07	11	2.57/1.54	13	1.97/1.52	13	1.91/0.86
Painting	14	1.56/1.17	5	2.00/0.94	11	2.07/1.36	10	1.36/0.49
OA Welding	13	3.67/2.30	9	10.62/15.05	11	4.75/3.47	12	11.08/9.09
Fasteners	13	1.70/1.45	5	3.75/2.06	12	1.79/1.33	10	1.76/0.76
FFA	12	2.74/1.87	9	2.73/1.57	12	1.84/1.09	11	2.60/1.24
Bill of Materials	12	1.82/1.08	8	4.31/8.38	13	1.21/0.41	14	2.87/2.40
OA Cutting	11	3.60/2.27	9	5.56/7.69	12	5.77/8.04	10	3.33/1.93
Arc Welding (SMAW)	10	11.37/12.60	9	12.62/14.53	11	10.44/11.47	11	15.12/8.64
Wood Working	10	6.68/4.26	8	9.50/8.02	10	12.05/10.20	9	5.77/3.96
Concrete	10	2.83/3.13	2	4.00/3.54	5	1.84/1.01	8	2.67/1.52
HH Plasma Cutting	9	4.09/3.74	4	3.75/3.43	9	2.79/3.06	9	3.49/3.04
Hot Metal Work	9	3.24/4.64	6	2.80/1.50	8	4.52/3.34	6	3.51 /2.05
Small Gas Engines	8	15.48/36.70	7	11.00/17.36	8	6.81/5.80	7	4.29/5.00
MIG Welding (GMAW)	8	5.58/4.13	8	5.00/4.61	7	5.96/3.41	8	11.68/8.76
Rope Work	8	1.38/1.50	0		2	1.65/1.91	2	1.00/0.00
Carpentry	7	7.26/8.55	4	1.50/0.58	8	4.19/3.82	7	4.48/3.23
Electrical Motors	7	1.40/0.90	3	2.67/2.08	7	2.62/3.50	6	1.26/0.43
Surveying	6	1.46/0.96	2	8.58/9.30	7	2.71/1.25	7	3.38/2.61
Metal Lathe Work	4	4.26/2.66	1	*	3	2.05/2.27	2	3.01/2.11
TIG Welding (GTAW)	4	2.75/2.60	4	4.13/3.07	2	5.05/7.00	8	6.00/6.82
Hydraulics	4	1.63/1.12	2	1.50/0.71	3	0.70/0.52	0	
Computerized Plasma/Mill	4	1.38/1.12	2	4.00/1.41	3	2.71/2.47	4	7.81/5.23
Large Engines	4	1.13/0.63	2	13.50/16.26	2	0.55/0.64	0	
Fence Construction	4	1.13/0.26	1	*	3	1.07/0.90	0	

Note. HH = Hand Held, OA = Oxy-Acetylene. *Data not reported due to small *n*.

Research Question 2.

The purpose of Research Question 2 was to determine how important Idaho Agricultural Science and Technology Teachers rate the individual agricultural mechanics units in their IAM curricula. The complete listing of units and their importance is located in Table 16. Those rating the unit an "8" or higher on a 10-point scale (anchors of *"not important"* to *"very important"*) were considered to have rated the unit as important (see Table 17); 17 units of instruction were rated as important by at least one-half of all respondents. Conversely, over one-half of the respondents indicated that five units were not important (rated 1 – 3 on 10-point scale). Ten units had bimodal distributions, with both important and not important ratings higher than those responding in the center of the scale. The units of *small gas engines*, *oxy-acetylene cutting*, *SMAW welding*, *GTAW welding*, *GMAW welding*, and *handheld plasma arc cutting* all had more than two times the number of respondents, indicating the units were important and not important as responded in the middle of the scale (see Table 17). Numbers bolded in the table indicate 50% or more of the respondents are in that category. Complete frequency and percentage tables are located in Appendix 6: Supporting Data Tables.

Table 16

The Importance of Selected Units of Instruction in Introductory Agricultural Mechanics Courses as Perceived by All Respondents

Unit	Rank	*n*	Mean	*SD*	Median
Safety Practices	1	99	9.69	0.98	10.0
Measuring	2	93	9.03	1.52	10.0
Cleaning & Tool Storage	3	98	8.55	1.95	10.0
Tool Use & ID	4	92	8.42	1.75	9.0
Handheld Power Tools	5	98	7.82	2.18	8.0
Stationary Power Tools	6	97	7.70	2.32	8.0
Individual & Team Projects	7	95	7.56	2.93	9.0
Hand Tools	8	98	7.51	2.31	8.0
Electrical Wiring	9	96	7.48	2.39	8.0
Principles of Electricity	10	99	7.43	2.39	8.0
Plumbing & Pipe Fitting	11	98	7.32	1.97	8.0
Tool Reconditioning & Maintenance	12	99	7.21	2.20	8.0
Arc (SMAW) Welding	13	98	7.20	3.27	8.0
Bill of Materials	14	94	6.97	2.42	7.5
Oxy-acetylene Cutting	15	99	6.93	3.23	8.0
Careers	16	98	6.88	2.82	8.0
Cold Metal Work	17	97	6.85	2.33	7.0
Oxy-acetylene Welding	18	99	6.84	3.03	8.0
SAE	19	97	6.69	2.83	7.0
MIG (GMAW) Welding	20	97	6.67	3.53	8.0
FFA	21	97	6.45	2.88	7.0
Drafting & Sketching	22	99	6.21	2.69	7.0
Handheld Plasma Arc Cutting	23	97	6.21	3.46	7.0
Wood Working	24	98	5.83	2.99	6.0
Fasteners	25	96	5.32	2.75	5.0
Carpentry	26	98	5.30	2.94	5.0
Small Gas Engines	27	97	5.29	3.14	6.0
TIG (GTAW) Welding	28	96	5.11	3.53	5.0
Hot Metal Work	29	95	5.02	2.69	5.0
Painting	30	96	4.99	2.76	5.0
Electrical Motors	31	95	4.69	2.80	5.0
Concrete	32	98	4.44	2.69	5.0
Surveying	33	97	4.34	2.68	5.0
Computerized Plasma or Mill Work	34	95	4.32	3.35	3.0
Hydraulics	35	94	3.83	2.95	3.0
Large Engines	36	93	3.54	2.98	2.0
Metal Lathe Work	37	94	3.43	2.79	3.0
Fence Construction	38	94	3.28	2.39	3.0
Rope Work	39	94	2.89	2.42	2.0

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = “Very Important” to 1 = “Not Very Important”

Table 17

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	98	1 / 1.02	4 / 0.00	93 / **95.88**
Measuring	92	1 / 1.09	9 / 7.61	82 / **84.54**
Tool Use & ID	97	2 / 2.06	23 / 9.28	72 / **74.23**
Shop Cleaning & Tool Storage	91	2 / 2.20	17 / 12.09	72 / **74.23**
Student Projects	97	18 / 18.56	16 / 5.15	63 / **64.95**
Electrical Wiring	94	14 / 14.89	18 / 10.64	62 / **63.92**
Stationary Power Tools	96	7 / 7.29	28 / 13.54	61 / **62.89**
Arc Welding (SMAW)	98	20 / 20.41	18 / 9.18	60 / **61.86**
Plumbing and Pipe Fitting	97	4 / 4.12	33 / 18.56	60 / **61.86**
Principles of Electricity	95	9 / 9.47	28 / 15.79	58 / **59.79**
HH Power Tools	98	10 / 10.20	32 / 17.35	56 / **57.73**
OA Cutting	98	17 / 17.35	26 / 14.29	55 / **56.70**
OA Welding	96	23 / 23.96	18 / 10.42	55 / **56.70**
Hand Tools	97	7 / 7.22	37 / 19.59	53 / **54.64**
Tool Reconditioning & Maintenance	98	7 / 7.14	39 / 24.49	52 / **53.61**
Careers	97	15 / 15.46	31 / 21.65	51 / **52.58**
MIG Welding (GMAW)	97	5 / 5.15	42 / 19.59	50 / **51.55**
Bill of Materials	93	8 / 8.60	39 / 26.88	46 / 47.42
Cold Metal Work	93	8 / 8.60	39 / 26.88	46 / 47.42
HH Plasma Cutting	96	26 / 27.08	25 / 11.46	45 / 46.39
SAE	96	16 / 16.67	40 / 19.79	40 / 41.24
FFA	96	10 / 10.42	46 / 16.67	40 / 41.24
Wood Working	96	18 / 18.75	39 / 17.71	39 / 40.21
Drafting & Sketching	98	17 / 17.35	46 / 20.41	35 / 36.08
Small Gas Engines	97	23 / 23.71	39 / 24.74	35 / 36.08
Computerized Plasma/Mill	96	34 / 35.42	32 / 16.67	30 / 30.93
Hot Metal Work	95	38 / 40.00	27 / 13.68	30 / 30.93
Carpentry	97	28 / 28.87	43 / 21.65	26 / 26.80
Fasteners	94	47 / **50.00**	24 / 14.89	23 / 23.71
TIG Welding (GTAW)	94	29 / 30.85	44 / 29.79	21 / 21.65
Painting	95	25 / 26.32	49 / 32.63	21 / 21.65
Electrical Motors	95	31 / 32.63	45 / 25.26	19 / 19.59
Hydraulics	94	35 / 37.23	42 / 25.53	17 / 17.53
Metal Lathe Work	93	49 / **52.69**	31 / 19.35	13 / 13.40
Large Engines	92	55 / **59.78**	25 / 14.13	12 / 12.37
Concrete	93	56 / **60.22**	25 / 16.13	12 / 12.37
Surveying	97	38 / 39.18	48 / 24.74	11 / 11.34
Rope Work	96	38 / 39.58	47 / 23.96	11 / 11.34
Fence Construction	93	54 / **58.06**	35 / 21.51	4 / 4.12

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important*". Bolded numbers represent majority opinions.

Mean importance ratings for teachers currently teaching an IAM course and teachers not teaching an IAM course were ranked for comparison (see Table 18). Rank differences of more than 10 positions occurred for seven units of instruction. The units of *electrical wiring, plumbing and pipe fitting, principles of electricity,* and *student projects* were all in the top 10 for teachers currently teaching IAM, but they were 23rd, 24th, 21st, and 18th respectively for teachers not teaching IAM. Teachers who reported not teaching IAM ranked *MIG Welding (GMAW), Handheld Plasma Arc Cutting,* and *TIG Welding (GTAW)* higher than teachers currently teaching IAM by 14, 16, and 17 places respectively. Those respondents teaching IAM felt 17 units were important and seven units were not important. Those not teaching felt 19 units were important and three units were not important. Complete frequency and percentage tables are located in Appendix 6: Supporting Data Tables.

Notable distributions occurred for several units of instruction. One fourth of respondents who were currently teaching IAM rated the unit of FFA as not important, with nearly equal ratings in neutral and important categories (see Table 19); however, only two respondents not teaching IAM found it not important (see Table 20). Bimodal distributions were found for four of the units rated by those respondents currently teaching IAM courses; *oxy-acetylene cutting*, *SMAW welding*, *GMAW welding*, and *handheld plasma cutting* each had peaks at both ends and fewer respondents in the neutral category. Numbers bolded in the table indicate 50% or more of the respondents are in that category.

Table 18

The Importance of Selected Units of Instruction in Introduction to Agricultural Mechanics (IAM) as Rated by Instructors Currently Teaching or Not Teaching IAM

	Teaching			Not Teaching		
	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*
Safety Practices	1	66	9.77/0.72	1	32	9.50/1.37
Measuring	2	64	8.97/1.64	2	28	9.14/1.24
Shop Cleaning & Tool Storage	3	66	8.76/1.95	4	31	8.06/1.90
Tool Use & Identification	4	61	8.57/1.59	3	30	8.07/2.03
HH Power Tools	5	65	7.89/2.12	7	32	7.69/2.33
Electrical Wiring	6	64	7.81/2.42	23	31	6.71/2.18
Student Projects	7	62	7.79/3.01	18	32	7.09/2.80
Stationary Power Tools	8	64	7.75/2.41	9	32	7.56/2.17
Principles of Electricity	9	66	7.70/2.42	21	32	6.81/2.25
Plumbing & Pipe Fitting	10	66	7.61/1.90	24	31	6.61/1.96
Hand Tools	11	65	7.49/2.41	10	32	7.56/2.18
Tool Reconditioning & Maintenance	12	66	7.18/2.22	16	32	7.19/2.18
Arc Welding (SMAW)	13	65	6.95/3.43	5	32	7.88/2.78
OA Welding	14	66	6.76/3.17	19	32	7.09/2.76
Cold Metal Work	15	65	6.75/2.45	20	31	6.94/2.07
Careers	16	65	6.71/2.93	17	32	7.13/2.60
OA Cutting	17	66	6.71/3.41	12	32	7.47/2.82
Bill of Materials	18	62	6.63/2.46	11	31	7.55/2.22
SAE	19	65	6.29/2.99	13	31	7.42/2.31
MIG Welding (GMAW)	20	64	6.22/3.61	6	32	7.75/3.06
FFA	21	64	5.92/3.08	14	32	7.41/2.12
Drafting & Sketching	22	66	5.88/2.81	22	32	6.78/2.28
Wood Working	23	65	5.75/3.07	25	32	5.97/2.89
HH Plasma Arc Cutting	24	64	5.58/3.54	8	32	7.63/2.80
Fasteners	25	65	5.45/2.74	30	30	5.03/2.82
Carpentry	26	65	5.02/2.97	27	32	5.84/2.91
Hot Metal Work	27	64	4.95/2.73	31	30	5.00/2.53
Small Gas Engines	28	65	4.95/3.25	26	31	5.94/2.87
Painting	29	65	4.91/2.79	32	30	5.00/2.61
Electrical Motors	30	62	4.40/2.95	29	32	5.19/2.47
Concrete	31	65	4.28/2.64	34	32	4.66/2.77
TIG Welding (GTAW)	32	63	4.11/3.30	15	32	7.22/3.04
Surveying	33	64	3.98/2.64	33	32	5.00/2.70
Computerized Plasma/Mill	34	63	3.78/3.42	28	31	5.52/2.93
Hydraulics	35	63	3.49/2.95	36	30	4.63/2.87
Metal Lathe Work	36	62	3.23/2.86	38	31	3.90/2.64
Large Engines	37	61	3.05/2.80	37	31	4.58/3.11
Fence Construction	38	62	2.56/1.96	35	31	4.65/2.60
Rope Work	39	63	2.51/2.21	39	30	3.77/2.66

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important*"

Table 19

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors Teaching IAM(f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	66	0/0.00	3/4.55	63/**95.45**
Measuring	64	1/1.56	7/10.94	56/**87.50**
Tool Use & ID	61	1/1.64	9/14.75	51/**83.61**
Shop Cleaning & Tool Storage	66	2/3.03	12/18.18	52/**78.79**
Student Projects	62	9/14.52	8/12.90	45/**72.58**
Electrical Wiring	64	5/7.81	16/25.00	43/**67.19**
Stationary Power Tools	64	4/6.25	19/29.69	41/**64.06**
Arc Welding (SMAW)	65	15/23.08	9/13.85	41/**63.08**
Plumbing and Pipe Fitting	66	3/4.55	22/33.33	41/**62.12**
Principles of Electricity	66	6/9.09	20/30.30	40/**60.61**
HH Power Tools	65	2/3.08	24/36.92	39/**60.00**
OA Cutting	66	16/24.24	11/16.67	39/**59.09**
OA Welding	66	13/19.70	15/22.73	38/**57.58**
Hand Tools	65	5/7.69	25/38.46	35/**53.85**
Tool Reconditioning & Maintenance	66	5/7.58	26/39.39	35/**53.03**
Careers	65	12/18.46	19/29.23	34/**52.31**
MIG Welding (GMAW)	64	19/29.69	12/18.75	33/**51.56**
Bill of Materials	62	6/9.68	30/48.39	26/41.94
Cold Metal Work	65	8/12.31	30/46.15	27/41.54
HH Plasma Cutting	64	23/35.94	15/23.44	26/40.63
SAE	65	14/21.54	25/38.46	26/40.00
FFA	64	16/25.00	25/39.06	23/35.94
Wood Working	65	15/23.08	27/41.54	23/35.38
Drafting & Sketching	66	15/22.73	31/46.97	20/30.30
Small Gas Engines	65	26/40.00	20/30.77	19/29.23
Computerized Plasma/Mill	63	38/**60.32**	10/15.87	15/23.81
Hot Metal Work	64	20/31.25	29/45.31	15/23.44
Carpentry	65	21/32.31	29/44.62	15/23.08
Fasteners	65	15/23.08	36/55.38	14/21.54
TIG Welding (GTAW)	63	34/**53.97**	16/25.40	13/20.63
Painting	65	22/33.85	30/46.15	13/20.00
Electrical Motors	62	26/41.94	25/40.32	11/17.74
Hydraulics	63	37/**58.73**	17/26.98	9/14.29
Metal Lathe Work	62	38/**61.29**	16/25.81	8/12.90
Large Engines	61	39/**63.93**	15/24.59	7/11.48
Concrete	65	25/38.46	34/52.31	6/9.23
Surveying	64	28/43.75	31/48.44	5/7.81
Rope Work	63	45/**71.43**	15/23.81	3/4.76
Fence Construction	62	41/**66.13**	21/33.87	0/0.00

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Table 20

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors Not Teaching IAM(f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	32	1 / 3.13	1 / 3.13	30 / **93.75**
Measuring	28	0 / 0.00	2 / 7.14	26 / **92.86**
Tool Use & ID	30	1 / 3.33	8 / 26.67	21 / **70.00**
Arc Welding (SMAW)	32	3 / 9.38	7 / 21.88	22 / **68.75**
MIG Welding (GMAW)	32	4 / 12.50	6 / 18.75	22 / **68.75**
OA Cutting	32	4 / 12.50	7 / 21.88	21 / **65.63**
HH Power Tools	32	2 / 6.25	9 / 28.13	21 / **65.63**
Shop Cleaning & Tool Storage	31	0 / 0.00	11 / 35.48	20 / **64.52**
Bill of Materials	31	2 / 6.45	9 / 29.03	20 / **64.52**
Stationary Power Tools	32	3 / 9.38	9 / 28.13	20 / **62.50**
HH Plasma Cutting	32	3 / 9.38	10 / 31.25	19 / **59.38**
Hand Tools	32	2 / 6.25	12 / 37.50	18 / **56.25**
Tool Reconditioning & Maintenance	32	2 / 6.25	13 / 40.63	17 / **53.13**
Careers	32	3 / 9.38	12 / 37.50	17 / **53.13**
OA Welding	32	4 / 12.50	11 / 34.38	17 / **53.13**
TIG Welding (GTAW)	32	4 / 12.50	11 / 34.38	17 / **53.13**
Student Projects	32	5 / 15.63	10 / 31.25	17 / **53.13**
FFA	32	2 / 6.25	14 / 43.75	16 / **50.00**
Principles of Electricity	32	4 / 12.50	12 / 37.50	16 / **50.00**
Electrical Wiring	31	4 / 12.90	12 / 38.71	15 / 48.39
Drafting & Sketching	32	2 / 6.25	15 / 46.88	15 / 46.88
SAE	31	2 / 6.45	15 / 48.39	14 / 45.16
Cold Metal Work	31	2 / 6.45	16 / **51.61**	13 / 41.94
Wood Working	32	8 / 25.00	12 / 37.50	12 / 37.50
Small Gas Engines	31	8 / 25.81	12 / 38.71	11 / 35.48
Carpentry	32	7 / 21.88	14 / 43.75	11 / 34.38
Plumbing and Pipe Fitting	31	2 / 6.45	20 / **64.52**	9 / 29.03
Computerized Plasma / Mill	31	9 / 29.03	14 / 45.16	8 / 25.81
Fasteners	30	10 / 33.33	13 / 43.33	7 / 23.33
Hot Metal Work	30	9 / 30.00	15 / **50.00**	6 / 20.00
Painting	30	9 / 30.00	15 / **50.00**	6 / 20.00
Electrical Motors	32	9 / 28.13	17 / **53.13**	6 / 18.75
Surveying	32	10 / 31.25	16 / **50.00**	6 / 18.75
Large Engines	31	16 / 51.61	10 / 32.26	5 / 16.13
Concrete	32	13 / 40.63	14 / 43.75	5 / 15.63
Hydraulics	30	12 / 40.00	14 / 46.67	4 / 13.33
Fence Construction	31	13 / 41.94	14 / 45.16	4 / 12.90
Metal Lathe Work	31	18 / **58.06**	9 / 29.03	4 / 12.90
Rope Work	30	17 / **56.67**	11 / 36.67	2 / 6.67

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Comparison of the importance of units between males and females revealed few differences. Mean differences between units did not exceed 1.5 on any of the units of instruction (see Table 21). Male respondents reported 18 units were important, with more than 50.0% of respondents in the important category (see Table 22); females only reported 15 units as important (see Table 23). Small gas engines had a nearly equal distribution, with almost one-third of respondents in each of the three categories for both genders. Female respondents reported a nearly even distribution for GMAW welding, with 63.01% of males reporting it as important. Approximately 30.0% of female respondents were in each category when rating GTAW welding (see Table 23), where males were more divided in their rankings, with 43.06% rating it as not important and 31.94% rating it as important (See Table 22). Male respondents also had a bimodal distribution for GMAW welding, with 23.29% rating it as not important and 63.01% rating it as important. Male respondents felt 18 units were important and six units were not important. Female respondents felt 15 units were important and five units were not important. Numbers bolded in the table indicate 50% or more of the respondents are in that category. Complete frequency and percentage tables are located in Appendix 6: Supporting Data Tables.

Table 21

The Importance of Selected Units of Instruction in Introduction to Agricultural Mechanics as Rated by Instructors Grouped by Gender

	Male			Female		
	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*
Safety Practices	1	74	9.80/0.62	1	24	9.33/1.63
Measuring	2	69	9.01/1.59	2	23	9.04/1.36
Cleaning & Tool Storage	3	73	8.62/1.89	4	24	8.29/2.16
Tool Use & Identification	4	67	8.42/1.68	3	24	8.38/1.97
Stationary Power Tools	5	74	7.81/2.34	10	22	7.27/2.27
Handheld Power Tools	6	73	7.75/2.30	5	24	8.04/1.83
Individual & Team Projects	7	73	7.63/3.04	9	21	7.29/2.63
Arc Welding (SMAW)	8	73	7.47/3.07	17	24	6.63/3.72
Electrical Wiring	9	71	7.46/2.48	8	24	7.42/2.13
Plumbing & Pipe Fitting	10	73	7.37/1.93	12	24	7.04/2.07
Hand Tools	10	73	7.37/2.50	6	24	7.96/1.65
Principles of Electricity	12	74	7.34/2.45	7	24	7.63/2.22
Tool Reconditioning & Maintenance	13	74	7.26/2.18	14	24	6.96/2.26
Oxyacetylene Cutting	13	74	7.26/2.98	22	24	6.04/3.85
MIG Welding (GMAW)	15	72	7.08/3.39	24	24	5.67/3.67
Oxyacetylene Welding	16	74	7.04/2.78	19	24	6.33/3.71
Bill of Materials	17	71	7.00/2.35	16	22	6.73/2.64
Cold Metal Work	18	73	6.90/2.37	18	23	6.52/2.19
Careers	19	73	6.79/2.90	13	24	7.00/2.59
SAE	20	72	6.51/2.77	11	24	7.08/3.01
HH Plasma Cutting	21	72	6.31/3.36	20	24	6.13/3.71
FFA	22	72	6.29/2.84	15	24	6.79/2.99
Drafting & Sketching	23	74	6.19/2.81	20	24	6.13/2.23
Wood Working	24	73	5.86/3.07	23	24	5.71/2.85
Fasteners	25	73	5.45/2.63	30	22	4.86/3.18
Carpentry	26	73	5.37/3.01	27	24	5.04/2.84
Small Gas Engines	27	72	5.26/3.20	25	24	5.29/3.07
TIG Welding (GTAW)	28	71	5.13/3.57	26	24	5.25/3.46
Painting, Brush & Spray Gun	29	71	5.01/2.71	31	24	4.71/2.79
Hot Metal Work	30	71	5.00/2.78	29	23	4.87/2.28
Electrical Motors	31	70	4.56/2.85	28	24	5.00/2.70
Concrete	32	73	4.45/2.70	32	24	4.25/2.66
Surveying	33	72	4.39/2.75	34	24	4.13/2.56
Computerized Plasma or Mill Work	33	70	4.39/3.50	32	24	4.25/2.95
Hydraulics	35	70	3.96/3.05	36	23	3.57/2.68
Large Engines	36	68	3.60/3.10	37	24	3.46/2.67
Metal Lathe Work	37	69	3.48/3.00	39	24	3.38/2.12
Fence Construction	38	69	3.06/2.38	35	24	3.83/2.41
Rope Work	39	70	2.76/2.43	38	23	3.39/2.41

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important*"

Table 22

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Male Prepared Idaho Agricultural Education Instructors (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	75	0/0.00	2/2.67	73/**97.33**
Measuring	70	1/1.43	5/7.14	64/**91.43**
Tool Use & ID	68	1/1.47	13/19.12	54/**79.41**
Shop Cleaning & Tool Storage	74	1/1.35	17/22.97	56/**75.68**
Student Projects	74	11/14.86	10/13.51	53/**71.62**
Arc Welding (SMAW)	74	13/17.57	11/14.86	50/**67.57**
Stationary Power Tools	75	5/6.67	20/26.67	50/**66.67**
OA Cutting	75	12/16.00	14/18.67	49/**65.33**
Electrical Wiring	72	7/9.72	19/26.39	46/**63.89**
MIG Welding (GMAW)	73	17/23.29	10/13.70	46/**63.01**
HH Power Tools	74	4/5.41	25/33.78	45/**60.81**
OA Welding	75	10/13.33	22/29.33	43/**57.33**
Principles of Electricity	75	8/10.67	24/32.00	43/**57.33**
Plumbing and Pipe Fitting	74	4/5.41	29/39.19	41/**55.41**
Tool Reconditioning & Maintenance	75	5/6.67	29/38.67	41/**54.67**
Careers	74	12/16.22	22/29.73	40/**54.05**
Hand Tools	74	7/9.46	27/36.49	40/**54.05**
Bill of Materials	72	6/8.33	29/40.28	37/**51.39**
HH Plasma Cutting	73	20/27.40	18/24.66	35/47.95
Cold Metal Work	74	6/8.11	35/47.30	33/44.59
Drafting & Sketching	75	14/18.67	31/41.33	30/40.00
SAE	73	12/16.44	32/43.84	29/39.73
Wood Working	74	17/22.97	29/39.19	28/37.84
FFA	73	14/19.18	31/42.47	28/38.36
TIG Welding (GTAW)	72	31/43.06	18/25.00	23/31.94
Small Gas Engines	73	27/36.99	24/32.88	22/30.14
Carpentry	74	22/29.73	31/41.89	21/28.38
Computerized Plasma/Mill	71	37/**52.11**	14/19.72	20/28.17
Hot Metal Work	72	22/30.56	32/44.44	18/25.00
Fasteners	74	17/22.97	41/**55.41**	16/21.62
Painting	72	22/30.56	35/48.61	15/20.83
Electrical Motors	71	28/39.44	32/45.07	11/15.49
Hydraulics	71	38/**53.52**	22/30.99	11/15.49
Large Engines	69	42/**60.87**	16/23.19	11/15.94
Metal Lathe Work	70	45/**64.29**	14/20.00	11/15.71
Concrete	74	28/37.84	36/48.65	10/13.51
Surveying	73	29/39.73	36/49.32	8/10.96
Rope Work	71	48/67.61	19/26.76	4/5.63
Fence Construction	70	42/**60.00**	26/37.14	2/2.86

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Table 23

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Female Prepared Idaho Agricultural Education Instructors (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	24	1/4.17	2/8.33	21/**87.50**
Measuring	23	0/0.00	4/17.39	19/**82.61**
Tool Use & ID	24	1/4.17	4/16.67	19/**79.17**
Shop Cleaning & Tool Storage	24	1/4.17	6/25.00	17/**70.83**
HH Power Tools	24	0/0.00	9/37.50	15/**62.50**
Principles of Electricity	24	2/8.33	8/33.33	14/**58.33**
Electrical Wiring	24	2/8.33	9/37.50	13/**54.17**
Arc Welding (SMAW)	24	6/25.00	5/20.83	13/**54.17**
Hand Tools	24	0/0.00	11/45.83	13/**54.17**
Stationary Power Tools	22	2/9.09	8/36.36	12/**54.55**
SAE	24	4/16.67	8/33.33	12/**50.00**
Tool Reconditioning & Maintenance	24	2/8.33	10/41.67	12/**50.00**
FFA	24	4/16.67	8/33.33	12/**50.00**
Careers	24	3/12.50	9/37.50	12/**50.00**
OA Welding	24	7/29.17	5/20.83	12/**50.00**
OA Cutting	24	8/33.33	5/20.83	11/45.83
Student Projects	21	3/14.29	8/38.10	10/47.62
Bill of Materials	22	2/9.09	10/45.45	10/45.45
Plumbing and Pipe Fitting	24	1/4.17	13/**54.17**	10/41.67
HH Plasma Cutting	24	7/29.17	7/29.17	10/41.67
MIG Welding (GMAW)	24	7/29.17	8/33.33	9/37.50
Cold Metal Work	23	4/17.39	11/47.83	8/34.78
Small Gas Engines	24	7/29.17	9/37.50	8/33.33
Wood Working	24	6/25.00	11/45.83	7/29.17
TIG Welding (GTAW)	24	8/33.33	9/37.50	7/29.17
Drafting & Sketching	24	3/12.50	15/**62.50**	6/25.00
Electrical Motors	24	7/29.17	11/45.83	6/25.00
Fasteners	22	8/36.36	9/40.91	5/22.73
Painting	24	9/37.50	10/41.67	5/20.83
Carpentry	24	6/25.00	13/**54.17**	5/20.83
Hot Metal Work	23	7/30.43	12/**52.17**	4/17.39
Surveying	24	9/37.50	12/**50.00**	3/12.50
Computerized Plasma/Mill	24	11/45.83	10/41.67	3/12.50
Hydraulics	23	12/**52.17**	9/39.13	2/8.70
Fence Construction	24	12/**50.00**	10/41.67	2/8.33
Concrete	24	10/41.67	12/**50.00**	2/8.33
Rope Work	23	15/**65.22**	7/30.43	1/4.35
Large Engines	24	14/**58.33**	9/37.50	1/4.17
Metal Lathe Work	24	12/**50.00**	11/45.83	1/4.17

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Comparison of the importance of units between traditionally (or university) prepared teachers and alternatively (or industry) certified teachers indicated very little difference. Mean differences between units did not exceed 1.5 hours on any of the units of instruction (see Table 24). The number of alternatively certified teachers is small (*n* = 6) in agricultural education in Idaho; and in this study, caution in comparing these groups is advised. *Small gas engines* had nearly equal distributions for both groups. University prepared teaches felt 17 units were important and six units were not important (see Table 25). Alternatively (or industry) certified respondents felt 21 units were important and only one unit was not important (see Table 26). University prepared respondents were divided in their ratings for *GMAW welding* and *handheld plasma cutting,* with bimodal distributions for both units. Alternatively certified teachers were divided (bimodal distributions) on the units of *oxy-acetylene welding*, *oxy-acetylene cutting*, *GTAW welding*, *GMAW welding*, and *large engines*. Numbers bolded in the table indicate 50% or more of the respondents are in that category. Complete frequency and percentage tables are located in Appendix 6: Supporting Data Tables.

Table 24

The Importance of Selected Units of Instruction in Introductory Agricultural Mechanics Courses Divided by Certification Pathway

	University Preparation			Alternatively Certified		
Unit	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*
Safety Practices	1	81	9.64/1.05	1	2	9.83/0.58
Measuring	2	77	9.03/1.41	2	6	9.36/0.92
Cleaning & Tool Storage	3	81	8.57/1.93	5	2	8.64/1.69
Tool Use & ID	4	75	8.41/1.61	6	8	8.58/2.28
HH Power Tools	5	81	7.67/2.08	3	2	8.67/1.83
Stationary Power Tools	6	79	7.53/2.35	3	4	8.67/1.37
Electrical Wiring	7	79	7.51/2.38	15	4	7.36/2.54
Student Projects	8	77	7.45/2.83	10	6	7.75/3.39
Principles of Electricity	9	81	7.41/2.39	11	2	7.67/2.54
Hand Tools	10	80	7.39/2.18	7	3	8.42/2.02
Plumbing and Pipe Fitting	11	81	7.36/1.87	21	2	6.67/2.31
Tool Reconditioning & Maintenance	12	81	7.23/2.06	17	2	7.25/2.42
Arc Welding	13	81	7.07/3.26	11	2	7.67/3.20
Bill of Materials	14	77	7.05/2.19	21	6	6.67/3.11
Cold Metal Work	15	81	6.83/2.27	20	2	6.73/2.94
OA Cutting	16	81	6.80/3.18	9	2	7.83/3.22
Careers in Ag Mech.	17	80	6.79/2.78	8	3	8.17/2.59
OA Welding	18	81	6.78/3.02	18	2	6.83/3.46
SAE	19	80	6.56/2.78	11	3	7.67/2.81
MIG Welding	20	80	6.55/3.52	23	3	6.64/3.67
FFA	21	80	6.36/2.80	14	3	7.42/2.78
Drafting & Sketching	22	81	6.06/2.61	16	2	7.33/2.10
HH Plasma Cutting	23	81	6.01/3.48	19	2	6.82/3.03
Wood Working	24	80	5.69/2.85	28	3	6.00/3.28
Small Gas Engines	25	81	5.33/3.16	29	2	5.73/3.38
Fasteners	26	79	5.20/2.61	25	4	6.36/2.66
Carpentry	27	80	5.09/2.91	27	3	6.17/2.44
Hot Metal Work	28	78	4.96/2.57	31	5	5.55/2.84
Painting	29	80	4.89/2.76	32	3	5.27/2.49
TIG Welding	30	79	4.81/3.42	24	4	6.55/3.67
Electrical Motors	31	78	4.58/2.85	26	5	6.25/2.26
Concrete	32	80	4.30/2.58	35	3	5.08/2.43
Surveying	33	80	4.29/2.78	36	3	5.00/2.05
Computerized Plasma or Mill Work	34	79	4.10/3.30	34	4	5.20/3.12
Hydraulics	35	79	3.68/2.84	30	4	5.60/3.69
Large Engines	36	77	3.43/2.86	32	6	5.27/3.66
Metal Lathe Work	37	77	3.36/2.63	38	6	4.36/3.38
Fence Construction	38	77	3.17/2.25	37	6	4.50/3.00
Rope Work	39	78	2.82/2.36	39	5	4.18/2.86

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important*"

Table 25

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by University Prepared Idaho Agricultural Education Instructors (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	81	1/1.23	4/4.94	76/**93.83**
Measuring	77	0/0.00	8/10.39	69/**89.61**
Shop Cleaning & Tool Storage	81	2/2.47	18/22.22	61/**75.31**
Tool Use & ID	75	1/1.33	14/18.67	60/**80.00**
Arc Welding (SMAW)	81	16/19.75	14/17.28	51/**62.96**
Student Projects	77	11/14.29	16/20.78	50/**64.94**
Electrical Wiring	79	8/10.13	21/26.58	50/**63.29**
Stationary Power Tools	79	6/7.59	25/31.65	48/**60.76**
OA Cutting	81	16/19.75	18/22.22	47/**58.02**
Principles of Electricity	81	9/11.11	26/32.10	46/**56.79**
HH Power Tools	81	3/3.70	32/39.51	46/**56.79**
MIG Welding (GMAW)	80	20/25.00	16/20.00	44/**55.00**
Tool Reconditioning & Maintenance	81	5/6.17	32/39.51	44/**54.32**
OA Welding	81	13/16.05	24/29.63	44/**54.32**
Plumbing and Pipe Fitting	81	4/4.94	34/41.98	43/**53.09**
Careers	80	12/15.00	27/33.75	41/**51.25**
Hand Tools	80	5/6.25	35/43.75	40/**50.00**
Bill of Materials	77	4/5.19	35/45.45	38/49.35
HH Plasma Cutting	81	24/29.63	21/25.93	36/44.44
Cold Metal Work	81	8/9.88	40/49.38	33/40.74
SAE	80	14/17.50	34/42.50	32/40.00
FFA	80	15/18.75	34/42.50	31/38.75
Wood Working	80	18/22.50	36/45.00	26/32.50
Drafting & Sketching	81	13/16.05	42/**51.85**	26/32.10
Small Gas Engines	81	29/35.80	26/32.10	26/32.10
TIG Welding (GTAW)	79	34/43.04	25/31.65	20/25.32
Carpentry	80	25/31.25	36/45.00	19/23.75
Computerized Plasma/Mill	79	42/**53.16**	20/25.32	17/21.52
Hot Metal Work	78	22/28.21	40/**51.28**	16/20.51
Fasteners	79	21/26.58	43/**54.43**	15/18.99
Painting	80	27/33.75	38/47.50	15/18.75
Electrical Motors	78	31/39.74	34/43.59	13/16.67
Surveying	80	34/42.50	36/45.00	10/12.50
Hydraulics	79	44/**55.70**	26/32.91	9/11.39
Large Engines	77	47/**61.04**	22/28.57	8/10.39
Metal Lathe Work	77	47/**61.04**	22/28.57	8/10.39
Concrete	80	33/41.25	39/48.75	8/10.00
Rope Work	78	52/**66.67**	22/28.21	4/5.13
Fence Construction	77	45/**58.44**	30/38.96	2/2.60

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Table 26

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Alternatively Certified Idaho Agricultural Education Instructors (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	12	0/0.00	0/0.00	12/**100.00**
Measuring	11	0/0.00	1/9.09	10/**90.91**
Tool Use & ID	12	1/8.33	1/8.33	10/**83.33**
HH Power Tools	12	0/0.00	2/16.67	10/**83.33**
Stationary Power Tools	12	0/0.00	2/16.67	10/**83.33**
Careers	12	1/8.33	2/16.67	9/**75.00**
OA Cutting	12	2/16.67	1/8.33	9/**75.00**
Hand Tools	12	0/0.00	3/25.00	9/**75.00**
Shop Cleaning & Tool Storage	11	0/0.00	3/27.27	8/**72.73**
Principles of Electricity	12	1/8.33	3/25.00	8/**66.67**
Arc Welding (SMAW)	12	2/16.67	2/16.67	8/**66.67**
Student Projects	12	2/16.67	2/16.67	8/**66.67**
SAE	12	1/8.33	4/33.33	7/**58.33**
Drafting & Sketching	12	1/8.33	4/33.33	7/**58.33**
FFA	12	1/8.33	4/33.33	7/**58.33**
OA Welding	12	3/25.00	2/16.67	7/**58.33**
Electrical Wiring	11	1/9.09	4/36.36	6/**54.55**
TIG Welding (GTAW)	11	3/27.27	2/18.18	6/**54.55**
MIG Welding (GMAW)	11	3/27.27	2/18.18	6/**54.55**
Tool Reconditioning & Maintenance	12	1/8.33	5/41.67	6/**50.00**
Bill of Materials	12	2/16.67	4/33.33	6/**50.00**
Cold Metal Work	11	2/18.18	4/36.36	5/45.45
HH Plasma Cutting	11	2/18.18	4/36.36	5/45.45
Plumbing and Pipe Fitting	12	1/8.33	6/**50.00**	5/41.67
Wood Working	12	3/25.00	4/33.33	5/41.67
Hydraulics	10	3/30.00	3/30.00	4/40.00
Hot Metal Work	11	4/36.36	3/27.27	4/36.36
Fasteners	11	1/9.09	6/**54.55**	4/36.36
Small Gas Engines	11	3/27.27	4/36.36	4/36.36
Large Engines	11	4/36.36	3/27.27	4/36.36
Carpentry	12	1/8.33	7/**58.33**	4/33.33
Electrical Motors	12	1/8.33	7/**58.33**	4/33.33
Computerized Plasma/Mill	10	3/30.00	4/40.00	3/30.00
Painting	11	3/27.27	5/45.45	3/27.27
Metal Lathe Work	11	5/45.45	3/27.27	3/27.27
Fence Construction	12	5/41.67	5/41.67	2/16.67
Concrete	12	2/16.67	8/**66.67**	2/16.67
Rope Work	11	6/**54.55**	4/36.36	1/9.09
Surveying	12	2/16.67	9/**75.00**	1/8.33

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Comparison of the importance of units between Agricultural Science and Technology Teachers with and without an additional science certification revealed little difference between the two groups (see Table 27). Mean differences between units did not exceed 1.5 for any of the units of instruction. Science certified teachers reported 15 units were important and six units were not important (see Table 28). Non-science certified respondents felt 20 units were important and five units were not important (see Table 29). None of the distributions for any units were bi-modal by more than two teachers. Numbers bolded in the table indicate 50% or more of the respondents are in that category. Complete frequency and percentage tables are located in Appendix 6: Supporting Data Tables.

Table 27

The Importance of Selected Units of Instruction in Introductory Agricultural Mechanics Courses Divided by Agricultural Science and Technology Teachers with and without Science Certification

	Ag & Science			Ag Only		
Unit	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*
Safety Practices in the Shop	1	49	9.73/0.73	1	46	9.61/1.22
Measuring	2	46	9.00/1.19	2	44	9.18/1.50
Shop Cleaning & Tool Storage	3	49	8.45/2.03	3	45	8.78/1.72
Tool Use & ID	4	46	8.26/1.71	4	43	8.70/1.68
HH Power Tools	5	49	7.67/1.84	6	46	7.89/2.51
Electrical Wiring	6	48	7.52/2.40	10	44	7.45/2.41
Plumbing & Pipe Fitting	7	49	7.51/1.71	15	46	7.13/2.19
Student Projects	8	45	7.49/2.75	8	46	7.65/3.05
Hand Tools	9	48	7.40/2.02	9	46	7.63/2.55
Stationary Power Tools	10	47	7.30/2.28	5	46	8.04/2.32
Principles of Electricity	11	49	7.22/2.60	7	46	7.67/2.17
Careers	12	48	7.17/2.54	20	46	6.59/3.07
Tool Reconditioning & Maintenance	13	49	7.16/1.99	11	46	7.43/2.24
Arc Welding (SMAW)	14	49	7.04/3.27	12	46	7.37/3.26
Bill of Materials	15	46	6.96/2.36	16	44	7.11/2.32
SAE	16	49	6.76/2.72	20	44	6.59/2.90
OA Welding	16	49	6.76/2.99	18	46	6.89/3.16
Cold Metal Work	18	49	6.59/2.44	17	45	7.07/2.18
OA Cutting	18	49	6.59/3.23	12	46	7.37/3.21
FFA	20	48	6.33/2.96	22	45	6.56/2.76
MIG Welding (GMAW)	21	48	6.15/3.60	14	45	7.33/3.25
HH Plasma Arc Cutting	22	49	6.14/3.37	23	45	6.42/3.47
Drafting & Sketching	23	49	5.82/2.37	19	46	6.83/2.76
Fasteners	24	48	5.56/2.70	28	44	5.20/2.78
Small Gas Engines	25	49	5.51/3.09	30	44	5.11/3.27
Wood Working	26	48	5.35/2.70	24	46	6.39/3.15
Carpentry	27	48	5.06/2.82	26	46	5.54/3.05
Hot Metal Work	28	48	4.85/2.54	27	43	5.35/2.71
Painting, Brush & Spray Gun	29	48	4.75/2.64	28	44	5.20/2.83
TIG Welding (GTAW)	30	47	4.55/3.34	25	45	5.69/3.59
Electrical Motors	31	47	4.45/2.94	31	44	5.07/2.66
Concrete	32	48	4.27/2.56	32	46	4.63/2.78
Surveying	33	48	4.19/2.55	33	45	4.62/2.84
Computerized Plasma or Mill Work	34	47	4.13/3.23	34	44	4.57/3.47
Hydraulics	35	47	3.72/2.96	35	43	4.21/2.97
Large Engines	36	47	3.38/2.89	37	42	3.90/3.14
Metal Lathe Work	37	46	3.15/2.44	36	44	3.93/3.11
Fence Construction	38	46	3.07/2.19	38	44	3.61/2.60
Rope Work	39	47	2.98/2.37	39	43	2.98/2.54

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important*"

Table 28

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Science Certified Idaho Agricultural Education Instructors (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	50	0/0.00	2/4.00	48/**96.00**
Measuring	47	0/0.00	4/8.51	43/**91.49**
Shop Cleaning & Tool Storage	50	2/4.00	10/20.00	38/**76.00**
Tool Use & ID	47	1/2.13	10/21.28	36/**76.60**
Electrical Wiring	49	6/12.24	11/22.45	32/**65.31**
Arc Welding (SMAW)	50	11/22.00	9/18.00	30/**60.00**
Student Projects	46	7/15.22	10/21.74	29/**63.04**
Plumbing and Pipe Fitting	50	1/2.00	20/40.00	29/**58.00**
Principles of Electricity	50	8/16.00	14/28.00	28/**56.00**
Careers	49	5/10.20	17/34.69	27/**55.10**
Stationary Power Tools	48	4/8.33	18/37.50	26/54.17
Tool Reconditioning & Maintenance	50	3/6.00	21/42.00	26/**52.00**
OA Welding	50	8/16.00	16/32.00	26/**52.00**
OA Cutting	50	11/22.00	13/26.00	26/**52.00**
HH Power Tools	50	0/0.00	25/**50.00**	25/**50.00**
MIG Welding (GMAW)	49	15/30.61	10/20.41	24/48.98
Bill of Materials	47	3/6.38	22/46.81	22/46.81
Hand Tools	49	2/4.08	25/**51.02**	22/44.90
SAE	50	7/14.00	21/42.00	22/44.00
HH Plasma Cutting	50	14/28.00	15/30.00	21/42.00
FFA	49	9/18.37	20/40.82	20/40.82
Cold Metal Work	50	7/14.00	26/**52.00**	17/34.00
Small Gas Engines	50	16/32.00	18/36.00	16/32.00
Drafting & Sketching	50	7/14.00	30/**60.00**	13/26.00
Wood Working	49	12/24.49	25/**51.02**	12/24.49
Fasteners	49	11/22.45	26/**53.06**	12/24.49
TIG Welding (GTAW)	48	23/47.92	15/31.25	10/20.83
Computerized Plasma/Mill	48	24/**50.00**	14/29.17	10/20.83
Hot Metal Work	49	15/30.61	24/48.98	10/20.41
Electrical Motors	48	21/43.75	18/37.50	9/18.75
Painting	49	17/34.69	23/46.94	9/18.37
Carpentry	49	15/30.61	25/**51.02**	9/18.37
Hydraulics	48	26/**54.17**	15/31.25	7/14.58
Metal Lathe Work	47	30/**63.83**	12/25.53	5/10.64
Large Engines	48	30/**62.50**	13/27.08	5/10.42
Concrete	49	18/36.73	26/**53.06**	5/10.20
Surveying	49	20/40.82	24/48.98	5/10.20
Rope Work	48	31/**64.58**	15/31.25	2/4.17
Fence Construction	47	28/**59.57**	18/38.30	1/2.13

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Table 29

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by non-Science Certified Idaho Agricultural Education Instructors (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	46	1/2.17	2/4.35	43/**93.48**
Measuring	44	0/0.00	5/11.36	39/**88.64**
Tool Use & ID	43	1/2.33	5/11.63	37/**86.05**
Shop Cleaning & Tool Storage	45	0/0.00	11/24.44	34/**75.56**
Stationary Power Tools	46	3/6.52	9/19.57	34/**73.91**
HH Power Tools	46	4/8.70	9/19.57	33/**71.74**
OA Cutting	46	8/17.39	6/13.04	32/**69.57**
Student Projects	46	6/13.04	8/17.39	32/**69.57**
Arc Welding (SMAW)	46	8/17.39	7/15.22	31/**67.39**
MIG Welding (GMAW)	45	8/17.78	8/17.78	29/**64.44**
Hand Tools	46	4/8.70	13/28.26	29/**63.04**
Principles of Electricity	46	2/4.35	16/34.78	28/**60.87**
Tool Reconditioning & Maintenance	46	3/6.52	16/34.78	27/**58.70**
OA Welding	46	9/19.57	10/21.74	27/**58.70**
Electrical Wiring	44	3/6.82	15/34.09	26/**59.09**
Bill of Materials	44	3/6.82	17/38.64	24/**54.55**
Careers	46	9/19.57	13/28.26	24/**52.17**
Cold Metal Work	45	3/6.67	19/42.22	23/**51.11**
HH Plasma Cutting	45	12/26.67	10/22.22	23/**51.11**
Drafting & Sketching	46	7/15.22	16/34.78	23/**50.00**
Plumbing and Pipe Fitting	46	4/8.70	20/43.48	22/47.83
Wood Working	46	9/19.57	15/32.61	22/47.83
FFA	45	8/17.78	18/40.00	19/42.22
SAE	44	8/18.18	18/40.91	18/40.91
TIG Welding (GTAW)	45	15/33.33	12/26.67	18/40.00
Carpentry	46	12/26.09	18/39.13	16/34.78
Small Gas Engines	44	17/38.64	13/29.55	14/31.82
Hot Metal Work	43	11/25.58	20/46.51	12/27.91
Computerized Plasma/Mill	44	22/**50.00**	10/22.73	12/27.27
Painting	44	13/29.55	20/45.45	11/25.00
Fasteners	44	12/27.27	23/**52.27**	9/20.45
Electrical Motors	44	12/27.27	24/**54.55**	8/18.18
Large Engines	42	23/54.76	12/28.57	7/16.67
Metal Lathe Work	44	24/**54.55**	13/29.55	7/15.91
Concrete	46	18/39.13	21/45.65	7/15.22
Hydraulics	43	21/48.84	16/37.21	6/13.95
Surveying	45	16/35.56	23/**51.11**	6/13.33
Rope Work	43	29/**67.44**	11/25.58	3/6.98
Fence Construction	44	23/**52.27**	18/40.91	3/6.82

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Comparisons of the importance of units across age groups are found in Table 30. The top four units ranked by importance were the same in all four experience groups, with their order changing some between experience groups. An additional three units, for a total of seven of the top 10 units in each experience group, were ranked similarly. A mean difference of more than 1.5 ranks was found for only one of the 10 highest rated units and between only two groups. Teachers with 11 to 20 years rated electrical wiring (M_{diff} = 1.56) higher than teachers with 21 or more years of experience. Complete frequency and percentage tables are located in Appendix 6: Supporting Data Tables.

Mean differences exceeding two rankings were found for the units of *carpentry* (M_{diff} = 2.55), *fasteners* (M_{diff} = 2.54), *SAE* (M_{diff} = 2.45), and *concrete* (M_{diff} = 2.42), *surveying* (M_{diff} = 2.42), and *fence construction* (M_{diff} = 2.17). Comparison between experience groups found that 26 mean importance ratings differed by more than 1 rank. Differences between teachers with one to five years of experience and teachers with six to 10 years of experience were the largest for 19 of the 39 mean differences (see Table 30).

Bimodal distributions were found for GMAW welding in both the one to five years of experience group and the six to 10 years of experience group. Respondents in the six to 10 years of experience group also reported bimodal distributions GTAW welding and handheld plasma cutting. Respondents in the 11 to 20 years of experience group were divided on small gas engines, with 40.0% and 45.0% of respondents rating the unit as not important and important respectively. Teachers in the one to five years of experience group felt 21 units were important and three units were not important (see Table 31). Teachers in the six to 10 years of experience group felt 15 units were important and 12 units were not important (see Table 32). Teachers in the 11 to 20 years of experience group felt 15 units were important and seven units were not important (see Table 33). Teachers with more than 20 years of experience felt 18 units were important and five units were not important (see Table 34). Numbers bolded in the table indicate 50% or more of the respondents are in that category.

Table 30

The Importance of Selected Units of Instruction in Introduction to Agricultural Mechanics (IAM) as Rated by Instructors Grouped by the Number of Years Teaching IAM

	1-5 Years			6-10 Years			11-20 Years			Over 20 Years		
	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*
Safety Practices	1	30	9.60/1.38	1	16	9.63/1.03	1	20	9.75/0.72	1	19	9.74/0.65
Measuring	2	28	9.54/0.84	3	16	8.31/1.86	2	19	9.16/1.34	2	17	9.12/1.36
Tool Use & Identification	3	28	8.68/1.93	4	16	8.06/1.98	4	20	8.55/1.40	3	15	8.53/0.83
Cleaning & Tool Storage	4	29	8.38/2.29	2	16	9.06/1.48	3	20	9.05/1.15	4	19	8.11/2.31
HH Power Tools	5	30	8.33/2.09	7	16	7.44/2.45	6	20	7.85/2.08	9	19	7.53/1.90
Hand Tools	6	30	8.23/2.16	9	16	7.13/2.50	10	20	7.35/2.23	12	18	7.33/2.14
Stationary Power Tools	6	30	8.23/2.10	13	14	6.93/2.84	8	20	7.65/2.50	7	19	7.68/2.16
Principles of Electricity	8	30	8.07/1.76	10	16	7.06/2.74	7	20	7.70/2.23	18	19	6.58/2.93
Individual & Team Projects	9	29	7.79/2.70	5	15	7.73/3.24	9	19	7.47/3.32	11	18	7.39/2.79
Electrical Wiring	9	28	7.79/2.17	11	16	7.00/2.73	5	20	8.30/1.72	17	19	6.74/2.83
SAE	11	29	7.76/2.59	22	16	5.31/3.03	16	20	6.75/2.59	22	19	5.89/2.69
Tool Reconditioning & Maintenance	12	30	7.57/2.16	12	16	6.94/1.88	14	20	6.95/2.40	9	19	7.53/1.74
Plumbing & Pipe Fitting	12	30	7.57/1.57	6	16	7.50/2.03	13	20	7.00/2.41	7	19	7.68/1.38
Careers	14	30	7.20/2.87	14	16	6.88/2.68	12	20	7.10/3.09	20	18	6.33/2.52
Drafting & Sketching	15	30	7.00/2.51	25	16	5.06/2.74	19	20	6.70/2.39	25	19	5.26/2.81
Cold Metal Work	15	30	7.00/2.52	17	16	6.38/2.39	20	20	6.55/2.70	13	19	7.21/1.72
Bill of Materials	17	28	6.96/2.13	19	16	5.88/2.90	11	17	7.29/2.09	13	19	7.21/1.72
OA Cutting	18	30	6.70/3.53	14	16	6.88/3.56	16	20	6.75/3.31	16	19	6.84/2.87
FFA	19	29	6.66/2.98	20	16	5.81/3.08	22	20	6.15/3.18	21	18	6.11/2.08
Arc Welding (SMAW)	20	30	6.47/3.77	8	16	7.25/3.19	16	20	6.75/3.39	5	19	7.84/2.77
Carpentry	21	30	6.43/3.05	28	16	3.88/2.22	29	20	5.10/3.16	28	18	4.89/3.01
OA Welding	22	30	6.37/3.29	16	16	6.44/3.65	15	20	6.85/2.98	15	19	7.11/2.56
MIG Welding (GMAW)	23	29	6.28/3.77	18	16	6.06/3.73	24	20	5.85/3.59	6	18	7.78/2.88
Wood Working	24	30	6.20/3.01	21	16	5.44/2.87	23	20	5.95/3.15	23	18	5.83/2.94
HH Plasma Arc Cutting	25	29	6.17/3.43	24	16	5.13/3.88	25	20	5.75/3.37	19	18	6.56/3.37
Fasteners	26	29	5.69/3.03	30	16	3.81/2.83	21	20	6.35/2.48	24	18	5.39/1.91
Electrical Motors	27	29	5.41/2.71	28	16	3.88/2.55	31	20	4.80/3.35	34	16	3.75/2.54
Painting	28	29	5.31/2.80	31	16	3.75/2.79	26	20	5.70/2.79	29	18	4.61/2.25
Concrete	29	30	5.23/2.74	34	16	2.81/2.23	32	20	4.40/2.46	32	18	4.22/2.46
Hot Metal Work	30	29	5.14/2.83	27	16	4.69/2.44	28	19	5.37/2.73	33	17	4.00/2.55

Table Continues

Table Continued

	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*	Rank	*n*	*M/SD*
TIG Welding (GTAW)	31	29	4.93/3.42	26	16	4.88/4.06	34	20	4.00/3.39	26	17	5.24/3.15
Computerized Plasma/Mill Work	31	28	4.93/3.46	32	16	3.31/3.28	35	20	3.80/3.33	30	17	4.47/3.66
Small Gas Engines	33	28	4.79/3.22	23	16	5.19/3.51	27	20	5.60/3.56	27	19	5.11/2.83
Surveying	34	29	4.48/2.61	37	16	2.63/2.13	30	20	5.05/2.72	31	18	4.33/2.70
Hydraulics	35	28	4.32/3.10	33	16	3.06/2.62	33	20	4.05/3.33	35	17	3.12/2.67
Large Engines	36	27	4.15/3.34	35	15	2.80/2.27	37	20	3.55/3.30	35	17	3.12/2.80
Fence Construction	37	28	4.11/2.60	39	16	1.94/1.29	38	20	2.95/1.85	38	16	2.56/2.22
Metal Lathe Work	38	29	3.93/3.06	36	15	2.73/2.58	36	20	3.60/3.12	37	16	3.06/2.54
Rope Work	39	27	3.56/2.53	38	16	2.31/2.06	39	20	2.70/2.47	39	18	2.44/2.06

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important*"

Table 31

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors with 1 - 5 years of experience teaching IAM (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	30	1/3.33	1/3.33	28/**93.33**
Measuring	28	0/0.00	1/3.57	27/**96.43**
Tool Use & ID	28	1/3.57	4/14.29	23/**82.14**
HH Power Tools	30	1/3.33	7/23.33	22/**73.33**
Stationary Power Tools	30	2/6.67	6/20.00	22/**73.33**
Shop Cleaning & Tool Storage	29	1/3.45	8/27.59	20/**68.97**
Principles of Electricity	30	0/0.00	10/33.33	20/**66.67**
Hand Tools	30	1/3.33	9/30.00	20/**66.67**
SAE	29	2/6.90	8/27.59	19/**65.52**
Tool Reconditioning & Maintenance	30	2/6.67	9/30.00	19/**63.33**
Careers	30	4/13.33	7/23.33	19/**63.33**
Electrical Wiring	28	1/3.57	10/35.71	17/**60.71**
Student Projects	29	2/6.90	10/34.48	17/**58.62**
Cold Metal Work	30	5/16.67	8/26.67	17/**56.67**
OA Cutting	30	7/23.33	6/20.00	17/**56.67**
Plumbing and Pipe Fitting	30	0/0.00	14/46.67	16/**53.33**
Arc Welding (SMAW)	30	9/30.00	5/16.67	16/**53.33**
Bill of Materials	28	2/7.14	11/39.29	15/**53.57**
MIG Welding (GMAW)	29	9/31.03	5/17.24	15/**51.72**
Drafting & Sketching	30	3/10.00	12/40.00	15/**50.00**
OA Welding	30	7/23.33	8/26.67	15/**50.00**
FFA	29	5/17.24	10/34.48	14/48.28
HH Plasma Cutting	29	8/27.59	8/27.59	13/44.83
Wood Working	30	7/23.33	10/33.33	13/43.33
Carpentry	30	5/16.67	13/43.33	12/40.00
TIG Welding (GTAW)	29	12/41.38	8/27.59	9/31.03
Small Gas Engines	28	11/39.29	9/32.14	8/28.57
Computerized Plasma/Mill	28	12/42.86	8/28.57	8/28.57
Hot Metal Work	29	10/34.48	11/37.93	8/27.59
Fasteners	29	8/27.59	13/44.83	8/27.59
Painting	29	8/27.59	13/44.83	8/27.59
Electrical Motors	29	6/20.69	16/**55.17**	7/24.14
Concrete	30	8/26.67	16/**53.33**	6/20.00
Large Engines	27	14/**51.85**	8/29.63	5/18.52
Hydraulics	28	13/46.43	10/35.71	5/17.86
Metal Lathe Work	29	15/**51.72**	9/31.03	5/17.24
Surveying	29	10/34.48	16/**55.17**	3/10.34
Rope Work	27	15/**55.56**	10/37.04	2/7.41
Fence Construction	28	12/42.86	14/**50.00**	2/7.14

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Table 32

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors with 6 - 10 years of experience teaching IAM (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Shop Cleaning & Tool Storage	16	0/0.00	2/12.50	14/**87.50**
Safety Practices in the Shop	16	0/0.00	2/12.50	14/**87.50**
Measuring	16	0/0.00	4/25.00	12/**75.00**
Student Projects	15	3/20.00	1/6.67	11/**73.33**
Tool Use & ID	16	0/0.00	6/37.50	10/**62.50**
OA Cutting	16	4/25.00	2/12.50	10/**62.50**
Arc Welding (SMAW)	16	3/18.75	3/18.75	10/**62.50**
Careers	16	2/12.50	5/31.25	9/**56.25**
OA Welding	16	4/25.00	3/18.75	9/**56.25**
HH Power Tools	16	1/6.25	6/37.50	9/**56.25**
Stationary Power Tools	14	2/14.29	4/28.57	8/**57.14**
Plumbing and Pipe Fitting	16	1/6.25	7/43.75	8/**50.00**
Electrical Wiring	16	3/18.75	5/31.25	8/**50.00**
MIG Welding (GMAW)	16	5/31.25	3/18.75	8/**50.00**
Hand Tools	16	1/6.25	7/43.75	8/**50.00**
Principles of Electricity	16	3/18.75	6/37.50	7/43.75
Tool Reconditioning & Maintenance	16	0/0.00	10/**62.50**	6/37.50
Small Gas Engines	16	7/43.75	3/18.75	6/37.50
TIG Welding (GTAW)	16	8/**50.00**	2/12.50	6/37.50
HH Plasma Cutting	16	7/43.75	3/18.75	6/37.50
Wood Working	16	3/18.75	8/**50.00**	5/31.25
Bill of Materials	16	3/18.75	8/**50.00**	5/31.25
Cold Metal Work	16	2/12.50	9/**56.25**	5/31.25
SAE	16	6/37.50	6/37.50	4/25.00
FFA	16	4/25.00	8/**50.00**	4/25.00
Drafting & Sketching	16	5/31.25	8/**50.00**	3/18.75
Computerized Plasma/Mill	16	11/**68.75**	2/12.50	3/18.75
Hot Metal Work	16	5/31.25	9/**56.25**	2/12.50
Painting	16	9/**56.25**	5/31.25	2/12.50
Electrical Motors	16	9/**56.25**	5/31.25	2/12.50
Hydraulics	16	10/**62.50**	4/25.00	2/12.50
Large Engines	15	10/**66.67**	4/26.67	1/6.67
Metal Lathe Work	15	10/**66.67**	4/26.67	1/6.67
Fasteners	16	8/**50.00**	7/43.75	1/6.25
Carpentry	16	6/37.50	9/56.25	1/6.25
Rope Work	16	12/**75.00**	4/25.00	0/0.00
Fence Construction	16	12/**75.00**	4/25.00	0/0.00
Concrete	16	11/**68.75**	5/31.25	0/0.00
Surveying	16	11/**68.75**	5/31.25	0/0.00

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Table 33

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated Idaho Agricultural Education Instructors with 11 to 20 Years of experience teaching IAM (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	20	0/0.00	1/5.00	19/**95.00**
Measuring	19	0/0.00	2/10.53	17/**89.47**
Shop Cleaning & Tool Storage	20	0/0.00	3/15.00	17/**85.00**
Tool Use & ID	20	0/0.00	3/15.00	17/**85.00**
Electrical Wiring	20	1/5.00	3/15.00	16/**80.00**
Student Projects	19	4/21.05	2/10.53	13/**68.42**
OA Welding	20	3/15.00	4/20.00	13/**65.00**
OA Cutting	20	4/20.00	3/15.00	13/**65.00**
Arc Welding (SMAW)	20	4/20.00	3/15.00	13/**65.00**
Principles of Electricity	20	2/10.00	6/30.00	12/**60.00**
Careers	20	4/20.00	4/20.00	12/**60.00**
Stationary Power Tools	20	1/5.00	7/35.00	12/**60.00**
Tool Reconditioning & Maintenance	20	2/10.00	7/35.00	11/**55.00**
HH Power Tools	20	1/5.00	8/40.00	11/**55.00**
Plumbing & Pipe Fitting	20	3/15.00	7/35.00	10/**50.00**
Small Gas Engines	20	8/40.00	3/15.00	9/45.00
MIG Welding (GMAW)	20	6/30.00	5/25.00	9/45.00
Hand Tools	20	2/10.00	9/45.00	9/45.00
FFA	20	5/25.00	7/35.00	8/40.00
Fasteners	20	2/10.00	10/**50.00**	8/40.00
HH Plasma Cutting	20	6/30.00	6/30.00	8/40.00
Bill of Materials	17	0/0.00	10/**58.82**	7/41.18
SAE	20	3/15.00	10/**50.00**	7/35.00
Drafting & Sketching	20	1/5.00	12/**60.00**	7/35.00
Wood Working	20	5/25.00	8/40.00	7/35.00
Painting	20	4/20.00	10/**50.00**	6/30.00
Hot Metal Work	19	5/26.32	9/47.37	5/26.32
Cold Metal Work	20	3/15.00	12/**60.00**	5/25.00
Carpentry	20	8/40.00	7/35.00	5/25.00
Electrical Motors	20	9/45.00	6/30.00	5/25.00
Hydraulics	20	11/**55.00**	4/20.00	5/25.00
Computerized Plasma/Mill	20	11/**55.00**	4/20.00	5/25.00
TIG Welding (GTAW)	20	11/**55.00**	5/25.00	4/20.00
Large Engines	20	13/**65.00**	3/15.00	4/20.00
Metal Lathe Work	20	13/**65.0**0	3/15.00	4/20.00
Rope Work	20	14/**70.00**	4/20.00	2/10.00
Concrete	20	8/40.00	10/**50.00**	2/10.00
Surveying	20	5/25.00	13/**65.00**	2/10.00
Fence Construction	20	12/**60.00**	8/40.00	0/0.00

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Table 34

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors with over 20 years of experience teaching IAM (f/%)

Units	*n*	1 – 3 Not Important	4 -7 Neutral	8 -10 Important
Safety Practices in the Shop	19	0/0.00	0/0.00	19/**100.00**
Measuring	17	0/0.00	1/5.88	16/**94.12**
Tool Use & ID	15	0/0.00	1/6.67	14/**93.33**
Student Projects	18	3/16.67	1/5.56	14/**77.78**
Arc Welding (SMAW)	19	2/10.53	3/15.79	14/**73.68**
MIG Welding (GMAW)	18	2/11.11	3/16.67	13/**72.22**
Shop Cleaning & Tool Storage	19	1/5.26	5/26.32	13/**68.42**
Plumbing & Pipe Fitting	19	0/0.00	7/36.84	12/**63.16**
Tool Reconditioning & Maintenance	19	1/5.26	7/36.84	11/**57.89**
Stationary Power Tools	19	1/5.26	7/36.84	11/**57.89**
HH Plasma Cutting	18	4/22.22	4/22.22	10/**55.56**
Hand Tools	18	1/5.56	7/38.89	10/**55.56**
Bill of Materials	19	0/0.00	9/47.37	10/**52.63**
Cold Metal Work	19	0/0.00	9/47.37	10/**52.63**
Principles of Electricity	19	4/21.05	5/26.32	10/**52.63**
OA Welding	19	2/10.53	7/36.84	10/**52.63**
OA Cutting	19	3/15.79	6/31.58	10/**52.63**
HH Power Tools	19	0/0.00	9/47.37	10/**52.63**
Electrical Wiring	19	3/15.79	7/36.84	9/47.37
Wood Working	18	3/16.67	8/44.44	7/38.89
Careers	18	2/11.11	10/**55.56**	6/33.33
Computerized Plasma/Mill	17	8/47.06	4/23.53	5/29.41
FFA	18	2/11.11	11/**61.11**	5/27.78
SAE	19	3/15.79	11/**57.89**	5/26.32
Drafting & Sketching	19	5/26.32	9/47.37	5/26.32
TIG Welding (GTAW)	17	6/35.29	7/41.18	4/23.53
Carpentry	18	6/33.33	8/44.44	4/22.22
Small Gas Engines	19	6/31.58	9/47.37	4/21.05
Surveying	18	7/38.89	8/44.44	3/16.67
Hot Metal Work	17	7/41.18	8/47.06	2/11.76
Fasteners	18	2/11.11	14/**77.78**	2/11.11
Electrical Motors	16	7/43.75	8/**50.00**	1/6.25
Metal Lathe Work	16	9/**56.25**	6/37.50	1/6.25
Large Engines	17	10/**58.82**	6/35.29	1/5.88
Concrete	18	6/33.33	11/**61.11**	1/5.56
Painting	18	6/33.33	11/**61.11**	1/5.56
Rope Work	18	12/**66.67**	6/33.33	0/0.00
Fence Construction	16	11/**68.75**	5/31.25	0/0.00
Hydraulics	17	10/**58.82**	7/41.18	0/0.00

Note. HH = Hand Held, OA = Oxy-Acetylene; Ranked on a 10-point scale from 10 = "*Very Important*" to 1 = "*Not Very Important.*" Bolded numbers represent majority opinions.

Kendall tau correlations were used to describe the relationship between the unit's reported importance and the number of hours of instruction devoted to the unit (see Table 35). A very strong negative relationship (Davis, 1971) was found for the unit *hydraulics* (τ = -.734, n = 9), indicating that teachers who ranked it higher in importance tended to teach the unit for a shorter duration. A substantial positive relationship was found for *woodworking* (τ = .497, n = 37), indicating that importance and time devoted to the unit tended to increase and decrease together. Moderate positive relationships were found for fence construction (τ = .435, n = 8), *hot metalwork* (τ = .426, n = 29), *student projects* (τ = .419, n = 45), *carpentry* (τ = .389, n = 26), *drafting and sketching* (τ = .382, n = 44), *electrical wiring* (τ = .345, n = 51), and *SAE* (τ = .321, n = 56), indicating teachers who reported the units as more important also taught them longer than teachers who reported them being less important.

Table 35

Kendall's Tau B Correlations between Teachers Importance Rating for the Unit and the Time Devoted to Teaching the Unit (Standardized Hours of Instruction)

Units	*n*	Correlation Coefficient	Strength of Relationship*
Wood Working	37	0.497	Substantial
Fence Construction	8	0.435	Moderate
Hot Metal Work	29	0.426	Moderate
Student Projects	45	0.419	Moderate
Carpentry	26	0.389	Moderate
Drafting and Sketching	44	0.382	Moderate
Electrical Wiring	51	0.345	Moderate
SAE	46	0.321	Moderate
TIG Welding	16	0.283	Low
Tool Reconditioning & Maintenance	54	0.282	Low
Rope Work	11	0.265	Low
Painting	40	0.252	Low
Measuring	56	0.244	Low
Electrical Motors	23	0.212	Low
Small Gas Engines	29	0.198	Low
Safety Practices	60	0.175	Low
Cold Metal Work	51	0.174	Low
Careers	49	0.170	Low
OA Cutting	41	0.147	Low
Cleaning & Tool Storage	63	0.145	Low
Principles of Electricity	54	0.118	Low
Bill of Materials	45	0.116	Low
Arc Welding	40	0.110	Low
FFA	43	0.093	Low
OA Welding	44	0.087	Negligible
HH Plasma Arc Cutting	29	0.083	Negligible
Concrete	25	0.077	Negligible
Hand Tools	54	0.077	Negligible
Plumbing & Pipe Fitting	53	0.072	Negligible
MIG Welding	30	0.069	Negligible
HH Power Tools	56	0.059	Negligible
Surveying	22	0.036	Negligible
Stationary Power Tools	56	0.033	Negligible
Tool Use & Identification	54	0.032	Negligible
Metal Lathe Work	10	0.000	Negligible
Fasteners	40	-0.086	Negligible
Computerized Plasma or Mill Work	13	-0.098	Low
Large Engines	8	-0.160	Low
Hydraulics	9	-0.734	Very Strong

Note. *Relationship strength described using Davis (1971) conventions, .01–.09 = negligible, .10–.29 = low, .30–.49 = moderate, .50–.69 = substantial, .70–.99 = very high, 1.0 = perfect.

Research Question 3.

The purpose of Research Question 3 was to determine the perceptions Idaho Agricultural Science and Technology Teachers have regarding integration of STEM into their introductory agricultural mechanics courses. Three constructs were used to determine teachers' perceptions of STEM integration, the IAM Context construct, the STEM facilities construct, and the Benefits of STEM Integration construct. In relation to IAM Context construct (see Table 36), a summated mean for the six STEM sub-disciplines was calculated. Overall, teachers reported a mean score of 4.45 on a six-point scale or a "*slightly agree*." Complete frequency and distribution tables are located in Appendix 6. Overall, highest agreement was found for mathematics (M = 5.11), and lowest agreement was for English (M = 4.00).

Table 36

Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines

	n	Disagree (*f*/%)	Agree (*f*/%)	Mean	*SD*
Science	83	13/8.43	46/84.34	4.45	1.17
Technology	90	11/8.89	55/87.78	4.53	1.10
Engineering	92	8/4.35	53/91.30	4.61	0.96
Mathematics	92	2/1.09	76/97.83	5.11	0.78
English	93	24/11.83	31/74.19	4.00	1.08
Communications	93	9/3.23	50/90.32	4.56	0.94
Construct	83			4.45	1.17

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Comparison by demographic groups (see Table 37 through Table 40) found no significant differences between any of the groups. Idaho Agricultural Science and Technology Teachers *slightly agree* that STEM disciplines can be taught through the context of IAM, with mathematics being the highest and English being the lowest rated disciplines for all groups. Complete frequency and distribution tables are located in Appendix 6.

Table 37

Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines Split by Gender

	Male			Female		
	n	Mean	*SD*	*n*	Mean	*SD*
Science	60	4.42	1.12	23	4.52	1.31
Technology	67	4.45	1.12	23	4.78	1.04
Engineering	69	4.54	0.93	23	4.83	1.03
Mathematics	69	5.07	0.79	23	5.22	0.74
English	70	3.93	1.07	23	4.22	1.13
Communications	70	4.59	0.93	23	4.48	0.99
Construct	56	4.46	0.73	23	4.67	0.75

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 38

Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines Split by Agricultural Science and Technology Teachers with Science Certification vs. without Certification

	With Science Cert.			Without Science Cert.		
	n	Mean	*SD*	*n*	Mean	*SD*
Science	43	4.51	1.2	38	4.39	1.15
Technology	47	4.62	1.09	41	4.46	1.14
Engineering	47	4.72	0.9	43	4.53	1.01
Mathematics	48	5.10	0.69	42	5.12	0.89
English	48	4.00	1.05	43	4.02	1.14
Communications	48	4.56	0.85	43	4.53	1.05
Construct	41	4.60	0.67	36	4.45	0.83

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 39

Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines Split by Certification Pathway

	University			Alt/Industry		
	n	Mean	*SD*	*n*	Mean	*SD*
Science	67	4.37	1.14	12	4.75	1.36
Technology	75	4.49	1.07	12	4.75	1.36
Engineering	75	4.53	0.94	12	5.00	0.95
Mathematics	76	5.04	0.79	12	5.42	0.67
English	76	3.97	1.05	12	3.83	1.19
Communications	76	4.45	0.90	12	4.92	1.08
Construct	65	4.48	0.71	12	4.78	0.91

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 40

Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines Split by Certification Pathway

	1-5 Years			6-10 Years			11-20 Years			Over 20 Years		
Disciplines	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Science	26	4.50	1.36	15	4.20	1.27	17	4.59	0.94	14	4.36	1.01
Technology	27	4.78	1.19	15	4.33	1.23	18	4.56	1.10	20	4.20	1.06
Engineering	28	4.86	1.04	15	4.80	1.27	18	4.39	0.98	20	4.35	0.67
Mathematics	28	5.36	0.87	15	4.87	0.83	19	5.00	0.67	20	5.15	0.67
English	28	4.07	1.25	15	3.73	1.03	19	3.89	1.15	20	4.10	0.85
Communications	28	4.71	1.05	15	4.20	0.86	19	4.53	1.17	20	4.45	0.61
Construct	25	4.65	0.88	15	4.36	0.72	15	4.52	0.76	14	4.40	0.63

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

In relation to the facilities required to integrate STEM into IAM courses, teachers reported they "*slightly disagreed*" (m = 3.36, n = 83) that their current facilities were adequate to teach STEM, with equipment to teach integrated STEM identified as the lowest rated component of their facilities and equipment to build projects as the highest rated component (see Table 41). Differences by gender (see Table 42), M_{diff} = 0.36, additional science certification (see (Table 43, M_{diff} = 0.26), and experience teaching IAM courses (see Table 44, M_{diff} = 1.05) had small differences. Mean differences were the largest (M_{diff} = 1.21) between traditionally certified and alternatively or industry certified teachers. Alternatively or industry certified teachers reported their facilities were less adequate than their university-prepared counterparts in all areas covered in the study.

Table 41

Teachers Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	*n*	Disagree	Agree	*M*	*SD*
Space to teach integrated STEM	93	48/51.61	45/48.39	3.34	1.68
Equipment to teach integrated STEM	85	56/65.88	29/34.12	2.91	1.49
Technology to allow students to design projects	92	50/54.35	42/45.65	3.17	1.49
Equipment to allow students to build projects	92	25/27.17	67/72.83	4.04	1.56
Space to allow students to evaluate and test student designed projects	93	42/45.16	51/54.84	3.54	1.72
Construct	83			3.36	1.35

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 42

Teachers Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses Split by Gender

	Male			Female		
Facilities Statements	*n*	*M*	*SD*	*n*	*M*	*SD*
Space to teach integrated STEM	71	3.45	1.62	22	3.00	1.88
Equipment to teach integrated STEM	64	2.94	1.48	21	2.81	1.57
Technology to allow students to design projects	70	3.17	1.50	22	3.18	1.50
Equipment to allow students to build projects	70	4.13	1.52	22	3.77	1.69
Space to allow students to evaluate and test student designed projects	71	3.66	1.72	22	3.14	1.70
Construct	62	3.45	1.32	21	3.09	1.44

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 43

Teachers Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses Split by Science Certification

	With Science			Without		
Facilities Statements	*n*	*M*	*SD*	*n*	*M*	*SD*
Space to teach integrated STEM	49	3.41	1.66	43	3.23	1.73
Equipment to teach integrated STEM	46	3.04	1.52	38	2.68	1.44
Technology to allow students to design projects	48	3.17	1.45	43	3.21	1.57
Equipment to allow students to build projects	49	4.06	1.56	42	4.00	1.59
Space to allow students to evaluate and test student designed projects	49	3.63	1.65	43	3.47	1.80
Construct	45	3.47	1.34	37	3.21	1.40

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 44

Teachers Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses Split by Years of Experience

	1-5 Years			6-10 Years			11-20 Years			Over 20 Years		
Facilities Statements	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Space to teach integrated STEM	27	3.19	1.90	15	3.47	1.81	20	3.40	1.64	20	3.90	1.41
Equipment to teach integrated STEM	24	2.71	1.63	14	2.93	1.64	18	2.72	1.41	18	3.78	1.26
Technology to allow students to design projects	27	3.15	1.63	15	3.20	1.61	20	3.20	1.51	19	3.42	1.35
Equipment to allow students to build projects	26	3.81	1.79	15	4.20	1.37	20	4.05	1.73	20	4.60	1.00
Space to allow students to evaluate and test student designed projects	27	3.33	1.88	15	3.53	1.64	20	3.95	1.70	20	3.95	1.57
Construct	23	3.03	1.57	14	3.51	1.35	18	3.38	1.22	17	4.09	0.99

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 45

Teachers Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

	University			Alt/Industry		
Facilities Statements	*n*	*M*	*SD*	*n*	*M*	*SD*
Space to teach integrated STEM	79	3.51	1.63	10	2.10	1.29
Equipment to teach integrated STEM	71	3.06	1.47	10	2.00	1.25
Technology to allow students to design projects	78	3.31	1.47	10	2.60	1.51
Equipment to allow students to build projects	79	4.23	1.46	10	2.80	1.75
Space to allow students to evaluate and test student designed projects	79	3.80	1.64	10	2.20	1.62
Construct	70	3.55	1.28	10	2.34	1.34

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Ten statements comprise the benefits of STEM integration construct (see Table 46). The mean construct score was 4.50, indicating teachers "*slightly agree"* with the benefits of STEM integration into the IAM courses contained in the construct. The lowest rated statement in the construct related to loss of technical content, and the highest related to teaching students to work as a team. Comparison of the STEM Benefits construct scores between gender (see Table 47); additional science certification (see Table 48); completing traditional or university preparation pathways vs. those completing an industry or alternative certification pathway (see Table 49); and between teachers with different years of experience teaching IAM (see Table 50) revealed little difference exists on how teachers perceive the benefits of STEM integration in IAM courses. Teachers in every group reported the highest agreement with the statement "*teaching my students to be a productive part of a team will make my students more employable*." Lowest agreement for every group was with the statement, "*STEM can be integrated into IAM without loss of technical skills*."

Table 46

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct

Construct Statements	*n*	*M*	*SD*
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	87	3.67	1.31
Teaching students to explore their own ideas will make my students more employable.	89	4.58	1.02
Teaching students to design solutions to problems will make my students more employable.	90	4.93	0.99
Teaching students to be a productive part of a team will make my students more employable.	88	5.18	0.94
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	89	5.08	0.98
My introductory curriculum ties mechanical skills to scientific processes.	88	4.05	1.16
My introductory curriculum allows students to explore, design, and solve real-world problems.	88	4.27	1.05
My introductory curriculum routinely requires the use of mathematics.	88	4.61	1.08
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	89	4.37	1.13
Agricultural mechanics courses integrated with science content will make my students more employable.	89	4.52	1.11
Construct	84	4.50	0.80

Note. As measured on a 6-Point Likert Scale with 1 = *“Strongly Disagree”* and 6 = *“Strongly Agree”*

Table 47

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct Split by Gender

	Male			Female		
Construct Statements	*n*	*M*	*SD*	*n*	*M*	*SD*
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	69	3.65	1.27	19	3.74	1.45
Teaching students to explore their own ideas will make my students more employable.	71	4.46	1.03	19	5.00	0.88
Teaching students to design solutions to problems will make my students more employable.	71	4.83	1.03	20	5.35	0.75
Teaching students to be a productive part of a team will make my students more employable.	70	5.06	0.99	19	5.63	0.50
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	71	4.99	1.02	19	5.42	0.69
My introductory curriculum ties mechanical skills to scientific processes.	71	4.14	1.20	18	3.72	0.96
My introductory curriculum allows students to explore, design, and solve real-world problems.	71	4.34	1.04	18	4.06	1.06
My introductory curriculum routinely requires the use of mathematics.	71	4.72	1.03	18	4.22	1.17
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	71	4.32	1.16	19	4.58	1.02
Agricultural mechanics courses integrated with science content will make my students more employable.	71	4.52	1.09	19	4.53	1.17
Construct	67	4.48	0.84	17	4.56	0.63

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 48

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct Split by Agriculture Teacher with and without Science Certification

	With Science			Without Science		
Construct Statements	*n*	*M*	*SD*	*n*	*M*	*SD*
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	47	3.72	1.33	40	3.58	1.28
Teaching students to explore their own ideas will make my students more employable.	48	4.67	0.83	41	4.46	1.21
Teaching students to design solutions to problems will make my students more employable.	49	5.00	0.87	41	4.88	1.14
Teaching students to be a productive part of a team will make my students more employable.	47	5.23	0.76	41	5.12	1.12
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	48	5.04	0.85	41	5.12	1.12
My introductory curriculum ties mechanical skills to scientific processes.	48	3.92	1.13	40	4.23	1.21
My introductory curriculum allows students to explore, design, and solve real-world problems.	48	4.17	1.00	40	4.43	1.11
My introductory curriculum routinely requires the use of mathematics.	48	4.50	1.07	40	4.78	1.07
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	48	4.35	0.98	41	4.44	1.29
Agricultural mechanics courses integrated with science content will make my students more employable.	48	4.42	1.09	41	4.63	1.14
Construct	44	4.48	0.68	39	4.51	0.93

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 49

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct Split by Certification Pathway

	University			Industry/Alternative		
Construct Statements	*n*	*M*	*SD*	*n*	*M*	*SD*
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	75	3.64	1.29	9	3.33	1.32
Teaching students to explore their own ideas will make my students more employable.	76	4.50	1.01	10	5.10	0.88
Teaching students to design solutions to problems will make my students more employable.	77	4.84	1.03	10	5.50	0.53
Teaching students to be a productive part of a team will make my students more employable.	75	5.09	0.98	10	5.70	0.48
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	76	4.97	1.01	10	5.70	0.48
My introductory curriculum ties mechanical skills to scientific processes.	76	4.05	1.15	9	4.00	1.12
My introductory curriculum allows students to explore, design, and solve real-world problems.	76	4.24	1.04	9	4.22	0.97
My introductory curriculum routinely requires the use of mathematics.	76	4.61	1.06	9	4.44	1.24
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	76	4.28	1.12	10	4.90	0.99
Agricultural mechanics courses integrated with science content will make my students more employable.	76	4.47	1.10	10	4.50	1.18
Construct	72	4.46	0.82	8	4.54	0.53

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 50

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct Split by Years Teaching Introductory Agricultural Mechanics Courses

	1-5 Years		6-10 Years		11-20 Years		21+ Years	
Construct Statements	*n*	*M/SD*	*n*	*M/SD*	*n*	*M/SD*	*n*	*M/SD*
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	24	3.33/1.31	15	3.93/1.10	20	3.90/1.25	19	3.47/1.54
Teaching students to explore their own ideas will make my students more employable.	25	4.60/1.16	15	4.87/0.52	20	4.30/1.13	20	4.40/0.94
Teaching students to design solutions to problems will make my students more employable.	25	5.00/1.12	16	5.38/0.62	20	4.90/0.85	20	4.45/1.10
Teaching students to be a productive part of a team will make my students more employable.	24	5.29/1.12	16	5.38/0.50	20	5.10/0.85	19	4.84/1.12
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	24	5.25/1.15	16	5.38/0.50	20	4.85/0.88	20	4.70/1.13
My introductory curriculum ties mechanical skills to scientific processes.	24	4.00/1.18	16	4.00/1.27	20	4.45/0.89	20	3.75/1.29
My introductory curriculum allows students to explore, design, and solve real-world problems.	24	4.42/1.02	16	4.25/1.18	20	4.40/0.94	20	4.05/1.05
My introductory curriculum routinely requires the use of mathematics.	24	4.54/1.14	16	4.69/0.79	20	4.80/1.06	20	4.60/1.27
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	24	4.54/1.25	16	4.56/1.09	20	4.35/0.99	20	3.90/1.07
Agricultural mechanics courses integrated with science content will make my students more employable.	24	4.50/1.22	16	4.69/0.87	20	4.45/1.10	20	4.30/1.13
Construct	23	4.50/0.87	14	4.67/0.56	20	4.55/0.70	18	4.22/1.00

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Research Question 4

The purpose of Research Question 4 was to identify the extent of STEM integration occurring in IAM courses in Idaho. STEM best practices, as identified in the literature, were presented to teachers to identify the percentage of their instruction that utilized the practices. Teachers reported utilizations across the full spectrum of choices (ranges from 96-100 for all practices). Mean and median values for the construct had teachers reporting between 35.94 and 40.66 percent of instruction in IAM utilized STEM best practices (see Table 51).

Table 51

Percentage of the Instructional Period Respondents Reported Utilizing STEM Best Practices Pedagogies

Best Practices	*n*	*M*	*SD*	Median	Range
Exploration	85	29.91	24.46	21	96
Design	83	38.49	27.32	30	100
Problem Solving	88	50.70	29.19	51	100
Teamwork	87	47.15	32.18	40	100
Reflection	87	46.98	32.33	40	100
Explicit Mathematics	88	35.85	28.65	25.5	100
Implicit Mathematics	89	40.87	26.86	40	100
Technology	85	30.15	27.16	19	100
Construct	78	40.66	22.49	35.94	84.13

STEM best practices compared by gender (see Table 52) had small mean differences between the percentages of time they reported utilizing STEM best practices (1.38%), with male teachers reporting a slightly higher percentage of their time utilizing the practices.

Table 52

Percentage of the Instructional Period Male Respondents Reported Utilizing STEM Best Practices Pedagogies Split by Gender

		Male			Female	
Best Practices	*n*	*M*	*SD*	*n*	*M*	*SD*
Exploration	51	28.57	21.227	11	23.55	17.99
Design	50	35.64	25.80	10	39.10	26.19
Problem Solving	54	51.63	27.30	11	38.55	24.02
Teamwork	53	48.36	30.36	11	51.09	35.89
Reflection	53	44.68	30.37	11	54.82	32.74
Explicit Mathematics	54	37.89	29.20	11	33.36	32.84
Implicit Mathematics	54	41.80	24.99	11	34.55	32.46
Technology	52	32.94	26.54	11	18.00	21.86
Construct	47	39.88	21.30	10	38.50	20.93

STEM best practices compared by preparation pathway (see Table 53) had a mean difference of 12.14% with industry or alternatively certified teachers reporting utilizing STEM best practices more than traditionally or university prepared teachers in all eight areas.

Table 53

Percentage of The Instructional Period Instructors Reported Utilizing STEM Best Practices Pedagogies Split by Certification Pathway

	University Preparation			Alt & Industry Certification		
Best Practices	*n*	*M*	*SD*	*n*	*M*	*SD*
Exploration	71	28.44	24.33	10	43.40	24.43
Design	69	35.86	27.61	10	50.90	22.55
Problem Solving	74	50.03	28.37	10	58.00	31.25
Teamwork	73	44.42	31.50	10	67.80	27.57
Reflection	73	46.21	31.68	10	57.40	35.71
Explicit Mathematics	74	35.23	28.43	10	39.20	26.65
Implicit Mathematics	75	39.00	26.06	10	51.60	28.72
Technology	71	28.87	25.89	10	42.40	33.42
Construct	64	39.11	21.64	10	51.34	22.94

STEM best practices reported by teachers holding an additional science certification (see Table 54) was 10.98% lower than those reported by teachers not holding an additional science certification. STEM best practices were utilized more by non-science certified teachers than teachers holding both agriculture and science certifications. Teachers with additional science certification utilize STEM best practices less than their non-science certified counterparts.

Table 54

Percentage of The Instructional Period Instructors Reported Utilizing STEM Best Practices Pedagogies Split by Science Certification

	Science Certified			Not Science Certified		
Best Practices	*n*	*M*	*SD*	*n*	*M*	*SD*
Exploration	44	23.66	19.44	40	36.55	27.93
Design	41	29.51	23.89	41	47.17	28.20
Problem Solving	46	45.30	25.51	41	56.54	32.42
Teamwork	45	41.16	30.91	41	53.39	33.02
Reflection	45	43.42	31.65	41	51.32	33.22
Explicit Mathematics	46	32.13	28.85	41	39.44	28.38
Implicit Mathematics	46	35.93	24.78	42	46.02	28.59
Technology	45	28.42	25.78	39	32.69	28.96
Construct	40	35.33	19.26	37	46.31	24.80

STEM best practices compared by years of experience teaching IAM courses (see Table 55) had a mean range of 10.09% between the four groups of teachers, with teachers in the six to 10 years of experience group reporting utilizing the highest percentage of STEM best practices and teachers in the 11 to 20 year group reporting utilizing them the least. Utilization of STEM best practices were similar among all years of experience.

Table 55

Percentage of The Instructional Period Instructors Reported Utilizing STEM Best Practices Pedagogies Split by Science Certification

	1-5 Years			6-10 Years			11-20 Years			Over 20 Years		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Exploration	26	28.92	25.75	15	31.27	19.11	19	28.84	24.14	19	31.79	27.95
Design	25	44.12	30.52	15	42.27	27.46	18	31.50	24.08	19	29.79	23.46
Problem Solving	26	51.46	31.94	15	55.20	26.34	21	43.86	23.13	20	51.90	28.17
Teamwork	26	51.27	32.33	15	56.07	33.63	20	36.20	31.50	20	46.65	30.04
Reflection	26	47.85	32.59	15	60.33	27.63	20	36.35	28.96	20	44.10	31.59
Explicit Mathematics	26	34.85	29.02	15	42.13	32.63	21	30.10	24.02	20	42.40	30.93
Implicit Mathematics	27	45.22	31.70	15	46.40	25.80	21	32.81	22.46	20	39.80	23.94
Technology	26	36.88	33.27	15	34.47	27.42	19	23.00	21.17	19	25.63	21.03
Construct	24	42.14	26.10	15	46.02	18.61	15	35.93	18.25	18	38.08	22.18

Research Question 5.

The purpose of Research Question 5 was to determine the peak Stages of Concern (SOC) for Idaho agricultural educators, relating to STEM integration in agricultural mechanics. Percentile scores were calculated using the conversion table found in Appendix 6: Supporting Data Tables. Comparison of the peak SOC scores aids in the descriptions of the concerns of the participants. As a whole (see Table 56, & *Figure 7*), Idaho Agricultural Science and Technology Teachers' SOC profiles are nearly textbook nonuser profiles (George et al., 2006). Heightened concerns in Stage 0, in conjunction with higher scores in Stage 1 and tapering to Stage 2 concerns, indicate Idaho Agricultural Science and Technology Teachers as a group are "not fully aware of the innovation and [are] somewhat more concerned about other things"; however; "because Stages 1 and 2 are also high . . . it can be inferred that the individual is interested in learning more about the innovation" (George et al., 2006, pp. 38-39). Lower scores in Stages 4 and 5 suggest teachers are not as concerned about the impact on students or collaboration at this time. The tailing up of Stage 6 indicates that this group may have other ideas or innovations they consider "of more merit" (pp. 41-42). George et al. cautioned that tailing up of five to seven percent on Stage 6 is a noticeable concern and "the respondent may be resistant to the innovation" (pp. 42).

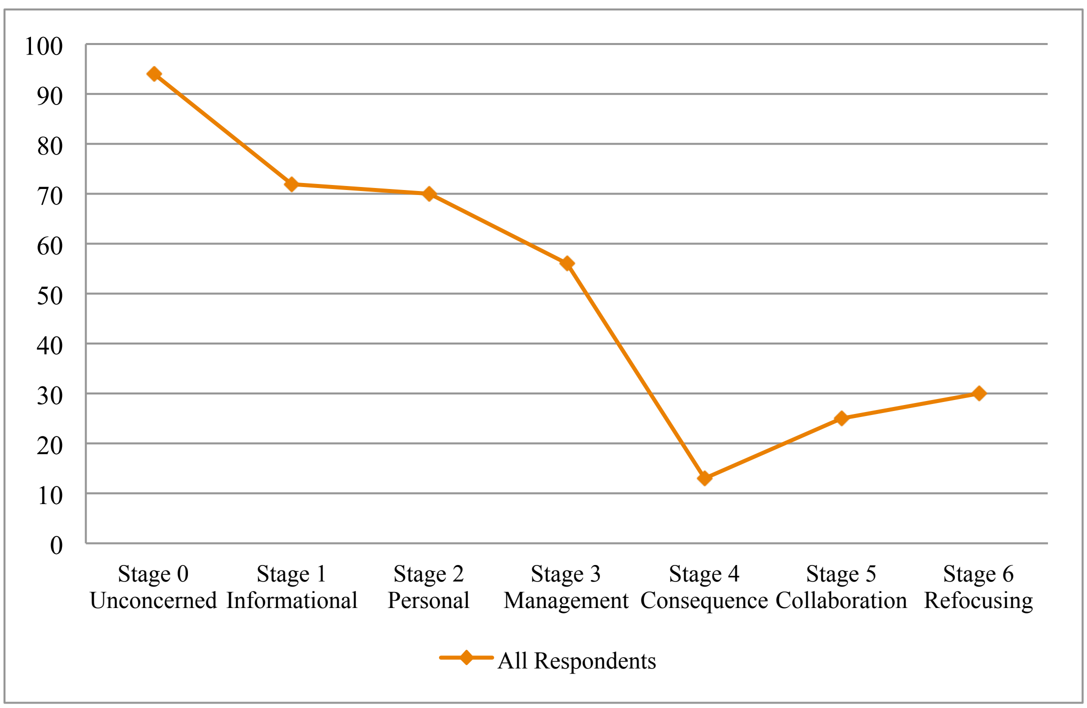

Figure 7. Stages of Concern Profile for All Respondents

Table 56

Stages of Concern Percentile Scores Relating to the Integration of STEM into Introductory Agricultural Mechanics Courses

Stages of Concern	*n*	Percentile
Stage 0 Unconcerned	93	94
Stage 1 Informational	94	72
Stage 2 Personal	94	70
Stage 3 Management	94	56
Stage 4 Consequence	94	13
Stage 5 Collaboration	93	25
Stage 6 Refocusing	94	30

Research Question 6.

The purpose of Research Question 6 was to determine the relationships between teacher characteristics and their Stages of Concern. Comparison of the Stages of Concern profiles for male and female respondents revealed one distinct difference from the overall profile for all Agricultural Science and Technology Teachers. Female teachers have a tailed down Stage 6. This downward tail indicates that, as an interested nonuser, they do not have ideas that would be in direct competition with the integration of STEM into IAM courses. Additionally, female concerns are less intense than their male counterparts in all stages (see Table 57 & *Figure 8*)

Table 57

Stages of Concern Percentile Scores for Males and Females Relating to the Integration of STEM into Introductory Agricultural Mechanics Courses

	All Respondents		Males		Females	
Stages of Concern	*n*	Percentile	*n*	Percentile	*n*	Percentile
Stage 0 Unconcerned	93	94	72	96	21	75
Stage 1 Informational	94	72	72	72	22	66
Stage 2 Personal	94	70	72	70	22	63
Stage 3 Management	94	56	72	60	22	43
Stage 4 Consequence	94	13	72	13	22	11
Stage 5 Collaboration	93	25	71	25	22	25
Stage 6 Refocusing	94	30	72	30	22	22

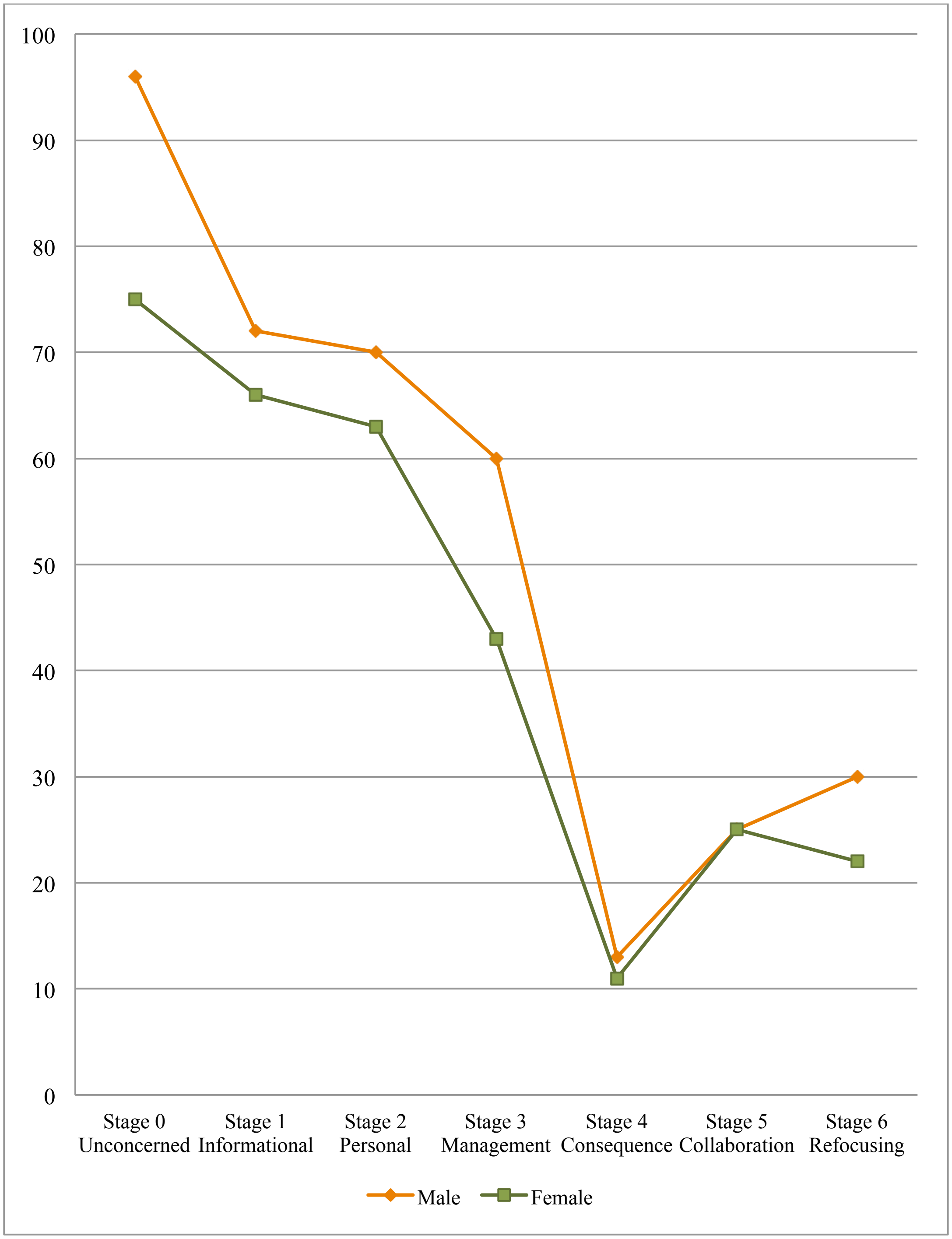

Figure 8. The Stages of Concern Profiles for male and female respondents

Comparison of the Stages of Concern of alternatively or industry certified teachers (see Table 58 & *Figure 9*) with their university prepared counterparts revealed alternatively certified teachers are more in doubt of the integration of STEM in IAM courses. The “negative one-two split” (George et al., 2006, pp. 40), where Stage 2 concerns are higher than Stage 1 concerns, indicates this group doubts the innovation and may also provide resistance to the change. Adding a negative one-two split to a tailing-up in Stage 6 suggests that alternatively certified teachers are resistive non-users who are likely not willing to adopt the integration of STEM in IAM courses.

Table 58

Stages of Concern Percentile Scores Based on Preparation Pathway Relating to the Integration of STEM into Introductory Agricultural Mechanics Courses

	All Respondents		University		Alt/Industry	
Stages of Concern	*n*	Percentile	*n*	Percentile	*n*	Percentile
Stage 0 Unconcerned	88	94	76	94	12	94
Stage 1 Informational	89	72	77	72	12	72
Stage 2 Personal	89	70	77	70	12	76
Stage 3 Management	89	56	77	56	12	60
Stage 4 Consequence	89	13	77	13	12	16
Stage 5 Collaboration	88	25	76	25	12	22
Stage 6 Refocusing	89	30	77	30	12	30

Figure 9. The Stages of Concern Profiles for university prepared teachers and alternatively or industry certified teachers

Comparison of the Stages of Concern of science certified teachers and teachers without the additional science certification (see Table 59 & *Figure 10*) revealed two nearly identical groups whose overall profiles are nearly identical to all respondents, suggesting that there were no differences between their concerns when split by additional science certification. Both groups are classic non-users who are receptive to the idea of STEM integration into IAM courses, but they may have competing ideas they consider to have more merit.

Table 59

Stages of Concern Percentile Scores Relating to the Integration of STEM into Introductory Agricultural Mechanics Courses Based on Teachers Holding an Additional Science Certification

	All Respondents		Ag & Science		Ag Only	
Stages of Concern	*n*	Percentile	*n*	Percentile	*n*	Percentile
Stage 0 Unconcerned	91	94	48	94	43	94
Stage 1 Informational	92	72	49	72	43	72
Stage 2 Personal	92	70	49	67	43	70
Stage 3 Management	92	56	49	56	43	56
Stage 4 Consequence	92	13	49	13	43	13
Stage 5 Collaboration	91	25	49	25	42	25
Stage 6 Refocusing	92	30	49	30	43	30

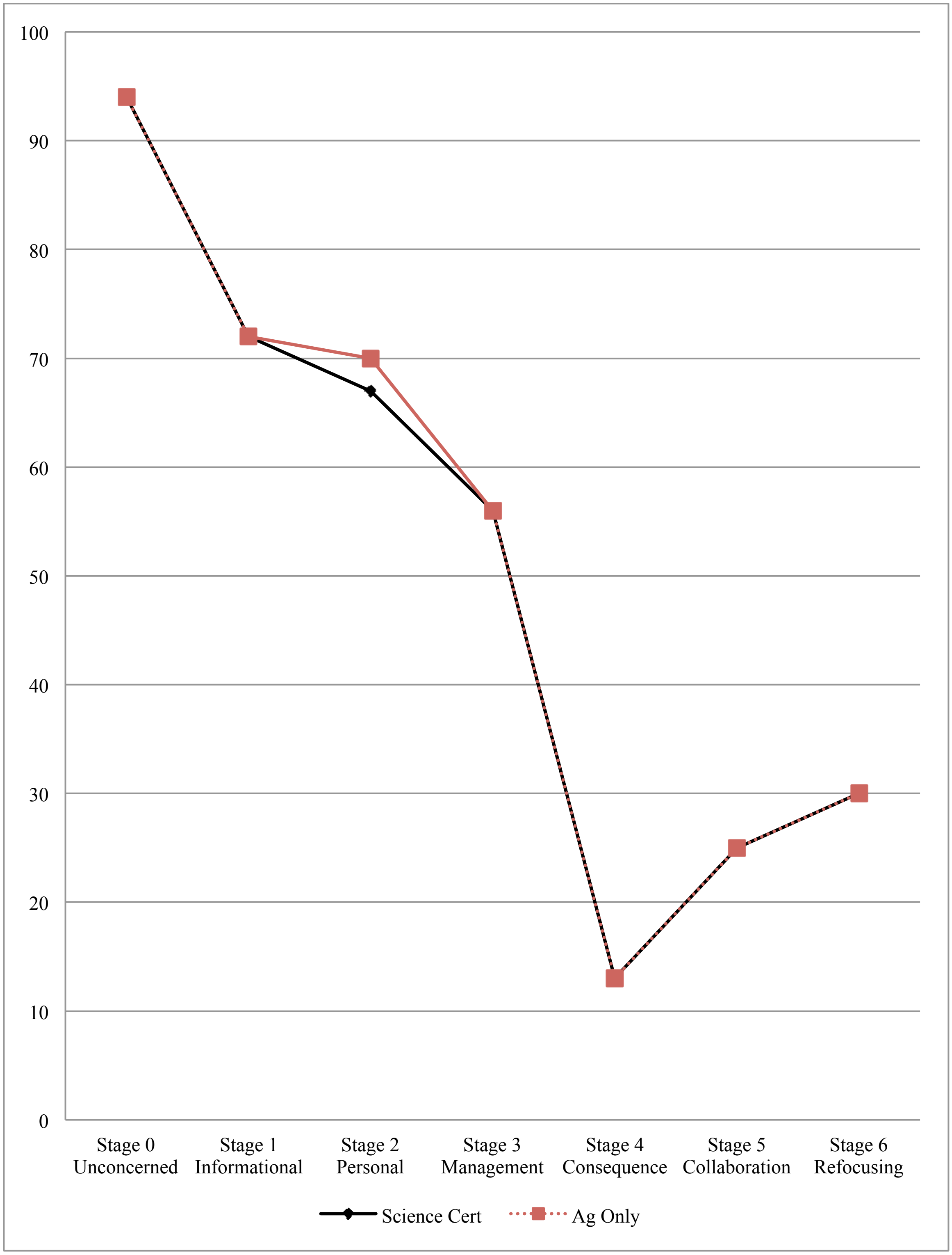

Figure 10. The Stages of Concern Profile for Agricultural Science and Technology Teachers with and without science certification

The intensities of the concerns on the Stages of Concern profiles across years of experience varied; however, the relative intensities are very similar, with teachers in the six to 10 years of experience group having the highest concerns and teachers in the over 20 years of experience group having the lowest concerns. All groups were classic nonusers who are receptive to the innovation and want to learn more about it, albeit with ideas that may be in competition with the integration of STEM in IAM courses.

Table 60

Stages of Concern Percentile Scores Relating to the Integration of STEM into Introductory Agricultural Mechanics Courses Based on Teachers' Years of Experience Teaching Introduction to Agricultural Mechanics Courses

	All Respondents		1-5		6-10		11-20		21+	
Stages of Concern	*n*	Percentile	*n*	Percentile	*n*	Percentile	*n*	Percentile	*n*	Percentile
Stage 0 Unconcerned	81	94	27	94	14	98	20	91	20	96
Stage 1 Informational	82	72	27	75	15	84	20	75	20	69
Stage 2 Personal	82	70	27	72	15	78	20	70	20	67
Stage 3 Management	82	56	27	65	15	69	20	65	20	43
Stage 4 Consequence	82	13	27	16	15	21	20	21	20	8
Stage 5 Collaboration	82	25	27	28	15	36	20	28	20	14
Stage 6 Refocusing	82	30	27	34	15	38	20	38	20	20

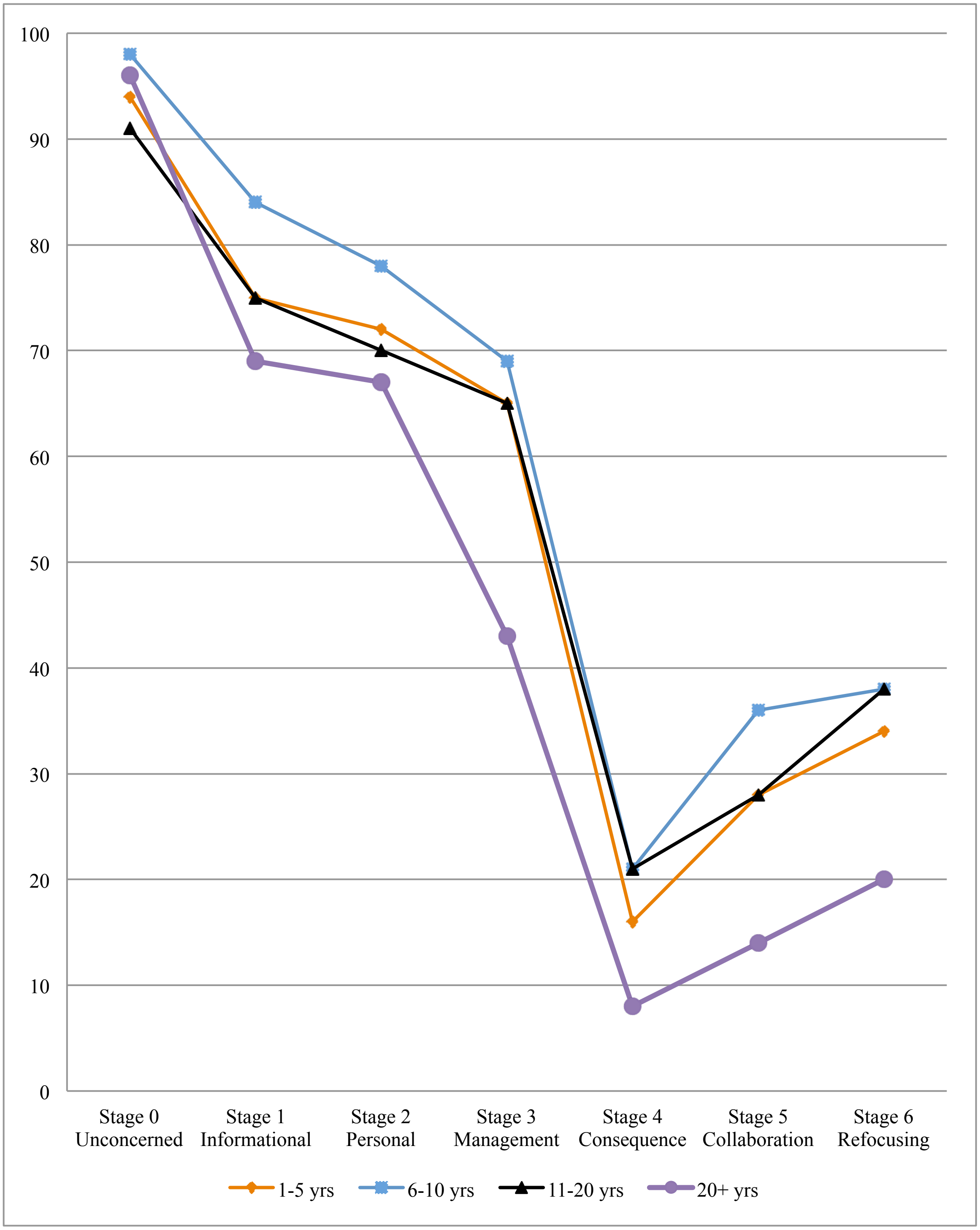

Figure 11. The Stages of Concern Profile for teachers grouped by the number of years teaching an Introductory Agricultural Mechanics Course

Chapter 5:
Conclusions/Recommendations/Implications

This chapter includes a brief summary of the study, followed by conclusions. Conclusions and recommendations are grouped by research question. Finally, implication and directions for future research are presented. The purpose of this study was to utilize the Concerns-Based Adoption Model to describe the integration of STEM into the Idaho introductory agricultural mechanics curriculum.

Research Questions

The following research questions guided this study:

1. How much time do teachers report spending on units in their introductory agricultural mechanics curriculum?
2. How important do Idaho Agricultural Science and Technology Teachers rate the individual agricultural mechanics units in their introductory agricultural mechanics curriculum?
3. What are teachers' perceptions of STEM integration into the introductory agricultural mechanics curriculum?
4. To what extent do Idaho Agricultural Science and Technology Teachers integrate STEM into their introductory agricultural mechanics courses?
5. What are the Stages of Concern for Idaho agricultural educators relating to STEM integration in agricultural mechanics?
6. What are the relationships between teacher characteristics and their Stages of Concern?

Overview

This study utilized survey methodology to conduct a census of Idaho Agricultural Science and Technology Teachers. Dillman et al. (2009) and the Tailored Design Method guided the questionnaire delivery and collection procedures. One hundred and eleven of the 124 teachers (89.5%) returned the questionnaire; and, following removal of unusable responses, 80.6% of Idaho Agricultural Science and Technology Teachers were included in the sample. Cronbach's alpha coefficients for the instrument ranged from .82 to .91 on scales created for this study and from .77 to .94 for the SOC questionnaire. Data were analyzed using SPSS and Microsoft Excel. Demographic comparisons occurred between four characteristics: gender, science certification, certification pathway, and years of experience teaching IAM courses. Research Question 2 also examined the importance ratings between those teachers teaching and not currently teaching IAM courses.

Conclusions

Research Question 1.

Research Question 1 sought to determine the duration of instruction for 39 units of instruction, selected both from the literature and through expert opinions, typically utilized in an Idaho introductory agricultural mechanics

(IAM) course. Analysis of the units revealed there was a core of units taught by the majority of the instructors and identified as important which could fill the minutes of instruction in a typical one-semester IAM course. A minimum of two-thirds of the instructors currently teaching IAM (44 teachers) reported teaching 19 units of instruction, whose mean times totaled 97.78 hours of instruction and median times totaled 71.62 hours. Beyond the core 19 units of instruction, times and number of instructors reporting teaching the units varied widely. Idaho's Professional-Technical Education curriculum guides utilize 70.5 hours of instruction for all of their 47 semester-based courses. The current state IAM curriculum provides too many units of instruction. When reported hours of instruction are compared with the state recommended units of instruction (see Appendix 8), hours required to cover all units exceed the number of hours available in one-semester. The state approved list includes 25 units of instruction, all included in this study. Total median number of hours of instruction for these units (98.14 hours) exceeds the 70.5 hours of instruction available in a one-semester class. Additionally, two units of instruction not included in the state-approved curriculum are FFA and SAE. FFA and SAE instruction should not be optional to programs whose integrated three-circle model purports both FFA and SAE as integral for student success. Focusing professional development and curriculum resource development on these 19 units would provide the greatest benefit to the IAM curriculum of Idaho.

Several units of instruction differed notably between two of the four demographic groups considered in this study. Group comparison by gender indicated female teachers taught *stationary power tools* less than half as long as their male counterparts. Teachers without science certification taught *stationary power tools*, *drafting and sketching*, and *woodworking* longer than science certified teachers. While *stationary power tool* and *woodworking* instruction are both dependent upon school resources, and the differences may be based on what tools and equipment were available, *drafting and sketching* does not necessarily require specialized tools. Differences of over two hours of instruction in these units suggest a need for further exploration, as all three units have broad application regardless of a student's specific agricultural mechanics career pathway.

Using a 19-unit core and the median hours of instruction for each unit as the state curriculum will leave local schools the opportunity to tailor their curriculum to the needs of their respective communities. Units not included in the core may be important to some communities. Flexibility to meet local needs (*local specialization units*) allows agriculture programs to customize, while a set core of instruction ensures students have similar foundational skills across the state. Units of instruction not included among the core units of instruction were considered "*local specialization units,*" whose instructional times depend on local and instructor variables outside the scope of this study but warrant further investigation and analysis. One instructional unit, *student projects* (M = 19.69, SD = 20.09), had a large range (1-125 hours), suggesting the use of student projects in the IAM curriculum needs to be studied further to determine how teachers are using the unit, what accounts for the large variations in its application, and what impact student projects have on student learning.

The second largest variation in hours of instruction occurred in the reported times for *small gasoline engines* (M = 9.51, SD = 20.49). Two instructors reported teaching 106.06 hours and 50.00 hours of instruction, accounting for the majority of the variation. The number of hours of instruction reported by these two instructors exceeded

60% of the total instructional time available in a one-semester course. Since the next highest number of hours of instruction in *small gasoline engines* is 15 hours, these longer instructional times for *Small Gas Engines* are rare exceptions to what is typical in Idaho. The two courses taught with over 50 hours devoted to one unit are not IAM courses, and it is likely they should be reclassified as Small Engines courses and course titles for these classes should reflect their real emphasis.

Six units are currently taught by less than 20% of the teachers reporting teaching IAM courses. *Computerized plasma (or mill work), rope work, metal lathe work, hydraulics, fence construction,* and *large engines* all ranked at the bottom of the number of teachers teaching these units. These six units of instruction are specialized and may need either removal from the curriculum entirely or to be moved to courses further along in the agricultural mechanics or agricultural welding instructional pathways.

Research Question 2.

Research Question 2 sought to determine the importance of the units of instruction in an IAM course. Teachers ranked 39 units on the importance to the IAM curriculum in their school districts. Overall, 50% of all respondents felt that 17 units were important, with an additional three units receiving more than 46% of responses in the important (8 – 10) classification (see Table 17). Only nine units with stronger than a low correlation between teachers' ratings of importance and the time they spent teaching IAM units were reported (see Table 35). This low correlation suggests two possibilities: one, that a unit's importance should not correlate to the time required to teach the unit; or two, that teachers need to reevaluate the curriculum they are teaching to better align what they feel is important and the instructional time devoted to the unit. Units' evaluations on an individual basis should occur, as both options could be true to some degree depending upon the unit under consideration.

Bimodal distributions occurred for several units in each of the demographic groupings under consideration. *Small gas engines*, along with five units relating to metalworking and fabrication, received polarized reviews, suggesting there were dichotomous feelings about these units' inclusion in the IAM curriculum. As these differences occurred across multiple groups, the inclusion of metalworking and fabrication in the introductory agricultural mechanics curriculum should receive further study. Idaho's curriculum offerings in agricultural mechanics already include specialized instruction in multiple classes devoted to metalworking, and the polarity of the responses may indicate that a large portion of the teachers feel they are not as important to the introductory curriculum.

Fourteen of the 17 units rated as the most important were also among the 19 units most taught, which would also fit into a one-semester (70.5 hour) introductory agricultural mechanics course (see Table 11 & Table 61). The seven least important units, as rated by all instructors, included five of the six units least taught. *Fence construction*, *rope work*, *large engines*, *metal lathe work*, and *hydraulics* were all units which were both taught the least and rated as unimportant to the IAM curriculum. Based on the units being both unimportant and not utilized, removal from the curriculum is recommended. The unit of *rope work* appears to not belong in the IAM curriculum, which is similar to the findings reported by Heimgartner (1980). In addition, units that may have been relevant to the curricula of the 1970s and 1980s, which no longer need to be included in the introductory curriculum, include *large engines, fence construction, metal lathe work,* and *hydraulics*.

Two units rated as unimportant that still have industry validated relevance and are included in the National Agriculture, Food, and Natural Resources (AFNR) Content Standards for agricultural mechanics, despite infrequent utilization in Idaho, were the units of *surveying* and *concrete*. Both *concrete* and *surveying* hold strong relevance to agriculture, agricultural mechanics, and farming in general; they have also been listed among the essential skills agriculture teachers need to know (Saucier et al., 2012). *Metal lathe work*, while relevant to the agricultural mechanics industry, was not found important to the IAM curriculum, suggesting it is a specialized skill which belongs in advanced and capstone courses but not in the IAM curriculum. While Idaho has not adopted the current national standards, their use as a standard for reviewing Idaho agricultural mechanics curriculum is advised. Updated AFNR standards are due out to the public in 2015. Comparing core units, and units included in the local specialization, with the industry-validated standards, once revised standards are released, to determine what additional changes should occur for the IAM curriculum and pathway is recommended.

Follow-up studies should look at teachers with six to 10 years of experience teaching IAM courses. This group accounted for more variation in the study than any other demographic group and consistently rated units differently from their peers. Qualitative studies, with the intention of further describing this group and their views, are needed. Investigations into the teaching paradigms of this group, beyond agricultural mechanics, are warranted.

Research Question 3.

Research Question 3 describes the utilization of STEM in IAM courses. Three constructs described teachers' utilization of STEM and attitudes regarding STEM in IAM courses. Teachers agreed Science, Technology, Engineering, Mathematics, English and Communications were a good context in which to teach agricultural mechanics content. The construct mean was 4.45 on a six-point scale, with the highest agreement in relation to mathematics and the lowest agreement with English, with all disciplines receiving some level of agreement. Comparisons between groups found Idaho Agricultural Science and Technology Teachers in agreement that STEM content areas serve as a good context for teaching agricultural mechanics content. Industry or alternatively certified teachers reported the highest level of agreement with the construct (M = 4.78).

The second construct described the adequacy of teachers' facilities to enable STEM integration. Overall, teachers were neutral in their assessment of their facility's adequacy to integrate STEM in IAM courses (M = 3.36). Teachers who were alternatively or industry certified had the lowest construct scores, with a mean of 2.34, and were lower than their university prepared counterparts. Teachers reported they need more space, equipment, and technology to integrate STEM into their IAM courses. Given recent changes to the Idaho funding formula for agricultural education (boost of $5,000 (50%) to added cost funding in the state), teachers who most need equipment and technology should be able to purchase the items they feel they are in greatest need of obtaining. If STEM resources are a priority, increased added cost funding can meet the need for more technology and equipment. If teachers perceive there are more pressing needs, despite an increase of 50% to teacher budgets, STEM integration will continue to want for facilities and resources.

The final construct utilized ten Likert-type statements to determine what teachers perceived were the impacts of STEM integration on their students. The construct mean (4.50) indicated slight agreement among all teachers, with the lowest statement relating to the maintenance of technical skills and integration of STEM into IAM courses. Similar scores across all four demographic classifications indicate that, once again, Idaho Agricultural Science and Technology Teachers show little variance in their opinion of STEM integration into IAM courses.

Research Question 4.

Teachers estimated what percentage of their IAM curriculum utilized the eight STEM best practices. Overall, teachers reported an average of 40.66% of their curriculum utilized STEM best practices. The percentages were similar when comparing utilization by gender or by preparation program. Of note were the differences found in the percentage of the curriculum utilizing STEM best practices when comparing science certified Agricultural Science and Technology Teachers and those Agricultural Science and Technology Teachers without science certification. Non-science certified teachers reported utilizing STEM best practices 10.98% more than science certified teachers. Given the hands-on nature of science, this finding runs counter to expectations and needs further investigation. What is it about science certified teachers that makes them different? Alternatively, does a lack of science training cause the difference? Both options need exploration, both in Idaho and across the country, given the rising number of science credit agriculture courses being offered and the growing need for students to be trained in STEM fields.

The two least utilized practices were the use of exploration and the use of technology. While technology has monetary costs, exploration's costs are more time related. Given the number of units of instruction Idaho agricultural mechanics instructors reported teaching, it is not surprising that a time intensive process like exploration is not utilized more. Reduction of the number of units teachers teach, or the establishment of an intermediate agricultural mechanics course, would enable teachers to add more time intensive methods to their instruction. Honey et al. (2014) stressed that integrating STEM benefits students through the use of real world problems, which require interdisciplinary knowledge to solve. By necessity, solving real world problems requires exploration. Students will gain far more from allocation of time in the areas of problem solving and exploration than they will gain from time spent trying to fit more specialized units of instruction into their curriculum. Identification of a core curriculum will allow teachers more time to utilize STEM pedagogies in their classrooms and focus on broad technical skills rather than specialized pathway skills in the introductory curriculum.

Combining the constructs in Research Questions 3 and 4 provides a snapshot of STEM integration in Idaho. Teachers feel they could teach IAM content through a wide range of STEM contexts. They also reported STEM integration would benefit their students. While no comparison is available in the literature, 40% utilization of STEM best practices provides a current utilization level that future studies can use to measure progress in STEM integration efforts. Finally, teachers need more facilities and resources if they are to fully integrate STEM into

IAM, adding greater expense to an already costly career pathway. Measuring specific needs relating to integration against the current facilities available in Idaho agricultural programs could provide a more precise estimate of facility and technology needs. Warnick et al. (2004) found that agriculture and science teachers could collaborate to implement science integration in Oregon agriculture programs. Conducting similar need assessments that identify possible cooperative efforts and methods to improve cooperation could provide the needed technology at a reduced cost to agriculture programs. For STEM integration in IAM courses to progress, teachers will need to share limited educational resources.

Research Question 5.

The purpose of Research Question 5 was to describe the peak Stages of Concern (SOC) for Idaho Agricultural Science and Technology Teachers. Integration of STEM into IAM courses constitutes a change for Idaho Agricultural Science and Technology Teachers. Change is never easy, despite teachers' willingness to incorporate physical science (White & Wolf, 2014) and, in this study, STEM concepts. The Concerns Based Adoption Model (CBAM) aids change agents in monitoring and providing in-service for decreasing teachers' concerns as they implement innovations. The SOC is the first step in utilizing the CBAM. Idaho teachers overall had their highest two SOC's in Stage 1 and Stage 2, tapering off sharply through Stage 5, and then tailing-up for Stage 6. This interested non-user profile suggests that Idaho teachers are interested in the idea of integrating STEM into their IAM courses. Visual analysis of the SOC profile indicates that there may be competing ideas of what is best for the IAM course at their school. This is a promising profile. Because teachers have reported in the past (White & Wolf, 2014) that they are willing to incorporate physical science into their classes, this further expands their integration to include all of STEM. While there were competing paradigms among teachers, if teachers are given the help they need through curriculum resources and professional development, there is a strong chance that STEM integration could become more prevalent and student instruction could become more interdisciplinary.

A STEM enhanced curriculum will increase the relevance of agricultural education as a part of science education in Idaho. The Next Generation Science Standards call for an integrated STEM approach to teaching science and its related disciplines, including communications and engineering. Additional resources need to be allocated to meeting teacher needs in the area of STEM integration. Idaho agriculture programs have reported that they need more equipment and technology to make this effort succeed. As interested non-users, now is the time to help teachers make the changes to their curriculum to develop a more integrated and STEM best practices oriented curriculum, which will stretch student imaginations and interest in STEM careers.

Research Question 6.

Comparisons of the SOC for teachers, in relation to demographic variables, revealed that Idaho teachers are a very homogenous group. Many of their profiles did not vary enough to even distinguish multiple lines on their SOC profile charts. Two demographic groupings did provide some difference. Female teachers do not have the same level of competing ideas about STEM integration that male teachers have. This indicates that they may adopt proposed changes faster and with fewer reservations than their male counterparts. It also helps to identify female teachers as a target audience should limited resources become available and small pilot programs become a possibility.

The second grouping that had some variation were the years of experience teaching IAM courses. Teachers with more experience tended to have less concern overall. Fullan (2007) proposes that more experienced teachers, who have been presented with multiple changes over their teaching careers, will not worry about new innovations and are conditioned that this innovation will pass as it has in the past. While the intensities changed in relation to experience, the relationships between SOC's did not. Teachers in the six to 10 years of experience group had the smallest tailing-up between Stage 5 and Stage 6; however, all groups tailed up at the end. Teachers' open-ended responses suggested that time, curriculum resources, and money were their biggest needs in relation to STEM integration. However, several voiced that they felt STEM permeated the IAM curriculum already. Further inquiry into IAM instruction is required to determine which group is correct.

Recommendations for Practice

Given the presence of a core of units that all received agreement and utilization from the majority of Idaho Agricultural Science and Technology Teachers, the state PTE division should revise the approved curriculum to emphasize the core units found in Table 61. These units, and their corresponding instructional times, represent a consensus of more than two-thirds of Idaho Agricultural Science and Technology Teachers. Median times, rounded to the nearest half hour, served as the recommended time for each unit and totaled 71 hours of instruction. This leaves most schools with additional hours to specialize the curriculum within the bounds of a one-semester course. In addition, the content of the units within the curriculum itself needs revisited to determine if the units of instruction, as presented in the curriculum guide, are adequate to meet the needs of teachers. These units provide many opportunities for teachers to meet the industry validated Agriculture, Food, and Natural Resource Standards, while still allowing for teachers to customize the curriculum to local needs. Given teachers' limited knowledge of what STEM integration in agricultural mechanics was, and would look like, creation of a summary of STEM and integration opportunities is a logical next step and should precede the creation of Innovation Configuration Maps. In-service unifying IAM instruction needs to be a priority. The diversity of offerings across the state may be necessary, however efforts to unify a core of instruction would benefit students and industry alike and provide a more uniform skill set among graduates.

The Power, Structural and Technology Systems pathway needs an intermediate general agricultural mechanics curriculum to provide a link to the advanced pathway options that schools are utilizing. In addition, this would provide teachers with another course outside the courses in the Agricultural Welding Pathway to diversify their mechanics course offerings. Given teachers' current interest in STEM integration in IAM courses, it is also recommended that the curriculum have direct connections to the Next Generation Science Standards, STEM best practices, explicit mathematics application, and that the curriculum focus on establishing foundational skills and exploratory team-based experiences. These additional courses should tie to industry validated standards, and provide students with skills needed in their local agricultural mechanics related industries. Emerging fields such as precision agriculture and global information systems, alternative energy, and drone technology are needed in advanced agricultural mechanics courses, and should be introduced in the IAM curriculum. Utilizing industry professionals to validate and enhance the list of necessary skills will provide the best validation for the level of skills secondary students need to be successful in 21st century careers.

Table 61

Recommended Units of Instruction and Hours of Instruction for Introductory Agricultural Mechanics

Unit	Hours of Instruction
Bill of Materials	2.0
Careers	2.0
Cleaning & Tool Storage	2.0
Cold Metal Work	3.0
Drafting & Sketching	2.0
Electrical Wiring	5.0
FFA	2.0
Hand Tools	2.0
Handheld Power Tools	2.0
Measuring	3.0
Oxy-Acetylene Welding\Cutting	5.0
Plumbing and Pipe Fitting	5.0
Principles of Electricity	3.0
SAE	2.0
Safety Practices	6.0
Stationary Power Tools	2.0
Student Projects	15.0
Tool Reconditioning & Maintenance	3.0
Tool Use & ID	5.0

Idaho teachers have successfully integrated biological content in their courses for over 20 years, and they are currently willing to integrate STEM into their agricultural mechanics courses as well. While efforts to integrate STEM into agricultural mechanics courses were not successful in the past (E. Osborne, personal communication, May 19, 2014), this is a new era in agricultural education. Teachers today are expected to be more integrated, more cross-disciplinary, and all teachers are asked to meet Common Core State Standards in their classes. This culmination of events suggests that now is the time to move an old idea once again to the front. Agricultural education has adapted from vocational agriculture to agricultural science and technology; therefore, integration of STEM represents an exciting new adaptation for agricultural education.

Recommendations for Research

The CBAM next requires the creation of Innovation Configuration Maps. The SOC profiles of the teachers suggest they will need further information about STEM integration and what it could potentially look like prior to, or as a part of, an Innovation Configuration Workshop. It is crucial to the success of STEM integration that teachers, researchers, and administrators all provide input into what the ideal STEM integrated IAM course looks like, and equally as important, what it does not look like. Providing clear expectations for all participants makes implementation and assessment easier and improves the chance of success (Hall & Hord, 2014).

A review of other change theories, in relation to the current data, indicates there may be a way to utilize the CBAM with a smaller group of teachers. Teachers reported needing more information, and that they were willing to integrate STEM into their IAM courses. Given the scarcity of research dollars, a smaller group needs to be targeted to complete the time and resource intense CBAM Innovation Configuration Maps. Diffusion of Innovation Theory (Rogers, 2003) suggests that innovation adoption occurs through social systems. By identifying those teachers considered opinion leaders, Rogers has found that adoption rates can increase. Given the similarities among opinions from this group of Agricultural Science and Technology Teachers in relation to STEM integration, care must be taken to analyze the social system and identify teachers most likely to be opinion leaders and focus efforts to develop Innovation Configuration maps on this group, and then take the models to the rest of the group. Utilization of this theory by the Extension Service over the past 100 years attests to its benefits among those agricultural occupations (Rogers, 2003). Using a group of opinion leaders in place of trying to get all Agricultural Science and Technology Teachers in one place at one time to focus on the Innovation Configuration Maps would save resources and decrease the time needed to develop these maps. Caution is advised that the use of opinion leaders has been perceived as favoritism among some groups attempting to utilize this change strategy. If analysis of the social structure of this group reveals there are multiple subgroups with differing opinion leaders, including opinion leaders from each group will be a critical component of successful integration and diffusion of the Innovation Configuration Maps and of the STEM integration process.

Implications & Future Directions for Research

Several needs emerge as next-steps relating to IAM and STEM integration. Innovation Configuration (IC) maps (Hall & Hord, 2014) should be created with the cooperation of those Idaho teachers who are currently teaching IAM courses and considered opinion leaders. The IC map implementation monitoring, using Levels of Use (LOU) observations in accordance with the process outlined in the Concerns Based Adoption Model, will provide a clearer picture of how teachers are integrating STEM in their IAM courses. These two processes will give teachers a voice in the process and may lead to exploration of the ideas teachers hold, which may be in direct competition with STEM integration. This cannot be a one-time in-service; it needs long-term support, with at least five years dedicated to the process, in-service, and curriculum monitoring.

Active learning and exploratory learning are two pedagogies IAM delivery can utilize to deliver instruction utilizing STEM best practices. Further research assessing their ability to empower students and improve the number of students pursuing STEM careers is needed. Should these pedagogies prove inadequate, teacher educators need to explore other methodologies in clinical settings, with teachers as active research partners.

Abandoning technical skill attainment in the pursuit of STEM integration cannot be an option. In addition to the integration of STEM, researchers need to monitor and provide assistance that helps teachers maintain the technical content of their IAM courses. Elimination of hands-on and active learning in the laboratory cannot be supplanted by classroom oriented STEM content. For students to succeed in STEM careers, they need to be able to think, reason, work as a team, and explore; but technical skills are also required.

Specific research priorities include:

1. Monitoring the impact of STEM integration on student achievement in agricultural mechanics using experimental design and the CBAM's Levels of Use.
2. Qualitative inquiry into the impact of the implementation process, specifically directed at teachers who represent each of the experience groups: one to five years, six to 10 years, 11 to 20 years, and more than 20 years of experience.
3. Longitudinal inquiry into the industry-required core competencies. Research, utilizing industry professionals, is lacking; and, as the end-user of our products (students), their opinion matters.
4. Replication of the current study in other states; however, based on the time required by many of the respondents, I recommend that the instrument be utilized in stages to prevent fatigue and resistance among teachers.
5. Qualitative inquiry into teachers in the six to 10 years of experience group. Teachers in this group reported seeing STEM integration differently than their peers and determining what made this group different could provide insight into additional ways to integrate STEM in IAM.

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Appendix 1: IRB Exemption

University *of* Idaho
Office of Research Assurances
Institutional Review Board
875 Perimeter Drive, MS 3010
Moscow ID 83844-3010
Phone: 208-885-6162
Fax: 208-885-5752
irb@uidaho.edu

To: Kattlyn Wolf

From: Traci Craig, Ph.D.,
Chair, University of Idaho Institutional Review Board
University Research Office
Moscow, ID 83844-3010

Date: 4/15/2014 2:20:00 PM

Title: STEM in Agricultural Mechanics

Project: 14-203

Certified: Certified as exempt under category 2 at 45 CFR 46.101(b)(2).

On behalf of the Institutional Review Board at the University of Idaho, I am pleased to inform you that the protocol for the above-named research project has been certified as exempt under category 2 at 45 CFR 46.101(b)(2).

This study may be conducted according to the protocol described in the Application without further review by the IRB. As specific instruments are developed, modify the protocol and upload the instruments in the portal. Every effort should be made to ensure that the project is conducted in a manner consistent with the three fundamental principles identified in the Belmont Report: respect for persons; beneficence; and justice.

It is important to note that certification of exemption is NOT approval by the IRB. Do not include the statement that the UI IRB has reviewed and approved the study for human subject participation. Remove all statements of IRB Approval and IRB contact information from study materials that will be disseminated to participants. Instead please indicate, 'The University of Idaho Institutional Review Board has Certified this project as Exempt.'

Certification of exemption is not to be construed as authorization to recruit participants or conduct research in schools or other institutions, including on Native Reserved lands or within Native Institutions, which have their own policies that require approvals before Human Subjects Research Projects can begin. This authorization must be obtained from the appropriate Tribal Government (or equivalent) and/or Institutional Administration. This may include independent review by a tribal or institutional IRB or equivalent. It is the investigator's responsibility to obtain all such necessary approvals and provide copies of these approvals to ORA, in order to allow the IRB to maintain current records.

As Principal Investigator, you are responsible for ensuring compliance with all applicable FERPA regulations, University of Idaho policies, state and federal regulations.

This certification is valid only for the study protocol as it was submitted to the ORA. Studies certified as Exempt are not subject to continuing review (this Certification does not expire). If any changes are made to the study protocol, you must submit the changes to the ORA for determination that the study remains Exempt before implementing the changes. Should there be significant changes in the protocol for this project, it will be necessary for you to submit an amendment to this protocol for review by the Committee using the Portal. If you have any additional questions about this process, please contact me through the portal's messaging system by clicking the ‘Reply’ button at either the top or bottom of this message.

Appendix 2: Questionnaire & Expert Reviewers

This survey was created in Qualtrics. Removal of the HTML coding improved presentation in print format. Statements and selection options are presented in the same order as the online instrument, however formatting changes have occurred to improve readability.

Q1 This questionnaire will provide a comprehensive evaluation of the Introduction to Agricultural Mechanics curriculum in your school. We appreciate your time. It is our hope that this research will help to clarify what is being taught and help improve instruction for our students. Once again, thank you for your time.

Q2 Introduction to Agricultural Mechanics courses provide a good context for teaching:

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science Technology (Computers, Current industry relevant machinery, etc.) Engineering Mathematics (implicit & explicit) English (Reading & Writing) Communications (Verbal and Written)					

Q3 Class periods at my school are _________ minutes long.

______ Class period length (1)

Q4 Please rate the following Introduction to Agricultural Mechanics units, based on their level of importance in YOUR Introduction to Agricultural Mechanics course. A "10" would represent an essential unit that is taught every year, no exceptions. A "1" would be a unit of little importance to the curriculum at your school. Then report how long (approximate total hours) you typically spend teaching the unit (use decimals for partial hours) in your typical year. If you do not teach the unit, please report ZERO for the total hours of instruction.

Importance of the Unit:											Total HOURS devoted to the Unit:
Not Taught	Little Importance	2	3	4	5	6	7	8	9	Great Deal of Importance	(Enter partial hours as decimals)

Shop Cleaning and Tool Storage
Safety Practices in the Shop (including all individual equipment safety instruction)
Measuring
SAE
Drafting and Sketching
Tool Use and Identification
Tool Reconditioning and Maintenance
Plumbing and Pipe Fitting (including Soldering)
Wood Working
Bill of Materials
Rope Work (knots, binding, braiding, etc.)
Hot Metal Work
Cold Metal Work (Tap & Die, Files, Hack Saws, etc.)
FFA
Fence Construction
Concrete
Fasteners
Painting, Brush & Spray Gun
Carpentry (Building structures, Framing, Rafter Cutting, etc.)
Surveying (Including Land Leveling)
Introduction to Electricity
Electrical Wiring
Electrical Motors
Careers in Agricultural Mechanics
Oxyacetylene Welding
Oxyacetylene Cutting
Arc Welding (SMAW)
TIG Welding (GTAW)
MIG Welding (GMAW)
Plasma Arc Cutting
Computerized plasma or mill work
Hand Tools
Handheld Power Tools
Stationary Power Tools
Small Gasoline Engines
Large Engines
Hydraulics
Metal Lathe Work

Q5 My facilities have adequate:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM						
Equipment to teach integrated STEM						
Technology to allow students to design projects						
Equipment to allow students to build projects						
Space to allow students to evaluate and test student designed projects						

Q6 Approximately how large of laboratory instructional area do you have available for introductory agricultural mechanics?

______ Laboratory Width (feet)
______ Laboratory Length (feet)

Q7 The purpose of the following questions is to determine what people who are using, or thinking about using, various programs are concerned about at various times during the adoption process. The innovation in question is: The integration of science, technology, engineering, and mathematics (STEM) in Introduction to Agricultural Mechanics Courses. The items were developed from typical responses of school and college teachers, who ranged from no knowledge at all about various programs to many years' experience using them. Therefore, many of the items in this section may appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items, please select: Irrelevant to me at this time. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher on the scale. Please respond to the items in terms of your present concerns, or how you feel about your involvement with STEM integration in Introduction to Agricultural Mechanics Courses. We do not hold to any one definition of the innovation, so please think of it in terms of your own perception of what it involves. Phrases such as "this approach" and "the new system" all refer to STEM integration in Introduction to Agricultural Mechanics Courses. Remember to respond to each item in terms of your present concerns about your involvement or potential involvement with STEM integration in Introduction to Agricultural Mechanics Courses.

	Irrelevant to me	Not at all true of me at this time 1	2	3	4	5	6	Very true of me at this time 7

1. I am concerned about students' attitudes toward the integration of STEM in ag mechanics.
2. I have integrated STEM into my agricultural mechanics course and I now know of some other approaches that might work better than STEM integration in ag mechanics.
3. In relation to my intro to ag mechanics course, I am more concerned about another innovation than STEM integration into ag mechanics.
4. Specifically in relation to my intro to ag mechanics course, I am concerned about not having enough time to organize myself each day if I integrate STEM into intro to ag mechanics.
5. I would like to help other faculty and teacher in their use of the integration of STEM in ag mechanics.
6. I have very limited knowledge about integrating STEM in ag mechanics.
7. I would like to know the effect of integrating STEM in ag mechanics on my professional status.
8. I am concerned about conflict between my interests and my responsibilities relating to my intro to ag mechanics course.
9. I am concerned about revising my use of STEM in ag mechanics.
10. I would like to develop working relationships with both teachers at my school and outside teachers related to STEM in ag mechanics.
11. I am concerned about how the integration of STEM in ag mechanics affects students.
12. I am not concerned about the integration of STEM in ag mechanics at this time.
13. I would like to know who will make the decisions related to integration of STEM in ag mechanics..
14. I would like to discuss the possibility of using STEM in ag mechanics.
15. I would like to know what resources are available if we decide to integrate STEM in ag mechanics.
16. I am concerned about my inability to manage all that the integration of STEM in ag mechanics requires.
17. I would like to know how my teaching is supposed to change if I integrate STEM in ag mechanics.
18. I would like to familiarize other departments or persons with the progress of the integration of STEM in ag mechanics.
19. I am concerned about evaluating my impact on students if I integrate STEM in ag mechanics.
20. I would like to revise the integration of STEM in ag mechanics approach.

21. In relation to my intro to ag mechanics course, I am preoccupied with things other than the integration of STEM in ag mechanics.
22. I would like to modify our use of STEM in ag mechanics based on the experiences of our students.
23. I spend little time thinking about the integration of STEM in ag mechanics.
24. I would like to excite my students about their part in integrating STEM in ag mechanics.
25. I am concerned about time spent working with nonacademic problems related to the integration of STEM in ag mechanics.
26. I would like to know what the use of STEM in ag mechanics will require in the immediate future.
27. I would like to coordinate my efforts with others to maximize the effects of integrating STEM in ag mechanics .
28. I would like to have more information on time and energy commitments required to integrate STEM in ag mechanics.
29. I would like to know what other faculty and teachers are doing related to STEM integration in ag mechanics.
30. Currently, other priorities relating to intro to ag mechanics prevent me from focusing my attention on the integration of STEM in ag mechanics.
31. I would like to determine how to supplement, enhance, or replace integrating STEM in ag mechanics.
32. I would like to use feedback from students to change the way I integrate STEM in ag mechanics.
33. I would like to know how my role will change when I am integrating STEM in ag mechanics.
34. Coordination of tasks and people relating to the integration of STEM in ag mechanics is taking too much of my time.
35. I would like to know how the integration of STEM in ag mechanics is better than what we have now.

Q8 Please indicate your level of agreement with the following statements about the Introduction to Agricultural Mechanics Curriculum.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree

STEM can be integrated into introductory agricultural mechanics without loss of technical skills.
Teaching students to explore their own ideas will make my students more employable.
Teaching students to design solutions to problems will make my students more employable.
Teaching students to be a productive part of a team will make my students more employable.
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.
My introductory curriculum ties mechanical skills to scientific processes.
My introductory curriculum allows students to explore, design, and solve real-world problems.
My introductory curriculum routinely requires the use of mathematics.
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.
Agricultural mechanics courses integrated with science content will make my students more employable.
High quality lesson planning resources for incorporating STEM into agricultural mechanics are easy to find. (

Q9 What percentage of your Introductory Agricultural Mechanics instruction utilizes the following practices: (Answers are not intended to total 100%)

Exploration (students explore topics of interest to them within the unit of instruction)
Design (projects allow student to design their own product given specific limitations)
Problem Solving (students are presented with real problems to solve)
Teamwork (working as a team or group on a project)
Reflection (students assess their work and have opportunity to evaluate performance)
Explicit Mathematics (step by step how to do mathematical processes)
Implicit Mathematics (informal use of mathematical processes)
Technology (computers, CNC, & related equipment)

Q10 How many students are enrolled in your high school?

High School Enrollment

Q11 My school uses:

Trimesters
Semesters

Q12 Are you currently teaching an Introductory Agricultural Mechanics course?

Yes
No

Q13 Including this year, how many years have you been teaching agricultural education courses?

Years teaching Introduction to Agricultural Mechanics:
Total years teaching agricultural education courses:

Q14 The Introduction to Agricultural Mechanics course at my school is _____________ semesters/trimesters long.

1
2
3

Q15 Approximately how many students are in your largest section of Introduction to Agricultural Mechanics each year?

Largest Student Enrollment in Agricultural Mechanics (1)

Q16 On a Scale from 1 to 10 with one being no experience and 10 being a great deal of experience, how much agricultural mechanics background does your average student bring to the Introduction to Agricultural Mechanics class?

	No Experience 1	2	3	4	5	6	7	8	9	Great Deal of Experience 10
Student Ag Mechanics Prior Experience										

Q17 How would you classify the majority of the students in your agriculture program?

Urban
Rural, Non-farm
Rural, Farm
Other ____________________

Q18 How many agricultural mechanics related courses did you take prior to beginning teaching? Please include technical college or industry courses if they directly relate to your agricultural mechanics instruction.

Total number of agricultural mechanics courses taken:
Total credits (Semesters) of agricultural mechanics preparatory courses

Q19 What was the source for the majority of your agricultural mechanics knowledge when you entered the teaching profession?

College preparation program
Prior farm background
Prior non-farm background
Other ____________________

Q20 Are you currently certified to teach science?

Yes
No

Q21 How did you obtain your teaching certification?

University Preparation Program
Industry or Alternatively Certified
Other ____________________

Q22 What is your gender?

Male
Female

Q23 What concerns do you have about incorporating STEM into your Introduction to Agricultural Mechanics courses?

Q24 What are your two largest needs related to instruction in Introduction to Agricultural Mechanics ?

Q25 Is there anything else relating to STEM in Introduction to Agricultural Mechanics you feel we need to know about that was not included in this survey?

Teacher Face-to-face Interviews

1. Nathan Moore, Washington Agriculture teacher with over 20 years of experience
2. Jason Tindall, Idaho Agriculture teacher with over 15 years of experience

Panel of Experts

1. Dr. Kattlyn Wolf, Associate Professor, Agricultural Education, UI
2. Dr. Jeremy Falk, Assistant Professor, Agricultural Education, UI
3. Mr. Marvin Heimgartner, Senior Instructor, Agricultural Systems Management, UI
4. Mr. Jack McHargue, Senior Instructor, Agricultural Systems Management, UI
5. Nathan Moore, Washington Agriculture teacher with over 20 years of experience

Appendix 3: Introduction Letter

Pre-Notice Email

_______,

Tomorrow, you will be sent a survey link from Qualtrics, an online survey website. The purpose of this study is to collect information that will aid in the evaluation of the introduction to agricultural mechanics course as it is taught in Idaho. Last year, you may have participated in a cursory study examining the receptiveness of teachers toward incorporating physical science into agricultural mechanics courses. The study suggests there were mixed feelings about this change. Additionally, the study revealed there is much we do not know about agricultural mechanics instruction in Idaho. This follow-up study will add to our knowledge of what is taught, what is the most relevant, how introduction to agricultural mechanics is taught, and what should be the direction of further efforts relating to the introduction to agricultural mechanics (AG 130) curriculum.

Agricultural mechanics is a large component of agricultural education in Idaho. This study is intended to help it remain integral to the program as we move toward a more standards-based education model in the state. To meet this expectation, we need everyone to complete this survey, not just those who currently teach agricultural mechanics courses. Every teacher's opinion is important if we are going to understand how Idaho teachers feel about changes in agricultural mechanics and integrated academic standards.

The survey will take you approximately 20 minutes to complete. As a token of our appreciation for your participation we are offering a drawing for one of three $50 gift cards to all those who complete the survey before February 9th. You are free to answer some, none, or all of the questions; you may exit the survey at any time without penalty, and your identity will be kept confidential. We will be most grateful for your feedback! All responses are kept confidential to the extent allowed by law.

We thank you for your participation. If you have any questions regarding your rights as a research participant, contact the Office of Research Assurance at the University of Idaho (208-885-6162). To obtain a copy of the results and to have any other questions answered, contact P. Troy White (208-885-6358 or pwhite@uidaho.edu) or Dr. Kattlyn Wolf (kwolf@uidaho.edu).

The University of Idaho Institutional Review Board has certified this project as exempt.

Investigator Faculty Sponsor

P. Troy White Dr. Kattlyn Wolf
University of Idaho

Department of Agricultural & Extension Education, Moscow, ID 83844-2040

Ph. 208-885-6358

Pilot Study E-Mail

Dear ________________________,

We would like to invite you to participate in a study of the Introductory Agricultural Mechanics Curriculum in the Pacific Northwest.

The purpose of this study is to collect data that will aid in the evaluation of the Introduction to Agricultural Mechanics curriculum. Last year, you may have participated in a cursory study examining the receptiveness of teachers toward incorporating physical science into agricultural mechanics courses. The study suggests there were mixed feelings about this possibility. Additionally, the study revealed there is much we do not know about agricultural mechanics instruction in the region. This follow-up study is designed to add to our knowledge of what is taught, what is the most relevant, how you teach introduction to agricultural mechanics, and what you feel should be the direction of further efforts relating to the introduction to agricultural mechanics curriculum.

Agricultural mechanics is a large component of agricultural education in the West. This study is intended to help it remain integral to the program as we move toward a more standards-based education model. To meet this expectation, we need everyone to complete this survey, even if you do not currently teach agricultural mechanics courses. It is anticipated it will take you approximately 15-20 minutes to complete.

You are free to answer some, none, or all of the questions; you may exit the interview at any time without penalty, and your identity will be kept confidential to the extent allowed by law. We will be most grateful for your feedback! We thank you for your participation.

If you have any questions regarding your rights as a research participant, contact the Office of Research Assurance at the University of Idaho (208-885-6162). To obtain a copy of the results and to have any other questions answered, contact Dr. Kattlyn Wolf kwolf@uidaho.edu, or P. Troy White (208-885-6358 or pwhite@uidaho.edu).

The University of Idaho Institutional Review Board has certified this project as exempt.

Investigator — Faculty Sponsor

P. Troy White — Dr. Kattlyn Wolf

University of Idaho, Department of Agricultural & Extension Education

Moscow, ID 83844-2040, Ph. 208-885-6358

Appendix 4: Follow-up E-mails

Initial E-Mail

Dear _________,

The purpose of this study is to collect information that will aid in the evaluation of the introduction to agricultural mechanics course. Agricultural mechanics is a large component of agricultural education in Idaho. This study is intended to help it remain integral to the program as we move toward a more standards-based education model in the state.

To meet this expectation, we need everyone to complete this survey, not just those who currently teach agricultural mechanics courses.

Every teacher's opinion is important if we are going to understand how Idaho teachers feel about changes in agricultural mechanics and integrated academic standards. It is anticipated it will take you approximately 20 minutes to complete.

As a token of our appreciation for your participation, we are offering a drawing for one of three $50 gift cards to all those who complete the survey before February 9th.

Follow this link to the Survey:

You are free to answer some, none, or all of the questions; you may exit the survey at any time without penalty, and your identity will be kept confidential. We will be most grateful for your feedback! All responses are kept confidential to the extent allowed by law. We thank you for your participation. If you have any questions regarding your rights as a research participant, contact the Office of Research Assurance at the University of Idaho (208-885-6162). To obtain a copy of the results and to have any other questions answered, contact P. Troy White (208-885-6358 or pwhite@uidaho.edu) or Dr. Kattlyn Wolf (kwolf@uidaho.edu). The

University of Idaho Institutional Review Board has certified this project as exempt.

Investigator   Faculty Sponsor
P. Troy White   Dr. Kattlyn Wolf

University of Idaho
Department of Agricultural & Extension Education, Moscow, ID 83844-2040
Ph. 208-885-6358

Follow the link to opt out of future emails

Reminder E-Mail

Hello ___________,

Last week you should have received an invitation to take a survey about the agricultural mechanics curriculum (AG 130) taught at your school. The purpose of this study is to determine what is currently being taught in introductory agricultural mechanics courses and to determine how much STEM content is being covered in those classes.

While not every agriculture program teaches agricultural mechanics courses, it is important that the opinions of all Idaho Agricultural Science and Technology Teachers are represented.

If you have already started the survey, thank you! You can use the link here to go in and complete the survey. If you haven't had a chance to take it yet, please take 20 minutes to provide your input about the introductory agricultural mechanics curriculum. The survey saves your responses, so you can complete it at your own pace.

Those who complete the survey prior to **February 9th** will have their names put in a drawing for one of three **$50 gift cards.**

Follow this link to the Survey:

Or copy and paste the URL below into your Internet browser:

Thank you for your time. I truly understand how busy you are and know how precious your time is.

Sincerely,

Troy White

University of Idaho
Agricultural & Extension Education
cell: 208-530-0076

Follow the link to opt out of future emails:

Third E-Mail

Agricultural mechanics is a large component of agricultural education in Idaho.

Even if you do not teach Introduction to Ag Mechanics, we would like your opinion.

If you do not teach Introduction to Agricultural Mechanics, several questions on the survey do not require your response; however, we would still like you to rate the units of instruction and give us your opinion on the integration of STEM in agricultural mechanics.

The complete survey has been taking 12-40 minutes, depending on the teacher, with most completing the survey in less than 25 minutes, and those not teaching agricultural mechanics courses taking much less time, often less than 10 minutes.

As a token of our appreciation for your participation we are offering a drawing for one of three $50 gift cards to all those who complete the survey before the end of the day on February 9th.

Follow this link to the Survey:

Or copy and paste the URL below into your internet browser:

Thank you for your help. I know you are busy.

Troy

Follow the link to opt out of future emails:

Fourth E-Mail

I have received several e-mails letting me know my survey didn't come through. I have sent several e-mails with a link over the past couple of weeks, but they may have been caught in your spam filters. I am trying this through my e-mail in hope that it comes through.

I need everyone to complete this survey, not just those who currently teach agricultural mechanics courses. Every teacher's opinion is important if we are going to understand how Idaho teachers feel about changes in agricultural mechanics and integrated academic standards. It is anticipated it will take you approximately 20 minutes to complete.

As a token of our appreciation for your participation, we are offering a drawing for one of three $50 gift cards to all those who complete the survey before February 9th.

You are free to answer some, none, or all of the questions; you may exit the survey at any time without penalty, and your identity will be kept confidential. We will be most grateful for your feedback! All responses are kept confidential to the extent allowed by law. We thank you for your participation.

https://uidahoed.az1.qualtrics.com/SE?Q_DL=d6bwOqNXxf3bwBn_cUxEEKoXDnye54F_MLRP_0lAoMP784n5dxrL

If you have any questions regarding your rights as a research participant, contact the Office of Research Assurance at the University of Idaho (208-885-6162). To obtain a copy of the results and to answer any other questions contact P. Troy White (208-885-6358 or pwhite@uidaho.edu) or Dr. Kattlyn Wolf (kwolf@uidaho.edu).

The University of Idaho Institutional Review Board has certified this project as exempt.

Investigator	Faculty Sponsor
P. Troy White	Dr. Kattlyn Wolf

University of Idaho
Department of Agricultural & Extension Education, Moscow, ID 83844-2040
Ph. 208-885-6358

Final E-Mail

Hello ________,
Just a reminder the three $50 gift cards will be selected tomorrow from all who respond before midnight.

If you don't teach ag mech and have no opinion at all about what is taught in introductory ag mech classes, the survey will take you less than 10 minutes.

I will begin calling those I don't hear from by midnight in the morning to get your information over the phone.

Follow this link to the Survey:
Or copy and paste the URL below into your internet browser:

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To: Peter Troy White (Licensee)
955 N Polk Ext
Moscow, ID 83843

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Information Associate
SEDL
Information Resource Center-Copyright Permissions
4700 Mueller Blvd.
Austin, TX 78723

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Date: October 3, 2014

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Sincerely,

Nancy Reynolds
Nancy Reynolds for SEDL

October 3, 2014
Date signed

Agreed and accepted:

Signature: Peter Troy White

10/3/14
Date signed

Printed name: Peter Troy White

Appendix 6: Supporting Data Tables

Table 62

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	97	15/15.46	1/1.03	2/2.06	3/3.09	3/3.09	2/2.06	8/8.25	16/16.49	12/12.37	35/36.08
Bill of Materials	93	4/4.30	2/2.15	2/2.15	5/5.38	12/12.90	13/13.98	9/9.68	19/20.43	12/12.90	15/16.13
Carpentry	97	18/18.56	5/5.15	5/5.15	10/10.31	13/13.40	8/8.25	12/12.37	11/11.34	5/5.15	10/10.31
Careers in Ag Mechanics	97	6/6.19	7/7.22	2/2.06	3/3.09	12/12.37	9/9.28	7/7.22	16/16.49	15/15.46	20/20.62
Cleaning & Tool Storage	97	0/0.00	1/1.03	1/1.03	3/3.09	6/6.19	3/3.09	11/11.34	11/11.34	12/12.37	49/50.52
Cold Metal Work	96	4/4.17	1/1.04	5/5.21	7/7.29	7/7.29	9/9.38	23/23.96	16/16.67	13/13.54	11/11.46
Computerized Plasma/Mill	94	37/39.36	3/3.19	7/7.45	4/4.26	6/6.38	8/8.51	6/6.38	8/8.51	5/5.32	10/10.64
Concrete	97	24/24.74	7/7.22	7/7.22	9/9.28	14/14.43	10/10.31	15/15.46	5/5.15	3/3.09	3/3.09
Drafting & Sketching	98	8/8.16	7/7.14	2/2.04	8/8.16	10/10.20	10/10.20	18/18.37	16/16.33	9/9.18	10/10.20
Electrical Motors	94	20/21.28	10/10.64	5/5.32	6/6.38	17/18.09	7/7.45	12/12.77	8/8.51	5/5.32	4/4.26
Electrical Wiring	95	4/4.21	2/2.11	3/3.16	1/1.05	7/7.37	8/8.42	12/12.63	23/24.21	14/14.74	21/22.11
Fasteners	95	16/16.84	4/4.21	5/5.26	5/5.26	19/20.00	12/12.63	13/13.68	9/9.47	4/4.21	8/8.42
Fence Construction	93	37/39.78	7/7.53	10/10.75	9/9.68	13/13.98	7/7.53	6/6.45	1/1.08	1/1.08	2/2.15
FFA	96	7/7.29	5/5.21	6/6.25	8/8.33	11/11.46	6/6.25	14/14.58	10/10.42	10/10.42	19/19.79
Hand Tools	97	2/2.06	1/1.03	4/4.12	2/2.06	12/12.37	7/7.22	16/16.49	14/14.43	11/11.34	28/28.87
HH Plasma Cutting	96	20/20.83	3/3.13	3/3.13	4/4.17	5/5.21	6/6.25	10/10.42	9/9.38	13/13.54	23/23.96
HH Power Tools	97	2/2.06	1/1.03	1/1.03	2/2.06	10/10.31	8/8.25	13/13.40	15/15.46	15/15.46	30/30.93

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Hot Metal Work	94	14/14.89	9/9.57	6/6.38	8/8.51	19/20.21	9/9.57	8/8.51	12/12.77	6/6.38	3/3.19
Hydraulics	93	35/37.63	7/7.53	7/7.53	6/6.45	11/11.83	7/7.53	7/7.53	3/3.23	5/5.38	5/5.38
Large Engines	92	41/44.57	6/6.52	8/8.70	4/4.35	9/9.78	4/4.35	8/8.70	3/3.26	4/4.35	5/5.43
Measuring	92	0/0.00	1/1.09	0/0.00	0/0.00	4/4.35	3/3.26	2/2.17	13/14.13	18/19.57	51/55.43
Metal Lathe Work	93	38/40.86	7/7.53	11/11.83	8/8.60	8/8.60	7/7.53	2/2.15	5/5.38	2/2.15	5/5.38
MIG Welding (GMAW)	96	19/19.79	2/2.08	2/2.08	3/3.13	6/6.25	4/4.17	5/5.21	11/11.46	12/12.50	32/33.33
OA Cutting	98	15/15.31	3/3.06	2/2.04	2/2.04	6/6.12	3/3.06	7/7.14	17/17.35	16/16.33	27/27.55
OA Welding	98	12/12.24	3/3.06	2/2.04	3/3.06	10/10.20	4/4.08	9/9.18	19/19.39	12/12.24	24/24.49
Painting	95	17/17.89	6/6.32	8/8.42	9/9.47	13/13.68	11/11.58	12/12.63	10/10.53	5/5.26	4/4.21
Plumbing and Pipe Fitting	97	2/2.06	1/1.03	2/2.06	3/3.09	6/6.19	13/13.40	20/20.62	25/25.77	13/13.40	12/12.37
Principles of Electricity	98	3/3.06	3/3.06	4/4.08	1/1.02	6/6.12	11/11.22	14/14.29	20/20.41	13/13.27	23/23.47
Rope Work	93	4/4.30	2/2.15	2/2.15	5/5.38	12/12.90	13/13.98	9/9.68	19/20.43	12/12.90	15/16.13
SAE	96	4/4.17	6/6.25	6/6.25	7/7.29	12/12.50	7/7.29	14/14.58	9/9.38	5/5.21	26/27.08
Safety Practices	98	0/0.00	0/0.00	1/1.02	0/0.00	0/0.00	0/0.00	4/4.08	3/3.06	6/6.12	84/85.71
Small Gas Engines	96	21/21.88	8/8.33	5/5.21	4/4.17	7/7.29	9/9.38	12/12.50	13/13.54	9/9.38	8/8.33
Stationary Power Tools	96	2/2.08	2/2.08	3/3.13	4/4.17	6/6.25	7/7.29	11/11.46	16/16.67	20/20.83	25/26.04
Student Projects	94	8/8.51	2/2.13	4/4.26	2/2.13	5/5.32	5/5.32	6/6.38	14/14.89	11/11.70	37/39.36
Surveying	96	25/26.04	7/7.29	6/6.25	10/10.42	15/15.63	8/8.33	14/14.58	6/6.25	1/1.04	4/4.17
TIG Welding (GTAW)	95	29/30.53	5/5.26	4/4.21	4/4.21	6/6.32	7/7.37	10/10.53	6/6.32	7/7.37	17/17.89
Tool Recond. & Maintenance	98	2/2.04	3/3.06	2/2.04	2/2.04	13/13.27	11/11.22	13/13.27	21/21.43	18/18.37	13/13.27
Tool Use & ID	91	0/0.00	0/0.00	2/2.20	1/1.10	6/6.59	5/5.49	5/5.49	19/20.88	22/24.18	31/34.07
Wood Working	97	16/16.49	1/1.03	6/6.19	8/8.25	12/12.37	12/12.37	7/7.22	12/12.37	10/10.31	13/13.40

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 63

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors Currently Teaching an Introductory Agriculture Mechanics Course (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	65	12/18.46	1/1.54	2/3.08	2/3.08	2/3.08	0/0.00	5/7.69	12/18.46	7/10.77	22/33.85
Bill of Materials	62	3/4.84	2/3.23	1/1.61	4/6.45	10/16.13	10/16.13	6/9.68	9/14.52	9/14.52	8/12.90
Careers in Ag Mechanics	65	5/7.69	5/7.69	2/3.08	2/3.08	7/10.77	5/7.69	5/7.69	12/18.46	9/13.85	13/20.00
Carpentry	65	15/23.08	2/3.08	4/6.15	6/9.23	9/13.85	6/9.23	8/12.31	7/10.77	2/3.08	6/9.23
Cleaning & Tool Storage	66	0/0.00	1/1.52	1/1.52	1/1.52	4/6.06	1/1.52	6/9.09	6/9.09	7/10.61	39/59.09
Cold Metal Work	65	4/6.15	0/0.00	4/6.15	4/6.15	5/7.69	6/9.23	15/23.08	10/15.38	9/13.85	8/12.31
Computerized Plasma/Mill	63	32/50.79	2/3.17	4/6.35	2/3.17	4/6.35	2/3.17	2/3.17	6/9.52	2/3.17	7/11.11
Concrete	65	18/27.69	5/7.69	2/3.08	6/9.23	10/15.38	8/12.31	10/15.38	4/6.15	0/0.00	2/3.08
Drafting & Sketching	66	8/12.12	5/7.58	2/3.03	3/4.55	7/10.61	8/12.12	13/19.70	9/13.64	4/6.06	7/10.61
Electrical Motors	62	18/29.03	6/9.68	2/3.23	3/4.84	11/17.74	4/6.45	7/11.29	5/8.06	3/4.84	3/4.84
Electrical Wiring	64	4/6.25	1/1.56	0/0.00	0/0.00	3/4.69	4/6.25	9/14.06	14/21.88	10/15.63	19/29.69
Fasteners	65	11/16.92	3/4.62	1/1.54	2/3.08	14/21.54	10/15.38	10/15.38	6/9.23	2/3.08	6/9.23
Fence Construction	62	33/53.23	4/6.45	4/6.45	8/12.90	7/11.29	3/4.84	3/4.84	0/0.00	0/0.00	0/0.00
FFA	64	7/10.94	3/4.69	6/9.38	7/10.94	9/14.06	4/6.25	5/7.81	4/6.25	6/9.38	13/20.31
Hand Tools	65	1/1.54	1/1.54	3/4.62	2/3.08	9/13.85	4/6.15	10/15.38	7/10.77	8/12.31	20/30.77
HH Plasma Cutting	64	17/26.56	3/4.69	3/4.69	2/3.13	4/6.25	5/7.81	4/6.25	7/10.94	7/10.94	12/18.75
HH Power Tools	65	1/1.54	1/1.54	0/0.00	0/0.00	8/12.31	7/10.77	9/13.85	7/10.77	11/16.92	21/32.31
Hot Metal Work	64	12/18.75	4/6.25	4/6.25	5/7.81	13/20.31	5/7.81	6/9.38	8/12.50	6/9.38	1/1.56
Hydraulics	63	30/47.62	3/4.76	4/6.35	2/3.17	9/14.29	3/4.76	3/4.76	3/4.76	4/6.35	2/3.17
Large Engines	61	35/57.38	1/1.64	3/4.92	3/4.92	8/13.11	2/3.28	2/3.28	3/4.92	2/3.28	2/3.28
Measuring	64	0/0.00	1/1.56	0/0.00	0/0.00	3/4.69	2/3.13	2/3.13	10/15.63	9/14.06	37/57.81

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	62	32/51.61	2/3.23	4/6.45	6/9.68	5/8.06	4/6.45	1/1.61	3/4.84	2/3.23	3/4.84
MIG Welding (GMAW)	64	15/23.44	2/3.13	2/3.13	2/3.13	5/7.81	2/3.13	3/4.69	8/12.50	7/10.94	18/28.13
OA Cutting	66	12/18.18	3/4.55	1/1.52	1/1.52	4/6.06	2/3.03	4/6.06	11/16.67	10/15.15	18/27.27
OA Welding	66	9/13.64	3/4.55	1/1.52	2/3.03	7/10.61	2/3.03	4/6.06	13/19.70	9/13.64	16/24.24
Painting	65	13/20.00	4/6.15	5/7.69	4/6.15	10/15.38	9/13.85	7/10.77	6/9.23	4/6.15	3/4.62
Plumbing and Pipe Fitting	66	1/1.52	1/1.52	1/1.52	2/3.03	2/3.03	6/9.09	12/18.18	20/30.30	12/18.18	9/13.64
Principles of Electricity	66	3/4.55	2/3.03	1/1.52	0/0.00	2/3.03	6/9.09	12/18.18	12/18.18	8/12.12	20/30.30
Rope Work	63	37/58.73	6/9.52	2/3.17	3/4.76	7/11.11	3/4.76	2/3.17	3/4.76	0/0.00	0/0.00
SAE	65	4/6.15	5/7.69	5/7.69	4/6.15	11/16.92	6/9.23	4/6.15	6/9.23	3/4.62	17/26.15
Safety Practices	66	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	3/4.55	2/3.03	2/3.03	59/89.39
Small Gas Engines	65	18/27.69	4/6.15	4/6.15	3/4.62	6/9.23	4/6.15	7/10.77	7/10.77	7/10.77	5/7.69
Stationary Power Tools	64	2/3.13	2/3.13	0/0.00	2/3.13	6/9.38	5/7.81	6/9.38	7/10.94	16/25.00	18/28.13
Student Projects	62	7/11.29	0/0.00	2/3.23	1/1.61	2/3.23	2/3.23	3/4.84	10/16.13	7/11.29	28/45.16
Surveying	64	21/32.81	3/4.69	4/6.25	6/9.38	12/18.75	3/4.69	10/15.63	3/4.69	0/0.00	2/3.13
TIG Welding (GTAW)	63	25/39.68	5/7.94	4/6.35	2/3.17	5/7.94	3/4.76	6/9.52	4/6.35	3/4.76	6/9.52
Tool Recond. & Maintenance	66	2/3.03	2/3.03	1/1.52	0/0.00	9/13.64	8/12.12	9/13.64	15/22.73	11/16.67	9/13.64
Tool Use & ID	61	0/0.00	0/0.00	1/1.64	1/1.64	2/3.28	2/3.28	4/6.56	14/22.95	16/26.23	21/34.43
Wood Working	65	12/18.46	0/0.00	3/4.62	7/10.77	9/13.85	7/10.77	4/6.15	6/9.23	8/12.31	9/13.85

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 64

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Male Idaho Agricultural Education Instructors (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	74	9/12.16	2/2.70	2/2.70	2/2.70	2/2.70	1/1.35	6/8.11	14/18.92	10/13.51	26/35.14
Bill of Materials	72	2/2.78	2/2.78	2/2.78	4/5.56	8/11.11	10/13.89	7/9.72	15/20.83	10/13.89	12/16.67
Careers in Ag Mechanics	74	6/8.11	5/6.76	1/1.35	2/2.70	9/12.16	6/8.11	5/6.76	13/17.57	11/14.86	16/21.62
Carpentry	74	14/18.92	3/4.05	5/6.76	5/6.76	10/13.51	7/9.46	9/12.16	9/12.16	4/5.41	8/10.81
Cleaning & Tool Storage	74	0/0.00	1/1.35	0/0.00	2/2.70	4/5.41	3/4.05	8/10.81	8/10.81	9/12.16	39/52.70
Cold Metal Work	74	4/5.41	1/1.35	1/1.35	6/8.11	5/6.76	7/9.46	17/22.97	13/17.57	9/12.16	11/14.86
Computerized Plasma/Mill	71	29/40.85	3/4.23	5/7.04	3/4.23	5/7.04	4/5.63	2/2.82	7/9.86	3/4.23	10/14.08
Concrete	74	19/25.68	4/5.41	5/6.76	6/8.11	10/13.51	9/12.16	11/14.86	6/8.11	2/2.70	2/2.70
Drafting & Sketching	75	7/9.33	5/6.67	2/2.67	6/8.00	7/9.33	8/10.67	10/13.33	13/17.33	6/8.00	11/14.67
Electrical Motors	71	15/21.13	9/12.68	4/5.63	5/7.04	11/15.49	6/8.45	10/14.08	3/4.23	4/5.63	4/5.63
Electrical Wiring	72	4/5.56	1/1.39	2/2.78	1/1.39	5/6.94	6/8.33	7/9.72	18/25.00	10/13.89	18/25.00
Fasteners	74	11/14.86	2/2.70	4/5.41	3/4.05	15/20.27	12/16.22	11/14.86	8/10.81	3/4.05	5/6.76
Fence Construction	70	32/45.71	3/4.29	7/10.00	6/8.57	11/15.71	5/7.14	4/5.71	0/0.00	0/0.00	2/2.86
FFA	73	6/8.22	3/4.11	5/6.85	5/6.85	10/13.70	4/5.48	12/16.44	8/10.96	6/8.22	14/19.18
Hand Tools	74	2/2.70	1/1.35	4/5.41	2/2.70	10/13.51	5/6.76	10/13.51	10/13.51	9/12.16	21/28.38
HH Plasma Cutting	73	14/19.18	3/4.11	3/4.11	3/4.11	5/6.85	4/5.48	6/8.22	8/10.96	11/15.07	16/21.92
HH Power Tools	74	2/2.70	1/1.35	1/1.35	1/1.35	8/10.81	7/9.46	9/12.16	10/13.51	13/17.57	22/29.73
Hot Metal Work	72	13/18.06	4/5.56	5/6.94	8/11.11	11/15.28	6/8.33	7/9.72	9/12.50	5/6.94	4/5.56
Hydraulics	71	27/38.03	6/8.45	5/7.04	3/4.23	9/12.68	4/5.63	6/8.45	2/2.82	5/7.04	4/5.63
Large Engines	69	32/46.38	5/7.25	5/7.25	3/4.35	6/8.70	2/2.90	5/7.25	3/4.35	4/5.80	4/5.80
Measuring	70	0/0.00	1/1.43	0/0.00	0/0.00	4/5.71	1/1.43	0/0.00	11/15.71	14/20.00	39/55.71

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	70	31/44.29	6/8.57	8/11.43	3/4.29	6/8.57	3/4.29	2/2.86	4/5.71	2/2.86	5/7.14
MIG Welding (GMAW)	73	13/17.81	2/2.74	2/2.74	1/1.37	3/4.11	2/2.74	4/5.48	10/13.70	11/15.07	25/34.25
OA Cutting	75	8/10.67	3/4.00	1/1.33	2/2.67	5/6.67	2/2.67	5/6.67	16/21.33	14/18.67	19/25.33
OA Welding	75	6/8.00	3/4.00	1/1.33	3/4.00	9/12.00	3/4.00	7/9.33	17/22.67	10/13.33	16/21.33
Painting	72	13/18.06	3/4.17	6/8.33	6/8.33	11/15.28	8/11.11	10/13.89	7/9.72	4/5.56	4/5.56
Plumbing and Pipe Fitting	74	1/1.35	1/1.35	2/2.70	1/1.35	6/8.11	8/10.81	14/18.92	20/27.03	11/14.86	10/13.51
Principles of Electricity	75	3/4.00	2/2.67	3/4.00	1/1.33	5/6.67	7/9.33	11/14.67	16/21.33	9/12.00	18/24.00
Rope Work	71	39/54.93	8/11.27	1/1.41	4/5.63	8/11.27	3/4.23	4/5.63	3/4.23	0/0.00	1/1.41
SAE	73	4/5.48	3/4.11	5/6.85	5/6.85	10/13.70	6/8.22	11/15.07	8/10.96	3/4.11	18/24.66
Safety Practices	75	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	2/2.67	2/2.67	5/6.67	66/88.00
Small Gas Engines	73	15/20.55	7/9.59	5/6.85	3/4.11	4/5.48	6/8.22	11/15.07	8/10.96	7/9.59	7/9.59
Stationary Power Tools	75	1/1.33	2/2.67	2/2.67	4/5.33	4/5.33	5/6.67	7/9.33	11/14.67	17/22.67	22/29.33
Student Projects	74	8/10.81	1/1.35	2/2.70	2/2.70	3/4.05	2/2.70	3/4.05	14/18.92	9/12.16	30/40.54
Surveying	73	19/26.03	5/6.85	5/6.85	4/5.48	14/19.18	6/8.22	12/16.44	4/5.48	0/0.00	4/5.48
TIG Welding (GTAW)	72	23/31.94	5/6.94	3/4.17	2/2.78	4/5.56	3/4.17	9/12.50	5/6.94	6/8.33	12/16.67
Tool Recond. & Maintenance	75	2/2.67	2/2.67	1/1.33	1/1.33	9/12.00	8/10.67	11/14.67	16/21.33	14/18.67	11/14.67
Tool Use & ID	68	0/0.00	0/0.00	1/1.47	1/1.47	4/5.88	3/4.41	5/7.35	15/22.06	16/23.53	23/33.82
Wood Working	74	12/16.22	1/1.35	4/5.41	7/9.46	10/13.51	8/10.81	4/5.41	9/12.16	8/10.81	11/14.86

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 65

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Female Idaho Agricultural Education Instructors (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	24	6/25.00	0/0.00	0/0.00	1/4.17	1/4.17	1/4.17	2/8.33	2/8.33	2/8.33	9/37.50
Bill of Materials	22	2/9.09	0/0.00	0/0.00	1/4.55	4/18.18	3/13.64	2/9.09	4/18.18	2/9.09	4/18.18
Careers in Ag Mechanics	24	0/0.00	2/8.33	1/4.17	1/4.17	3/12.50	3/12.50	2/8.33	3/12.50	4/16.67	5/20.83
Carpentry	24	4/16.67	2/8.33	0/0.00	5/20.83	3/12.50	2/8.33	3/12.50	2/8.33	1/4.17	2/8.33
Cleaning & Tool Storage	24	0/0.00	0/0.00	1/4.17	1/4.17	2/8.33	0/0.00	3/12.50	3/12.50	3/12.50	11/45.83
Cold Metal Work	23	0/0.00	0/0.00	4/17.39	1/4.35	2/8.70	2/8.70	6/26.09	3/13.04	4/17.39	1/4.35
Computerized Plasma/Mill	24	9/37.50	0/0.00	2/8.33	1/4.17	1/4.17	4/16.67	4/16.67	1/4.17	2/8.33	0/0.00
Concrete	24	5/20.83	3/12.50	2/8.33	3/12.50	4/16.67	1/4.17	4/16.67	0/0.00	1/4.17	1/4.17
Drafting & Sketching	24	1/4.17	2/8.33	0/0.00	2/8.33	3/12.50	2/8.33	8/33.33	3/12.50	3/12.50	0/0.00
Electrical Motors	24	5/20.83	1/4.17	1/4.17	1/4.17	6/25.00	1/4.17	3/12.50	5/20.83	1/4.17	0/0.00
Electrical Wiring	24	0/0.00	1/4.17	1/4.17	0/0.00	2/8.33	2/8.33	5/20.83	5/20.83	4/16.67	4/16.67
Fasteners	22	5/22.73	2/9.09	1/4.55	2/9.09	4/18.18	1/4.55	2/9.09	1/4.55	1/4.55	3/13.64
Fence Construction	24	5/20.83	4/16.67	3/12.50	3/12.50	3/12.50	2/8.33	2/8.33	1/4.17	1/4.17	0/0.00
FFA	24	1/4.17	2/8.33	1/4.17	3/12.50	1/4.17	2/8.33	2/8.33	2/8.33	4/16.67	6/25.00
Hand Tools	24	0/0.00	0/0.00	0/0.00	0/0.00	2/8.33	2/8.33	7/29.17	4/16.67	2/8.33	7/29.17
HH Plasma Cutting	24	7/29.17	0/0.00	0/0.00	1/4.17	0/0.00	2/8.33	4/16.67	1/4.17	2/8.33	7/29.17
HH Power Tools	24	0/0.00	0/0.00	0/0.00	1/4.17	2/8.33	1/4.17	5/20.83	5/20.83	2/8.33	8/33.33
Hot Metal Work	23	1/4.35	5/21.74	1/4.35	0/0.00	8/34.78	3/13.04	1/4.35	3/13.04	1/4.35	0/0.00
Hydraulics	23	9/39.13	1/4.35	2/8.70	3/13.04	2/8.70	3/13.04	1/4.35	1/4.35	0/0.00	1/4.35
Large Engines	24	10/41.67	1/4.17	3/12.50	1/4.17	3/12.50	2/8.33	3/12.50	0/0.00	0/0.00	1/4.17
Measuring	23	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	2/8.70	2/8.70	2/8.70	4/17.39	13/56.52

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	24	8/33.33	1/4.17	3/12.50	5/20.83	2/8.33	4/16.67	0/0.00	1/4.17	0/0.00	0/0.00
MIG Welding (GMAW)	24	7/29.17	0/0.00	0/0.00	2/8.33	3/12.50	2/8.33	1/4.17	1/4.17	1/4.17	7/29.17
OA Cutting	24	7/29.17	0/0.00	1/4.17	1/4.17	1/4.17	1/4.17	2/8.33	1/4.17	2/8.33	8/33.33
OA Welding	24	6/25.00	0/0.00	1/4.17	1/4.17	1/4.17	1/4.17	2/8.33	2/8.33	2/8.33	8/33.33
Painting	24	4/16.67	3/12.50	2/8.33	3/12.50	2/8.33	3/12.50	2/8.33	3/12.50	1/4.17	1/4.17
Plumbing and Pipe Fitting	24	1/4.17	0/0.00	0/0.00	2/8.33	0/0.00	5/20.83	6/25.00	5/20.83	2/8.33	3/12.50
Principles of Electricity	24	0/0.00	1/4.17	1/4.17	0/0.00	1/4.17	4/16.67	3/12.50	4/16.67	4/16.67	6/25.00
Rope Work	23	7/30.43	3/13.04	5/21.74	1/4.35	1/4.35	3/13.04	2/8.70	0/0.00	1/4.35	0/0.00
SAE	24	0/0.00	3/12.50	1/4.17	2/8.33	2/8.33	1/4.17	3/12.50	1/4.17	2/8.33	9/37.50
Safety Practices	24	0/0.00	0/0.00	1/4.17	0/0.00	0/0.00	0/0.00	2/8.33	1/4.17	1/4.17	19/79.17
Small Gas Engines	24	6/25.00	1/4.17	0/0.00	1/4.17	3/12.50	3/12.50	2/8.33	5/20.83	2/8.33	1/4.17
Stationary Power Tools	22	1/4.55	0/0.00	1/4.55	0/0.00	2/9.09	2/9.09	4/18.18	5/22.73	4/18.18	3/13.64
Student Projects	21	0/0.00	1/4.76	2/9.52	0/0.00	2/9.52	3/14.29	3/14.29	1/4.76	2/9.52	7/33.33
Surveying	24	6/25.00	2/8.33	1/4.17	6/25.00	1/4.17	3/12.50	2/8.33	2/8.33	1/4.17	0/0.00
TIG Welding (GTAW)	24	7/29.17	0/0.00	1/4.17	2/8.33	2/8.33	4/16.67	1/4.17	1/4.17	1/4.17	5/20.83
Tool Recond. & Maintenance	24	0/0.00	1/4.17	1/4.17	1/4.17	4/16.67	3/12.50	2/8.33	5/20.83	4/16.67	3/12.50
Tool Use & ID	24	0/0.00	0/0.00	1/4.17	0/0.00	2/8.33	2/8.33	0/0.00	4/16.67	6/25.00	9/37.50
Wood Working	24	4/16.67	0/0.00	2/8.33	1/4.17	2/8.33	5/20.83	3/12.50	3/12.50	2/8.33	2/8.33

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 66

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Science Certified Idaho Agricultural Education Instructors (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	50	8/16.00	2/4.00	1/2.00	1/2.00	1/2.00	2/4.00	5/10.00	10/20.00	4/8.00	16/32.00
Bill of Materials	47	2/4.26	0/0.00	1/2.13	2/4.26	9/19.15	5/10.64	6/12.77	7/14.89	6/12.77	9/19.15
Careers in Ag Mechanics	49	2/4.08	2/4.08	1/2.04	1/2.04	5/10.20	7/14.29	4/8.16	8/16.33	8/16.33	11/22.45
Carpentry	49	9/18.37	3/6.12	3/6.12	5/10.20	5/10.20	5/10.20	10/20.41	4/8.16	2/4.08	3/6.12
Cleaning & Tool Storage	50	0/0.00	1/2.00	1/2.00	2/4.00	1/2.00	1/2.00	6/12.00	7/14.00	8/16.00	23/46.00
Cold Metal Work	50	3/6.00	0/0.00	4/8.00	2/4.00	4/8.00	6/12.00	14/28.00	4/8.00	6/12.00	7/14.00
Computerized Plasma/Mill	48	22/45.83	1/2.08	1/2.08	2/4.17	3/6.25	5/10.42	4/8.33	5/10.42	3/6.25	2/4.17
Concrete	49	12/24.49	4/8.16	2/4.08	5/10.20	9/18.37	5/10.20	7/14.29	3/6.12	1/2.04	1/2.04
Drafting & Sketching	50	4/8.00	3/6.00	0/0.00	6/12.00	6/12.00	7/14.00	11/22.00	8/16.00	2/4.00	3/6.00
Electrical Motors	48	12/25.00	4/8.33	5/10.42	4/8.33	5/10.42	2/4.17	7/14.58	4/8.33	3/6.25	2/4.17
Electrical Wiring	49	2/4.08	1/2.04	3/6.12	0/0.00	1/2.04	2/4.08	8/16.33	14/28.57	7/14.29	11/22.45
Fasteners	49	6/12.24	2/4.08	3/6.12	2/4.08	12/24.49	6/12.24	6/12.24	4/8.16	4/8.16	4/8.16
Fence Construction	47	18/38.30	5/10.64	5/10.64	4/8.51	9/19.15	2/4.26	3/6.38	0/0.00	1/2.13	0/0.00
FFA	49	4/8.16	1/2.04	4/8.16	6/12.24	6/12.24	2/4.08	6/12.24	4/8.16	4/8.16	12/24.49
Hand Tools	49	0/0.00	0/0.00	2/4.08	2/4.08	6/12.24	3/6.12	14/28.57	7/14.29	4/8.16	11/22.45
HH Plasma Cutting	50	11/22.00	2/4.00	1/2.00	2/4.00	2/4.00	6/12.00	5/10.00	5/10.00	5/10.00	11/22.00
HH Power Tools	50	0/0.00	0/0.00	0/0.00	0/0.00	9/18.00	5/10.00	11/22.00	7/14.00	5/10.00	13/26.00
Hot Metal Work	49	7/14.29	5/10.20	3/6.12	3/6.12	11/22.45	6/12.24	4/8.16	5/10.20	4/8.16	1/2.04
Hydraulics	48	21/43.75	2/4.17	3/6.25	4/8.33	6/12.50	1/2.08	4/8.33	3/6.25	2/4.17	2/4.17
Large Engines	48	24/50.00	2/4.17	4/8.33	1/2.08	6/12.50	1/2.08	5/10.42	2/4.17	1/2.08	2/4.17
Measuring	47	0/0.00	0/0.00	0/0.00	0/0.00	1/2.13	1/2.13	2/4.26	10/21.28	11/23.40	22/46.81

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	47	21/44.68	2/4.26	7/14.89	4/8.51	5/10.64	3/6.38	0/0.00	4/8.51	1/2.13	0/0.00
MIG Welding (GMAW)	49	13/26.53	1/2.04	1/2.04	2/4.08	2/4.08	4/8.16	2/4.08	8/16.33	2/4.08	14/28.57
OA Cutting	50	8/16.00	2/4.00	1/2.00	2/4.00	3/6.00	3/6.00	5/10.00	9/18.00	6/12.00	11/22.00
OA Welding	50	6/12.00	2/4.00	0/0.00	3/6.00	5/10.00	2/4.00	6/12.00	11/22.00	4/8.00	11/22.00
Painting	49	9/18.37	3/6.12	5/10.20	4/8.16	7/14.29	5/10.20	7/14.29	5/10.20	2/4.08	2/4.08
Plumbing and Pipe Fitting	50	1/2.00	0/0.00	0/0.00	2/4.00	1/2.00	6/12.00	11/22.00	16/32.00	7/14.00	6/12.00
Principles of Electricity	50	2/4.00	2/4.00	4/8.00	0/0.00	1/2.00	4/8.00	9/18.00	10/20.00	6/12.00	12/24.00
Rope Work	48	23/47.92	4/8.33	4/8.33	4/8.33	5/10.42	2/4.17	4/8.33	1/2.08	1/2.08	0/0.00
SAE	50	1/2.00	3/6.00	3/6.00	4/8.00	6/12.00	5/10.00	6/12.00	5/10.00	3/6.00	14/28.00
Safety Practices	50	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	2/4.00	2/4.00	3/6.00	43/86.00
Small Gas Engines	50	9/18.00	5/10.00	2/4.00	1/2.00	3/6.00	5/10.00	9/18.00	8/16.00	4/8.00	4/8.00
Stationary Power Tools	48	1/2.08	1/2.08	2/4.17	2/4.17	3/6.25	5/10.42	8/16.67	8/16.67	10/20.83	8/16.67
Student Projects	46	2/4.35	1/2.17	4/8.70	0/0.00	3/6.52	3/6.52	4/8.70	9/19.57	4/8.70	16/34.78
Surveying	49	12/24.49	3/6.12	5/10.20	5/10.20	8/16.33	6/12.24	5/10.20	3/6.12	1/2.04	1/2.04
TIG Welding (GTAW)	48	18/37.50	2/4.17	3/6.25	2/4.17	1/2.08	5/10.42	7/14.58	3/6.25	2/4.17	5/10.42
Tool Recond. & Maintenance	50	1/2.00	1/2.00	1/2.00	1/2.00	4/8.00	7/14.00	9/18.00	14/28.00	6/12.00	6/12.00
Tool Use & ID	47	0/0.00	0/0.00	1/2.13	0/0.00	3/6.38	4/8.51	3/6.38	11/23.40	11/23.40	14/29.79
Wood Working	49	8/16.33	0/0.00	4/8.16	6/12.24	5/10.20	8/16.33	6/12.24	6/12.24	4/8.16	2/4.08

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 67

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors Without Science Certification (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	46	7/15.22	0/0.00	1/2.17	2/4.35	2/4.35	0/0.00	3/6.52	6/13.04	8/17.39	17/36.96
Bill of Materials	44	1/2.27	2/4.55	0/0.00	3/6.82	3/6.82	8/18.18	3/6.82	11/25.00	6/13.64	7/15.91
Careers in Ag Mechanics	46	4/8.70	4/8.70	1/2.17	2/4.35	7/15.22	2/4.35	2/4.35	7/15.22	7/15.22	10/21.74
Carpentry	46	8/17.39	2/4.35	2/4.35	4/8.70	8/17.39	4/8.70	2/4.35	7/15.22	3/6.52	6/13.04
Cleaning & Tool Storage	45	0/0.00	0/0.00	0/0.00	0/0.00	4/8.89	2/4.44	5/11.11	4/8.89	4/8.89	26/57.78
Cold Metal Work	45	1/2.22	1/2.22	1/2.22	4/8.89	3/6.67	3/6.67	9/20.00	12/26.67	6/13.33	5/11.11
Computerized Plasma/Mill	44	15/34.09	2/4.55	5/11.36	2/4.55	3/6.82	3/6.82	2/4.55	3/6.82	2/4.55	7/15.91
Concrete	46	10/21.74	3/6.52	5/10.87	4/8.70	5/10.87	5/10.87	7/15.22	3/6.52	2/4.35	2/4.35
Drafting & Sketching	46	3/6.52	3/6.52	1/2.17	2/4.35	4/8.70	3/6.52	7/15.22	8/17.39	7/15.22	8/17.39
Electrical Motors	44	7/15.91	5/11.36	0/0.00	1/2.27	12/27.27	5/11.36	6/13.64	4/9.09	2/4.55	2/4.55
Electrical Wiring	44	2/4.55	1/2.27	0/0.00	0/0.00	6/13.64	5/11.36	4/9.09	9/20.45	6/13.64	11/25.00
Fasteners	44	8/18.18	2/4.55	2/4.55	3/6.82	7/15.91	7/15.91	6/13.64	5/11.36	0/0.00	4/9.09
Fence Construction	44	16/36.36	2/4.55	5/11.36	5/11.36	5/11.36	5/11.36	3/6.82	1/2.27	0/0.00	2/4.55
FFA	45	2/4.44	4/8.89	2/4.44	2/4.44	5/11.11	4/8.89	7/15.56	6/13.33	5/11.11	8/17.78
Hand Tools	46	2/4.35	1/2.17	1/2.17	0/0.00	6/13.04	4/8.70	3/6.52	7/15.22	7/15.22	15/32.61
HH Plasma Cutting	45	9/20.00	1/2.22	2/4.44	2/4.44	3/6.67	0/0.00	5/11.11	4/8.89	8/17.78	11/24.44
HH Power Tools	46	2/4.35	1/2.17	1/2.17	2/4.35	1/2.17	3/6.52	3/6.52	8/17.39	10/21.74	15/32.61
Hot Metal Work	43	5/11.63	3/6.98	3/6.98	5/11.63	8/18.60	3/6.98	4/9.30	7/16.28	2/4.65	3/6.98
Hydraulics	43	12/27.91	5/11.63	4/9.30	2/4.65	5/11.63	6/13.95	3/6.98	0/0.00	3/6.98	3/6.98
Large Engines	42	16/38.10	4/9.52	3/7.14	3/7.14	3/7.14	3/7.14	3/7.14	1/2.38	3/7.14	3/7.14
Measuring	44	0/0.00	0/0.00	0/0.00	0/0.00	3/6.82	2/4.55	0/0.00	3/6.82	7/15.91	29/65.91

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	44	15/34.09	5/11.36	4/9.09	4/9.09	3/6.82	4/9.09	2/4.55	1/2.27	1/2.27	5/11.36
MIG Welding (GMAW)	45	6/13.33	1/2.22	1/2.22	1/2.22	4/8.89	0/0.00	3/6.67	3/6.67	10/22.22	16/35.56
OA Cutting	46	7/15.22	0/0.00	1/2.17	1/2.17	3/6.52	0/0.00	2/4.35	7/15.22	10/21.74	15/32.61
OA Welding	46	6/13.04	1/2.17	2/4.35	1/2.17	5/10.87	2/4.35	2/4.35	7/15.22	8/17.39	12/26.09
Painting	44	7/15.91	3/6.82	3/6.82	4/9.09	6/13.64	6/13.64	4/9.09	5/11.36	3/6.82	3/6.82
Plumbing and Pipe Fitting	46	1/2.17	1/2.17	2/4.35	0/0.00	5/10.87	7/15.22	8/17.39	9/19.57	6/13.04	7/15.22
Principles of Electricity	46	1/2.17	1/2.17	0/0.00	0/0.00	5/10.87	7/15.22	4/8.70	9/19.57	7/15.22	12/26.09
Rope Work	43	20/46.51	7/16.28	2/4.65	1/2.33	4/9.30	4/9.30	2/4.65	2/4.65	0/0.00	1/2.33
SAE	44	2/4.55	3/6.82	3/6.82	3/6.82	6/13.64	2/4.55	7/15.91	4/9.09	2/4.55	12/27.27
Safety Practices	46	0/0.00	0/0.00	1/2.17	0/0.00	0/0.00	0/0.00	2/4.35	1/2.17	3/6.52	39/84.78
Small Gas Engines	44	11/25.00	3/6.82	3/6.82	2/4.55	4/9.09	3/6.82	4/9.09	5/11.36	5/11.36	4/9.09
Stationary Power Tools	46	1/2.17	1/2.17	1/2.17	2/4.35	2/4.35	2/4.35	3/6.52	8/17.39	11/23.91	15/32.61
Student Projects	46	5/10.87	1/2.17	0/0.00	2/4.35	2/4.35	2/4.35	2/4.35	6/13.04	7/15.22	19/41.30
Surveying	45	11/24.44	4/8.89	1/2.22	4/8.89	7/15.56	3/6.67	9/20.00	3/6.67	0/0.00	3/6.67
TIG Welding (GTAW)	45	11/24.44	3/6.67	1/2.22	2/4.44	5/11.11	2/4.44	3/6.67	3/6.67	4/8.89	11/24.44
Tool Recond. & Maintenance	46	0/0.00	2/4.35	1/2.17	1/2.17	7/15.22	4/8.70	4/8.70	7/15.22	12/26.09	8/17.39
Tool Use & ID	43	0/0.00	0/0.00	1/2.33	0/0.00	3/6.98	1/2.33	1/2.33	8/18.60	11/25.58	18/41.86
Wood Working	46	7/15.22	1/2.17	1/2.17	2/4.35	7/15.22	5/10.87	1/2.17	6/13.04	6/13.04	10/21.74

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 68

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by University Certified Idaho Agricultural Education Instructors (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	81	13/16.05	2/2.47	1/1.23	2/2.47	3/3.70	2/2.47	7/8.64	16/19.75	9/11.11	26/32.10
Bill of Materials	77	2/2.60	1/1.30	1/1.30	4/5.19	11/14.29	12/15.58	8/10.39	16/20.78	11/14.29	11/14.29
Careers in Ag Mechanics	80	6/7.50	4/5.00	2/2.50	2/2.50	11/13.75	8/10.00	6/7.50	13/16.25	14/17.50	14/17.50
Carpentry	80	17/21.25	4/5.00	4/5.00	7/8.75	10/12.50	8/10.00	11/13.75	10/12.50	3/3.75	6/7.50
Cleaning & Tool Storage	81	0/0.00	1/1.23	1/1.23	2/2.47	4/4.94	3/3.70	9/11.11	10/12.35	10/12.35	41/50.62
Cold Metal Work	81	3/3.70	1/1.23	4/4.94	6/7.41	5/6.17	8/9.88	21/25.93	14/17.28	10/12.35	9/11.11
Computerized Plasma/Mill	79	34/43.04	3/3.80	5/6.33	3/3.80	4/5.06	7/8.86	6/7.59	7/8.86	3/3.80	7/8.86
Concrete	80	20/25.00	6/7.50	7/8.75	6/7.50	11/13.75	9/11.25	13/16.25	6/7.50	1/1.25	1/1.25
Drafting & Sketching	81	7/8.64	5/6.17	1/1.23	8/9.88	9/11.11	10/12.35	15/18.52	12/14.81	7/8.64	7/8.64
Electrical Motors	78	19/24.36	7/8.97	5/6.41	4/5.13	13/16.67	5/6.41	12/15.38	6/7.69	4/5.13	3/3.85
Electrical Wiring	79	4/5.06	1/1.27	3/3.80	0/0.00	4/5.06	7/8.86	10/12.66	21/26.58	12/15.19	17/21.52
Fasteners	79	13/16.46	3/3.80	5/6.33	3/3.80	17/21.52	12/15.19	11/13.92	8/10.13	3/3.80	4/5.06
Fence Construction	77	31/40.26	6/7.79	8/10.39	7/9.09	12/15.58	5/6.49	6/7.79	1/1.30	1/1.30	0/0.00
FFA	80	5/6.25	4/5.00	6/7.50	7/8.75	9/11.25	6/7.50	12/15.00	9/11.25	7/8.75	15/18.75
Hand Tools	80	1/1.25	1/1.25	3/3.75	2/2.50	10/12.50	6/7.50	17/21.25	12/15.00	10/12.50	18/22.50
HH Plasma Cutting	81	19/23.46	3/3.70	2/2.47	3/3.70	5/6.17	5/6.17	8/9.88	9/11.11	9/11.11	18/22.22
HH Power Tools	81	1/1.23	1/1.23	1/1.23	1/1.23	10/12.35	8/9.88	13/16.05	12/14.81	14/17.28	20/24.69
Hot Metal Work	78	11/14.10	8/10.26	3/3.85	8/10.26	16/20.51	9/11.54	7/8.97	9/11.54	6/7.69	1/1.28
Hydraulics	79	31/39.24	6/7.59	7/8.86	4/5.06	9/11.39	6/7.59	7/8.86	3/3.80	3/3.80	3/3.80
Large Engines	77	36/46.75	4/5.19	7/9.09	2/2.60	9/11.69	3/3.90	8/10.39	3/3.90	2/2.60	3/3.90
Measuring	77	0/0.00	0/0.00	0/0.00	0/0.00	4/5.19	3/3.90	1/1.30	13/16.88	14/18.18	42/54.55

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	77	31/40.26	5/6.49	11/14.29	6/7.79	8/10.39	6/7.79	2/2.60	4/5.19	1/1.30	3/3.90
MIG Welding (GMAW)	80	17/21.25	2/2.50	1/1.25	2/2.50	6/7.50	4/5.00	4/5.00	11/13.75	8/10.00	25/31.25
OA Cutting	81	13/16.05	2/2.47	1/1.23	2/2.47	6/7.41	3/3.70	7/8.64	16/19.75	12/14.81	19/23.46
OA Welding	81	11/13.58	2/2.47	0/0.00	3/3.70	10/12.35	3/3.70	8/9.88	16/19.75	10/12.35	18/22.22
Painting	80	16/20.00	5/6.25	6/7.50	6/7.50	11/13.75	10/12.50	11/13.75	7/8.75	5/6.25	3/3.75
Plumbing and Pipe Fitting	81	1/1.23	1/1.23	2/2.47	1/1.23	6/7.41	11/13.58	16/19.75	21/25.93	13/16.05	9/11.11
Principles of Electricity	81	3/3.70	2/2.47	4/4.94	0/0.00	3/3.70	11/13.58	12/14.81	16/19.75	12/14.81	18/22.22
Rope Work	78	40/51.28	8/10.26	4/5.13	5/6.41	8/10.26	4/5.13	5/6.41	3/3.85	1/1.28	0/0.00
SAE	80	3/3.75	5/6.25	6/7.50	6/7.50	9/11.25	7/8.75	12/15.00	8/10.00	5/6.25	19/23.75
Safety Practices	81	0/0.00	0/0.00	1/1.23	0/0.00	0/0.00	0/0.00	4/4.94	2/2.47	6/7.41	68/83.95
Small Gas Engines	81	18/22.22	6/7.41	5/6.17	2/2.47	6/7.41	5/6.17	13/16.05	12/14.81	8/9.88	6/7.41
Stationary Power Tools	79	2/2.53	2/2.53	2/2.53	4/5.06	5/6.33	6/7.59	10/12.66	12/15.19	20/25.32	16/20.25
Student Projects	77	6/7.79	1/1.30	4/5.19	2/2.60	4/5.19	4/5.19	6/7.79	15/19.48	10/12.99	25/32.47
Surveying	80	23/28.75	6/7.50	5/6.25	6/7.50	10/12.50	8/10.00	12/15.00	6/7.50	1/1.25	3/3.75
TIG Welding (GTAW)	79	26/32.91	5/6.33	3/3.80	3/3.80	6/7.59	6/7.59	10/12.66	5/6.33	3/3.80	12/15.19
Tool Recond. & Maintenance	81	1/1.23	2/2.47	2/2.47	2/2.47	9/11.11	10/12.35	11/13.58	20/24.69	15/18.52	9/11.11
Tool Use & ID	75	0/0.00	0/0.00	1/1.33	0/0.00	5/6.67	5/6.67	4/5.33	18/24.00	19/25.33	23/30.67
Wood Working	80	13/16.25	1/1.25	4/5.00	7/8.75	11/13.75	11/13.75	7/8.75	11/13.75	8/10.00	7/8.75

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 69

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Alternatively or Industry Certified Idaho Agricultural Education Instructors (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	12	1/8.33	0/0.00	1/8.33	1/8.33	0/0.00	0/0.00	1/8.33	0/0.00	3/25.00	5/41.67
Bill of Materials	12	1/8.33	1/8.33	0/0.00	1/8.33	1/8.33	1/8.33	1/8.33	2/16.67	1/8.33	3/25.00
Careers in Ag Mechanics	12	0/0.00	1/8.33	0/0.00	0/0.00	1/8.33	1/8.33	0/0.00	2/16.67	1/8.33	6/50.00
Carpentry	12	0/0.00	1/8.33	0/0.00	2/16.67	3/25.00	1/8.33	1/8.33	1/8.33	2/16.67	1/8.33
Cleaning & Tool Storage	11	0/0.00	0/0.00	0/0.00	0/0.00	1/9.09	0/0.00	2/18.18	1/9.09	2/18.18	5/45.45
Cold Metal Work	11	1/9.09	0/0.00	1/9.09	0/0.00	2/18.18	0/0.00	2/18.18	1/9.09	2/18.18	2/18.18
Computerized Plasma/Mill	10	2/20.00	0/0.00	1/10.00	1/10.00	2/20.00	1/10.00	0/0.00	1/10.00	1/10.00	1/10.00
Concrete	12	1/8.33	1/8.33	0/0.00	3/25.00	3/25.00	1/8.33	1/8.33	0/0.00	2/16.67	0/0.00
Drafting & Sketching	12	0/0.00	1/8.33	0/0.00	0/0.00	1/8.33	0/0.00	3/25.00	4/33.33	2/16.67	1/8.33
Electrical Motors	12	0/0.00	1/8.33	0/0.00	1/8.33	3/25.00	2/16.67	1/8.33	2/16.67	1/8.33	1/8.33
Electrical Wiring	11	0/0.00	1/9.09	0/0.00	0/0.00	2/18.18	0/0.00	2/18.18	2/18.18	1/9.09	3/27.27
Fasteners	11	0/0.00	1/9.09	0/0.00	2/18.18	2/18.18	1/9.09	1/9.09	1/9.09	1/9.09	2/18.18
Fence Construction	12	2/16.67	1/8.33	2/16.67	2/16.67	2/16.67	1/8.33	0/0.00	0/0.00	0/0.00	2/16.67
FFA	12	0/0.00	1/8.33	0/0.00	1/8.33	2/16.67	0/0.00	1/8.33	1/8.33	2/16.67	4/33.33
Hand Tools	12	0/0.00	0/0.00	0/0.00	0/0.00	2/16.67	1/8.33	0/0.00	2/16.67	1/8.33	6/50.00
HH Plasma Cutting	11	1/9.09	0/0.00	1/9.09	1/9.09	0/0.00	1/9.09	2/18.18	0/0.00	3/27.27	2/18.18
HH Power Tools	12	0/0.00	0/0.00	0/0.00	1/8.33	0/0.00	0/0.00	1/8.33	3/25.00	1/8.33	6/50.00
Hot Metal Work	11	1/9.09	0/0.00	3/27.27	0/0.00	2/18.18	0/0.00	1/9.09	3/27.27	0/0.00	1/9.09
Hydraulics	10	2/20.00	1/10.00	0/0.00	2/20.00	0/0.00	1/10.00	0/0.00	0/0.00	2/20.00	2/20.00
Large Engines	11	2/18.18	2/18.18	0/0.00	2/18.18	0/0.00	1/9.09	0/0.00	0/0.00	2/18.18	2/18.18
Measuring	11	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	1/9.09	0/0.00	4/36.36	6/54.55

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	11	3/27.27	2/18.18	0/0.00	2/18.18	0/0.00	1/9.09	0/0.00	1/9.09	1/9.09	1/9.09
MIG Welding (GMAW)	11	2/18.18	0/0.00	1/9.09	1/9.09	0/0.00	0/0.00	1/9.09	0/0.00	3/27.27	3/27.27
OA Cutting	12	1/8.33	0/0.00	1/8.33	1/8.33	0/0.00	0/0.00	0/0.00	0/0.00	4/33.33	5/41.67
OA Welding	12	1/8.33	1/8.33	1/8.33	1/8.33	0/0.00	1/8.33	0/0.00	1/8.33	2/16.67	4/33.33
Painting	11	0/0.00	1/9.09	2/18.18	2/18.18	2/18.18	1/9.09	0/0.00	2/18.18	0/0.00	1/9.09
Plumbing and Pipe Fitting	12	1/8.33	0/0.00	0/0.00	1/8.33	0/0.00	2/16.67	3/25.00	4/33.33	0/0.00	1/8.33
Principles of Electricity	12	0/0.00	1/8.33	0/0.00	0/0.00	2/16.67	0/0.00	1/8.33	3/25.00	1/8.33	4/33.33
Rope Work	11	2/18.18	2/18.18	2/18.18	0/0.00	1/9.09	2/18.18	1/9.09	0/0.00	0/0.00	1/9.09
SAE	12	0/0.00	1/8.33	0/0.00	0/0.00	3/25.00	0/0.00	1/8.33	1/8.33	0/0.00	6/50.00
Safety Practices	12	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	1/8.33	0/0.00	11/91.67
Small Gas Engines	11	2/18.18	1/9.09	0/0.00	1/9.09	0/0.00	3/27.27	0/0.00	1/9.09	1/9.09	2/18.18
Stationary Power Tools	12	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	1/8.33	1/8.33	4/33.33	1/8.33	5/41.67
Student Projects	12	1/8.33	1/8.33	0/0.00	0/0.00	1/8.33	1/8.33	0/0.00	0/0.00	1/8.33	7/58.33
Surveying	12	0/0.00	1/8.33	1/8.33	3/25.00	4/33.33	1/8.33	1/8.33	0/0.00	0/0.00	1/8.33
TIG Welding (GTAW)	11	2/18.18	0/0.00	1/9.09	1/9.09	0/0.00	1/9.09	0/0.00	0/0.00	3/27.27	3/27.27
Tool Recond. & Maintenance	12	0/0.00	1/8.33	0/0.00	0/0.00	2/16.67	1/8.33	2/16.67	1/8.33	3/25.00	2/16.67
Tool Use & ID	12	0/0.00	0/0.00	1/8.33	0/0.00	1/8.33	0/0.00	0/0.00	1/8.33	3/25.00	6/50.00
Wood Working	12	2/16.67	0/0.00	1/8.33	1/8.33	1/8.33	2/16.67	0/0.00	1/8.33	2/16.67	2/16.67

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 70

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors with One to Five Years of Experience Teaching Introductory Agricultural Mechanics (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	30	7/23.33	0/0.00	2/6.67	1/3.33	2/6.67	1/3.33	1/3.33	2/6.67	2/6.67	12/40.00
Bill of Materials	28	0/0.00	1/3.57	1/3.57	2/7.14	3/10.71	4/14.29	2/7.14	9/32.14	3/10.71	3/10.71
Careers in Ag Mechanics	30	1/3.33	3/10.00	0/0.00	2/6.67	3/10.00	1/3.33	1/3.33	6/20.00	5/16.67	8/26.67
Carpentry	30	5/16.67	0/0.00	0/0.00	2/6.67	2/6.67	4/13.33	5/16.67	3/10.00	3/10.00	6/20.00
Cleaning & Tool Storage	29	0/0.00	0/0.00	1/3.45	1/3.45	4/13.79	1/3.45	2/6.90	0/0.00	4/13.79	16/55.17
Cold Metal Work	30	1/3.33	1/3.33	3/10.00	0/0.00	3/10.00	1/3.33	4/13.33	7/23.33	7/23.33	3/10.00
Computerized Plasma/Mill	28	9/32.14	0/0.00	3/10.71	1/3.57	2/7.14	4/14.29	1/3.57	2/7.14	1/3.57	5/17.86
Concrete	30	4/13.33	3/10.00	1/3.33	2/6.67	7/23.33	2/6.67	5/16.67	2/6.67	2/6.67	2/6.67
Drafting & Sketching	30	2/6.67	0/0.00	1/3.33	1/3.33	4/13.33	2/6.67	5/16.67	6/20.00	4/13.33	5/16.67
Electrical Motors	29	5/17.24	1/3.45	0/0.00	2/6.90	6/20.69	5/17.24	3/10.34	4/13.79	1/3.45	2/6.90
Electrical Wiring	28	1/3.57	0/0.00	0/0.00	0/0.00	3/10.71	3/10.71	4/14.29	5/17.86	4/14.29	8/28.57
Fasteners	29	4/13.79	1/3.45	3/10.34	2/6.90	3/10.34	5/17.24	3/10.34	1/3.45	2/6.90	5/17.24
Fence Construction	28	8/28.57	1/3.57	3/10.71	2/7.14	5/17.86	5/17.86	2/7.14	0/0.00	1/3.57	1/3.57
FFA	29	2/6.90	1/3.45	2/6.90	3/10.34	3/10.34	2/6.90	2/6.90	3/10.34	4/13.79	7/24.14
Hand Tools	30	0/0.00	1/3.33	0/0.00	1/3.33	2/6.67	1/3.33	5/16.67	4/13.33	2/6.67	14/46.67
HH Plasma Cutting	29	6/20.69	0/0.00	2/6.90	2/6.90	1/3.45	2/6.90	3/10.34	3/10.34	3/10.34	7/24.14
HH Power Tools	30	0/0.00	1/3.33	0/0.00	1/3.33	1/3.33	2/6.67	3/10.00	6/20.00	2/6.67	14/46.67
Hot Metal Work	29	4/13.79	2/6.90	4/13.79	1/3.45	6/20.69	3/10.34	1/3.45	4/13.79	2/6.90	2/6.90
Hydraulics	28	7/25.00	4/14.29	2/7.14	3/10.71	3/10.71	3/10.71	1/3.57	0/0.00	2/7.14	3/10.71
Large Engines	27	10/37.04	2/7.41	2/7.41	3/11.11	1/3.70	1/3.70	3/11.11	0/0.00	2/7.41	3/11.11
Measuring	28	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	1/3.57	3/10.71	4/14.29	20/71.43

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	29	10/34.48	1/3.45	4/13.79	5/17.24	2/6.90	1/3.45	1/3.45	1/3.45	1/3.45	3/10.34
MIG Welding (GMAW)	29	7/24.14	0/0.00	2/6.90	1/3.45	3/10.34	1/3.45	0/0.00	1/3.45	4/13.79	10/34.48
OA Cutting	30	6/20.00	0/0.00	1/3.33	1/3.33	3/10.00	1/3.33	1/3.33	3/10.00	4/13.33	10/33.33
OA Welding	30	5/16.67	1/3.33	1/3.33	1/3.33	3/10.00	3/10.00	1/3.33	5/16.67	3/10.00	7/23.33
Painting	29	5/17.24	1/3.45	2/6.90	2/6.90	4/13.79	5/17.24	2/6.90	5/17.24	1/3.45	2/6.90
Plumbing and Pipe Fitting	30	0/0.00	0/0.00	0/0.00	1/3.33	1/3.33	6/20.00	6/20.00	9/30.00	2/6.67	5/16.67
Principles of Electricity	30	0/0.00	0/0.00	0/0.00	0/0.00	3/10.00	5/16.67	2/6.67	6/20.00	5/16.67	9/30.00
Rope Work	27	9/33.33	4/14.81	2/7.41	1/3.70	3/11.11	5/18.52	1/3.70	1/3.70	1/3.70	0/0.00
SAE	29	0/0.00	0/0.00	2/6.90	3/10.34	4/13.79	0/0.00	1/3.45	4/13.79	2/6.90	13/44.83
Safety Practices	30	0/0.00	0/0.00	1/3.33	0/0.00	0/0.00	0/0.00	1/3.33	0/0.00	2/6.67	26/86.67
Small Gas Engines	28	7/25.00	3/10.71	1/3.57	3/10.71	3/10.71	1/3.57	2/7.14	4/14.29	1/3.57	3/10.71
Stationary Power Tools	30	0/0.00	1/3.33	1/3.33	0/0.00	1/3.33	1/3.33	4/13.33	7/23.33	3/10.00	12/40.00
Student Projects	29	2/6.90	0/0.00	0/0.00	0/0.00	4/13.79	3/10.34	3/10.34	2/6.90	1/3.45	14/48.28
Surveying	29	6/20.69	2/6.90	2/6.90	3/10.34	7/24.14	3/10.34	3/10.34	1/3.45	0/0.00	2/6.90
TIG Welding (GTAW)	29	9/31.03	1/3.45	2/6.90	1/3.45	3/10.34	3/10.34	1/3.45	3/10.34	2/6.90	4/13.79
Tool Recond. & Maintenance	30	0/0.00	1/3.33	1/3.33	1/3.33	3/10.00	1/3.33	4/13.33	8/26.67	5/16.67	6/20.00
Tool Use & ID	28	0/0.00	0/0.00	1/3.57	0/0.00	2/7.14	2/7.14	0/0.00	3/10.71	6/21.43	14/50.00
Wood Working	30	4/13.33	0/0.00	3/10.00	2/6.67	1/3.33	6/20.00	1/3.33	5/16.67	3/10.00	5/16.67

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 71

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors with Six to Ten Years of Experience Teaching Introductory Agricultural Mechanics (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	16	2/12.50	1/6.25	0/0.00	0/0.00	0/0.00	1/6.25	2/12.50	3/18.75	2/12.50	5/31.25
Bill of Materials	16	2/12.50	1/6.25	0/0.00	2/12.50	1/6.25	3/18.75	2/12.50	2/12.50	1/6.25	2/12.50
Careers in Ag Mechanics	16	1/6.25	0/0.00	1/6.25	0/0.00	4/25.00	1/6.25	0/0.00	4/25.00	2/12.50	3/18.75
Carpentry	16	4/25.00	1/6.25	1/6.25	3/18.75	4/25.00	1/6.25	1/6.25	1/6.25	0/0.00	0/0.00
Cleaning & Tool Storage	16	0/0.00	0/0.00	0/0.00	0/0.00	1/6.25	0/0.00	1/6.25	3/18.75	1/6.25	10/62.50
Cold Metal Work	16	1/6.25	0/0.00	1/6.25	2/12.50	0/0.00	3/18.75	4/25.00	2/12.50	2/12.50	1/6.25
Computerized Plasma/Mill	16	9/56.25	0/0.00	2/12.50	1/6.25	0/0.00	0/0.00	1/6.25	1/6.25	1/6.25	1/6.25
Concrete	16	8/50.00	1/6.25	2/12.50	0/0.00	2/12.50	2/12.50	1/6.25	0/0.00	0/0.00	0/0.00
Drafting & Sketching	16	2/12.50	3/18.75	0/0.00	1/6.25	1/6.25	4/25.00	2/12.50	1/6.25	2/12.50	0/0.00
Electrical Motors	16	4/25.00	1/6.25	4/25.00	0/0.00	4/25.00	0/0.00	1/6.25	1/6.25	1/6.25	0/0.00
Electrical Wiring	16	0/0.00	1/6.25	2/12.50	0/0.00	2/12.50	1/6.25	2/12.50	2/12.50	2/12.50	4/25.00
Fasteners	16	6/37.50	1/6.25	1/6.25	0/0.00	4/25.00	1/6.25	2/12.50	0/0.00	0/0.00	1/6.25
Fence Construction	16	9/56.25	3/18.75	0/0.00	4/25.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00
FFA	16	2/12.50	1/6.25	1/6.25	1/6.25	3/18.75	0/0.00	4/25.00	0/0.00	1/6.25	3/18.75
Hand Tools	16	1/6.25	0/0.00	0/0.00	0/0.00	4/25.00	1/6.25	2/12.50	2/12.50	3/18.75	3/18.75
HH Plasma Cutting	16	5/31.25	2/12.50	0/0.00	1/6.25	1/6.25	0/0.00	1/6.25	0/0.00	3/18.75	3/18.75
HH Power Tools	16	1/6.25	0/0.00	0/0.00	0/0.00	2/12.50	2/12.50	2/12.50	3/18.75	2/12.50	4/25.00
Hot Metal Work	16	2/12.50	2/12.50	1/6.25	2/12.50	3/18.75	2/12.50	2/12.50	1/6.25	1/6.25	0/0.00
Hydraulics	16	8/50.00	0/0.00	2/12.50	2/12.50	2/12.50	0/0.00	0/0.00	1/6.25	1/6.25	0/0.00
Large Engines	15	8/53.33	0/0.00	2/13.33	0/0.00	4/26.67	0/0.00	0/0.00	1/6.67	0/0.00	0/0.00
Measuring	16	0/0.00	0/0.00	0/0.00	0/0.00	2/12.50	2/12.50	0/0.00	3/18.75	3/18.75	6/37.50

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	15	8/53.33	1/6.67	1/6.67	3/20.00	0/0.00	1/6.67	0/0.00	0/0.00	0/0.00	1/6.67
MIG Welding (GMAW)	16	4/25.00	1/6.25	0/0.00	0/0.00	2/12.50	0/0.00	1/6.25	2/12.50	2/12.50	4/25.00
OA Cutting	16	3/18.75	1/6.25	0/0.00	0/0.00	0/0.00	1/6.25	1/6.25	3/18.75	2/12.50	5/31.25
OA Welding	16	3/18.75	1/6.25	0/0.00	1/6.25	2/12.50	0/0.00	0/0.00	2/12.50	2/12.50	5/31.25
Painting	16	4/25.00	3/18.75	2/12.50	1/6.25	3/18.75	1/6.25	0/0.00	0/0.00	1/6.25	1/6.25
Plumbing and Pipe Fitting	16	0/0.00	1/6.25	0/0.00	0/0.00	1/6.25	1/6.25	5/31.25	2/12.50	4/25.00	2/12.50
Principles of Electricity	16	0/0.00	1/6.25	2/12.50	0/0.00	1/6.25	2/12.50	3/18.75	1/6.25	1/6.25	5/31.25
Rope Work	16	10/62.50	1/6.25	1/6.25	1/6.25	1/6.25	1/6.25	1/6.25	0/0.00	0/0.00	0/0.00
SAE	16	1/6.25	3/18.75	2/12.50	0/0.00	2/12.50	4/25.00	0/0.00	1/6.25	0/0.00	3/18.75
Safety Practices	16	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	2/12.50	0/0.00	0/0.00	14/87.50
Small Gas Engines	16	4/25.00	2/12.50	1/6.25	0/0.00	1/6.25	0/0.00	2/12.50	2/12.50	3/18.75	1/6.25
Stationary Power Tools	14	1/7.14	0/0.00	1/7.14	1/7.14	2/14.29	0/0.00	1/7.14	2/14.29	4/28.57	2/14.29
Student Projects	15	1/6.67	0/0.00	2/13.33	1/6.67	0/0.00	0/0.00	0/0.00	2/13.33	1/6.67	8/53.33
Surveying	16	9/56.25	0/0.00	2/12.50	1/6.25	2/12.50	1/6.25	1/6.25	0/0.00	0/0.00	0/0.00
TIG Welding (GTAW)	16	7/43.75	0/0.00	1/6.25	0/0.00	2/12.50	0/0.00	0/0.00	0/0.00	2/12.50	4/25.00
Tool Recond. & Maintenance	16	0/0.00	0/0.00	0/0.00	0/0.00	6/37.50	1/6.25	3/18.75	2/12.50	2/12.50	2/12.50
Tool Use & ID	16	0/0.00	0/0.00	0/0.00	0/0.00	3/18.75	1/6.25	2/12.50	2/12.50	2/12.50	6/37.50
Wood Working	16	3/18.75	0/0.00	0/0.00	2/12.50	4/25.00	2/12.50	0/0.00	2/12.50	2/12.50	1/6.25

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 72

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors with 11 to 20 Years of Experience Teaching Introductory Agricultural Mechanics (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	20	4/20.00	0/0.00	0/0.00	2/10.00	0/0.00	0/0.00	1/5.00	5/25.00	4/20.00	4/20.00
Bill of Materials	17	0/0.00	0/0.00	0/0.00	0/0.00	4/23.53	5/29.41	1/5.88	1/5.88	1/5.88	5/29.41
Careers in Ag Mechanics	20	2/10.00	1/5.00	1/5.00	0/0.00	1/5.00	1/5.00	2/10.00	3/15.00	4/20.00	5/25.00
Carpentry	20	3/15.00	3/15.00	2/10.00	1/5.00	2/10.00	1/5.00	3/15.00	2/10.00	0/0.00	3/15.00
Cleaning & Tool Storage	20	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	3/15.00	3/15.00	4/20.00	10/50.00
Cold Metal Work	20	2/10.00	0/0.00	1/5.00	1/5.00	1/5.00	2/10.00	8/40.00	0/0.00	1/5.00	4/20.00
Computerized Plasma/Mill	20	10/50.00	1/5.00	0/0.00	1/5.00	1/5.00	2/10.00	0/0.00	3/15.00	1/5.00	1/5.00
Concrete	20	4/20.00	2/10.00	2/10.00	1/5.00	2/10.00	5/25.00	2/10.00	2/10.00	0/0.00	0/0.00
Drafting & Sketching	20	0/0.00	1/5.00	0/0.00	3/15.00	4/20.00	0/0.00	5/25.00	2/10.00	1/5.00	4/20.00
Electrical Motors	20	5/25.00	3/15.00	1/5.00	0/0.00	3/15.00	0/0.00	3/15.00	1/5.00	2/10.00	2/10.00
Electrical Wiring	20	0/0.00	0/0.00	1/5.00	0/0.00	0/0.00	1/5.00	2/10.00	7/35.00	3/15.00	6/30.00
Fasteners	20	1/5.00	1/5.00	0/0.00	3/15.00	2/10.00	2/10.00	3/15.00	5/25.00	1/5.00	2/10.00
Fence Construction	20	7/35.00	2/10.00	3/15.00	3/15.00	4/20.00	0/0.00	1/5.00	0/0.00	0/0.00	0/0.00
FFA	20	1/5.00	2/10.00	2/10.00	3/15.00	2/10.00	0/0.00	2/10.00	1/5.00	2/10.00	5/25.00
Hand Tools	20	0/0.00	0/0.00	2/10.00	0/0.00	2/10.00	2/10.00	5/25.00	2/10.00	2/10.00	5/25.00
HH Plasma Cutting	20	5/25.00	0/0.00	1/5.00	1/5.00	1/5.00	2/10.00	2/10.00	2/10.00	4/20.00	2/10.00
HH Power Tools	20	0/0.00	0/0.00	1/5.00	0/0.00	2/10.00	2/10.00	4/20.00	1/5.00	4/20.00	6/30.00
Hot Metal Work	19	2/10.53	3/15.79	0/0.00	1/5.26	3/15.79	3/15.79	2/10.53	2/10.53	3/15.79	0/0.00
Hydraulics	20	8/40.00	2/10.00	1/5.00	0/0.00	3/15.00	0/0.00	1/5.00	2/10.00	2/10.00	1/5.00
Large Engines	20	10/50.00	2/10.00	1/5.00	0/0.00	1/5.00	0/0.00	2/10.00	2/10.00	1/5.00	1/5.00
Measuring	19	0/0.00	0/0.00	0/0.00	0/0.00	1/5.26	0/0.00	1/5.26	2/10.53	4/21.05	11/57.89

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	20	8/40.00	3/15.00	2/10.00	0/0.00	1/5.00	2/10.00	0/0.00	2/10.00	1/5.00	1/5.00
MIG Welding (GMAW)	20	5/25.00	1/5.00	0/0.00	2/10.00	0/0.00	1/5.00	2/10.00	3/15.00	2/10.00	4/20.00
OA Cutting	20	4/20.00	0/0.00	0/0.00	1/5.00	1/5.00	0/0.00	1/5.00	5/25.00	5/25.00	3/15.00
OA Welding	20	3/15.00	0/0.00	0/0.00	1/5.00	2/10.00	0/0.00	1/5.00	6/30.00	5/25.00	2/10.00
Painting	20	3/15.00	1/5.00	0/0.00	2/10.00	2/10.00	3/15.00	3/15.00	3/15.00	2/10.00	1/5.00
Plumbing and Pipe Fitting	20	1/5.00	0/0.00	2/10.00	0/0.00	1/5.00	1/5.00	5/25.00	6/30.00	1/5.00	3/15.00
Principles of Electricity	20	0/0.00	1/5.00	1/5.00	0/0.00	0/0.00	2/10.00	4/20.00	4/20.00	3/15.00	5/25.00
Rope Work	20	11/55.00	2/10.00	1/5.00	2/10.00	1/5.00	0/0.00	1/5.00	2/10.00	0/0.00	0/0.00
SAE	20	0/0.00	1/5.00	2/10.00	1/5.00	3/15.00	1/5.00	5/25.00	1/5.00	1/5.00	5/25.00
Safety Practices	20	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	1/5.00	0/0.00	2/10.00	17/85.00
Small Gas Engines	20	5/25.00	1/5.00	2/10.00	0/0.00	1/5.00	0/0.00	2/10.00	4/20.00	2/10.00	3/15.00
Stationary Power Tools	20	1/5.00	0/0.00	0/0.00	2/10.00	0/0.00	3/15.00	2/10.00	1/5.00	6/30.00	5/25.00
Student Projects	19	2/10.53	1/5.26	1/5.26	0/0.00	1/5.26	0/0.00	1/5.26	2/10.53	3/15.79	8/42.11
Surveying	20	3/15.00	2/10.00	0/0.00	3/15.00	3/15.00	2/10.00	5/25.00	0/0.00	0/0.00	2/10.00
TIG Welding (GTAW)	20	9/45.00	2/10.00	0/0.00	1/5.00	0/0.00	0/0.00	4/20.00	2/10.00	1/5.00	1/5.00
Tool Recond. & Maintenance	20	1/5.00	1/5.00	0/0.00	0/0.00	2/10.00	4/20.00	1/5.00	6/30.00	3/15.00	2/10.00
Tool Use & ID	20	0/0.00	0/0.00	0/0.00	0/0.00	1/5.00	1/5.00	1/5.00	6/30.00	5/25.00	6/30.00
Wood Working	20	3/15.00	1/5.00	1/5.00	1/5.00	2/10.00	3/15.00	2/10.00	2/10.00	1/5.00	4/20.00

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 73

Frequency Table of the Importance of Selected Units of Instruction to the Introductory Agricultural Mechanics Courses at their Respective Schools as Rated by Idaho Agricultural Education Instructors with More Than 20 Years of Experience Teaching Introductory Agricultural Mechanics (f/%)

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Arc Welding (SMAW)	19	2/10.53	0/0.00	0/0.00	0/0.00	1/5.26	0/0.00	2/10.53	5/26.32	2/10.53	7/36.84
Bill of Materials	19	0/0.00	0/0.00	0/0.00	1/5.26	4/21.05	1/5.26	3/15.79	4/21.05	6/31.58	0/0.00
Careers in Ag Mechanics	18	2/11.11	0/0.00	0/0.00	1/5.56	2/11.11	4/22.22	3/16.67	2/11.11	3/16.67	1/5.56
Carpentry	18	5/27.78	0/0.00	1/5.56	1/5.56	3/16.67	2/11.11	2/11.11	2/11.11	1/5.56	1/5.56
Cleaning & Tool Storage	19	0/0.00	1/5.26	0/0.00	1/5.26	0/0.00	2/10.53	2/10.53	3/15.79	2/10.53	8/42.11
Cold Metal Work	19	0/0.00	0/0.00	0/0.00	2/10.53	2/10.53	1/5.26	4/21.05	6/31.58	3/15.79	1/5.26
Computerized Plasma/Mill	17	7/41.18	1/5.88	0/0.00	1/5.88	2/11.76	0/0.00	1/5.88	2/11.76	0/0.00	3/17.65
Concrete	18	5/27.78	0/0.00	1/5.56	4/22.22	2/11.11	1/5.56	4/22.22	1/5.56	0/0.00	0/0.00
Drafting & Sketching	19	4/21.05	1/5.26	0/0.00	2/10.53	0/0.00	4/21.05	3/15.79	4/21.05	1/5.26	0/0.00
Electrical Motors	16	5/31.25	2/12.50	0/0.00	3/18.75	2/12.50	0/0.00	3/18.75	1/6.25	0/0.00	0/0.00
Electrical Wiring	19	3/15.79	0/0.00	0/0.00	0/0.00	0/0.00	3/15.79	4/21.05	4/21.05	3/15.79	2/10.53
Fasteners	18	2/11.11	0/0.00	0/0.00	0/0.00	8/44.44	3/16.67	3/16.67	2/11.11	0/0.00	0/0.00
Fence Construction	16	10/62.50	0/0.00	1/6.25	0/0.00	3/18.75	1/6.25	1/6.25	0/0.00	0/0.00	0/0.00
FFA	18	1/5.56	0/0.00	1/5.56	1/5.56	3/16.67	4/22.22	3/16.67	3/16.67	2/11.11	0/0.00
Hand Tools	18	0/0.00	0/0.00	1/5.56	1/5.56	3/16.67	0/0.00	3/16.67	4/22.22	3/16.67	3/16.67
HH Plasma Cutting	18	3/16.67	1/5.56	0/0.00	0/0.00	2/11.11	2/11.11	0/0.00	4/22.22	1/5.56	5/27.78
HH Power Tools	19	0/0.00	0/0.00	0/0.00	0/0.00	5/26.32	1/5.26	3/15.79	2/10.53	5/26.32	3/15.79
Hot Metal Work	17	5/29.41	1/5.88	1/5.88	2/11.76	4/23.53	0/0.00	2/11.76	2/11.76	0/0.00	0/0.00
Hydraulics	17	10/58.82	0/0.00	0/0.00	0/0.00	2/11.76	2/11.76	3/17.65	0/0.00	0/0.00	0/0.00
Large Engines	17	10/58.82	0/0.00	0/0.00	1/5.88	2/11.76	1/5.88	2/11.76	0/0.00	1/5.88	0/0.00
Measuring	17	0/0.00	0/0.00	0/0.00	0/0.00	1/5.88	0/0.00	0/0.00	4/23.53	2/11.76	10/58.82

Table Continues

Table Continued

Unit	*n*	1	2	3	4	5	6	7	8	9	10
Metal Lathe Work	16	9/56.25	0/0.00	0/0.00	0/0.00	5/31.25	0/0.00	1/6.25	1/6.25	0/0.00	0/0.00
MIG Welding (GMAW)	18	2/11.11	0/0.00	0/0.00	0/0.00	1/5.56	1/5.56	1/5.56	4/22.22	2/11.11	7/38.89
OA Cutting	19	2/10.53	1/5.26	0/0.00	0/0.00	2/10.53	1/5.26	3/15.79	4/21.05	3/15.79	3/15.79
OA Welding	19	1/5.26	1/5.26	0/0.00	0/0.00	3/15.79	0/0.00	4/21.05	5/26.32	1/5.26	4/21.05
Painting	18	3/16.67	0/0.00	3/16.67	2/11.11	3/16.67	2/11.11	4/22.22	1/5.56	0/0.00	0/0.00
Plumbing and Pipe Fitting	19	0/0.00	0/0.00	0/0.00	0/0.00	1/5.26	4/21.05	2/10.53	6/31.58	5/26.32	1/5.26
Principles of Electricity	19	3/15.79	0/0.00	1/5.26	0/0.00	0/0.00	2/10.53	3/15.79	6/31.58	2/10.53	2/10.53
Rope Work	18	11/61.11	1/5.56	0/0.00	1/5.56	4/22.22	0/0.00	1/5.56	0/0.00	0/0.00	0/0.00
SAE	19	2/10.53	1/5.26	0/0.00	2/10.53	3/15.79	2/10.53	4/21.05	2/10.53	1/5.26	2/10.53
Safety Practices	19	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	2/10.53	1/5.26	16/84.21
Small Gas Engines	19	4/21.05	1/5.26	1/5.26	1/5.26	1/5.26	4/21.05	3/15.79	2/10.53	2/10.53	0/0.00
Stationary Power Tools	19	0/0.00	1/5.26	0/0.00	0/0.00	2/10.53	2/10.53	3/15.79	2/10.53	5/26.32	4/21.05
Student Projects	18	2/11.11	0/0.00	1/5.56	0/0.00	0/0.00	0/0.00	1/5.56	8/44.44	3/16.67	3/16.67
Surveying	18	5/27.78	1/5.56	1/5.56	2/11.11	2/11.11	2/11.11	2/11.11	3/16.67	0/0.00	0/0.00
TIG Welding (GTAW)	17	3/17.65	2/11.76	1/5.88	1/5.88	1/5.88	2/11.76	3/17.65	1/5.88	1/5.88	2/11.76
Tool Recond. & Maintenance	19	0/0.00	0/0.00	1/5.26	0/0.00	1/5.26	3/15.79	3/15.79	4/21.05	6/31.58	1/5.26
Tool Use & ID	15	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	0/0.00	1/6.67	7/46.67	5/33.33	2/13.33
Wood Working	18	3/16.67	0/0.00	0/0.00	3/16.67	3/16.67	0/0.00	2/11.11	3/16.67	3/16.67	1/5.56

Note. Rated on a 10-Point Scale with anchors of 1 = *"Not Very Important"* to 10 = *"Very Important";* OA = Oxy-Acetylene, HH = Hand Held; SAE = Supervised Agricultural Experience

Table 74

All Respondent Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	2/2.41	5/6.02	6/7.23	24/28.92	33/39.76	13/15.66
Technology	1/1.11	7/7.78	3/3.33	24/26.67	42/46.67	13/14.44
Engineering	0/0.00	4/4.35	4/4.35	31/33.70	38/41.30	15/16.30
Mathematics	0/0.00	1/1.09	1/1.09	14/15.22	47/51.09	29/31.52
English	1/1.08	10/10.75	13/13.98	38/40.86	26/27.96	5/5.38
Communications	0/0.00	3/3.23	6/6.45	34/36.56	36/38.71	14/15.05

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 75

Respondents Currently Teaching IAM Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	2/3.77	4/7.55	3/5.66	16/30.19	23/43.40	5/9.43
Technology	1/1.64	5/8.20	3/4.92	20/32.79	25/40.98	7/11.48
Engineering	0/0.00	4/6.56	4/6.56	19/31.15	23/37.70	11/18.03
Mathematics	0/0.00	1/1.61	1/1.61	9/14.52	30/48.39	21/33.87
English	1/1.61	6/9.68	12/19.35	24/38.71	17/27.42	2/3.23
Communications	0/0.00	2/3.23	4/6.45	26/41.94	21/33.87	9/14.52

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 76

Respondents Not Teaching IAM Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	0/0.00	1/3.33	3/10.00	8/26.67	10/33.33	8/26.67
Technology	0/0.00	2/6.90	0/0.00	4/13.79	17/58.62	6/20.69
Engineering	0/0.00	0/0.00	0/0.00	12/38.71	15/48.39	4/12.90
Mathematics	0/0.00	0/0.00	0/0.00	5/16.67	17/56.67	8/26.67
English	0/0.00	4/12.90	1/3.23	14/45.16	9/29.03	3/9.68
Communications	0/0.00	1/3.23	2/6.45	8/25.81	15/48.39	5/16.13

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 77

Male Respondents Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	1/1.67	4/6.67	5/8.33	16/26.67	27/45.00	7/11.67
Technology	0/0.00	7/10.45	3/4.48	19/28.36	29/43.28	9/13.43
Engineering	0/0.00	3/4.35	3/4.35	26/37.68	28/40.58	9/13.04
Mathematics	0/0.00	1/1.45	1/1.45	10/14.49	37/53.62	20/28.99
English	1/1.43	7/10.00	11/15.71	32/45.71	15/21.43	4/5.71
Communications	0/0.00	2/2.86	4/5.71	26/37.14	27/38.57	11/15.71

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 78

Female Respondents Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	1/4.35	1/4.35	1/4.35	8/34.78	6/26.09	6/26.09
Technology	1/4.35	0/0.00	0/0.00	5/21.74	13/56.52	4/17.39
Engineering	0/0.00	1/4.35	1/4.35	5/21.74	10/43.48	6/26.09
Mathematics	0/0.00	0/0.00	0/0.00	4/17.39	10/43.48	9/39.13
English	0/0.00	3/13.04	2/8.70	6/26.09	11/47.83	1/4.35
Communications	0/0.00	1/4.35	2/8.70	8/34.78	9/39.13	3/13.04

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 79

University Certified Respondents Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	1/1.45	5/7.25	6/8.70	22/31.88	26/37.68	9/13.04
Technology	0/0.00	7/9.09	3/3.90	22/28.57	36/46.75	9/11.69
Engineering	0/0.00	4/5.19	3/3.90	29/37.66	32/41.56	9/11.69
Mathematics	0/0.00	1/1.28	1/1.28	13/16.67	42/53.85	21/26.92
English	1/1.28	8/10.26	11/14.10	33/42.31	23/29.49	2/2.56
Communications	0/0.00	3/3.85	5/6.41	30/38.46	33/42.31	7/8.97

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 80

Industry or Alternatively Certified Respondents Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	1/8.33	0/0.00	0/0.00	2/16.67	6/50.00	3/25.00
Technology	1/8.33	0/0.00	0/0.00	2/16.67	6/50.00	3/25.00
Engineering	1/8.33	0/0.00	0/0.00	2/16.67	5/41.67	4/33.33
Mathematics	0/0.00	0/0.00	0/0.00	1/8.33	5/41.67	6/50.00
English	0/0.00	2/16.67	2/16.67	5/41.67	2/16.67	1/8.33
Communications	0/0.00	0/0.00	1/8.33	4/33.33	2/16.67	5/41.67

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 81

Science Certified Respondents Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	1/2.33	3/6.98	2/4.65	12/27.91	17/39.53	8/18.60
Technology	1/2.13	0/0.00	3/6.38	12/25.53	24/51.06	7/14.89
Engineering	0/0.00	1/2.13	2/4.26	15/31.91	20/42.55	9/19.15
Mathematics	0/0.00	0/0.00	0/0.00	9/18.75	25/52.08	14/29.17
English	1/2.08	5/10.42	4/8.33	22/45.83	15/31.25	1/2.08
Communications	0/0.00	1/2.08	2/4.17	20/41.67	19/39.58	6/12.50

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 82

Non-Science Certified Respondents Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	1/2.63	2/5.26	3/7.89	12/31.58	15/39.47	5/13.16
Technology	0/0.00	4/9.76	3/7.32	10/24.39	18/43.90	6/14.63
Engineering	0/0.00	3/6.98	1/2.33	15/34.88	18/41.86	6/13.95
Mathematics	0/0.00	1/2.38	1/2.38	5/11.90	20/47.62	15/35.71
English	0/0.00	5/11.63	8/18.60	15/34.88	11/25.58	4/9.30
Communications	0/0.00	2/4.65	4/9.30	14/32.56	15/34.88	8/18.60

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 83

Respondents with One to Five Years Experience Teaching IAM Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	2/7.69	0/0.00	2/7.69	7/26.92	9/34.62	6/23.08
Technology	1/3.70	1/3.70	0/0.00	6/22.22	12/44.44	7/25.93
Engineering	0/0.00	1/3.57	1/3.57	8/28.57	9/32.14	9/32.14
Mathematics	0/0.00	1/3.57	0/0.00	1/3.57	12/42.86	14/50.00
English	1/3.57	2/7.14	5/17.86	9/32.14	8/28.57	3/10.71
Communications	0/0.00	1/3.57	2/7.14	8/28.57	10/35.71	7/25.00

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 84

Respondents with Six to 10 Years Experience Teaching IAM Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	0/0.00	2/13.33	1/6.67	7/46.67	2/13.33	3/20.00
Technology	0/0.00	2/13.33	1/6.67	4/26.67	6/40.00	2/13.33
Engineering	0/0.00	2/13.33	0/0.00	1/6.67	8/53.33	4/26.67
Mathematics	0/0.00	0/0.00	1/6.67	3/20.00	8/53.33	3/20.00
English	0/0.00	2/13.33	4/26.67	5/33.33	4/26.67	0/0.00
Communications	0/0.00	0/0.00	3/20.00	7/46.67	4/26.67	1/6.67

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 85

Respondents with 11 to 20 Years Experience Teaching IAM Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	0/0.00	1/5.88	0/0.00	6/35.29	8/47.06	2/11.76
Technology	0/0.00	1/5.56	2/11.11	4/22.22	8/44.44	3/16.67
Engineering	0/0.00	1/5.56	1/5.56	8/44.44	6/33.33	2/11.11
Mathematics	0/0.00	0/0.00	0/0.00	4/21.05	11/57.89	4/21.05
English	0/0.00	3/15.79	3/15.79	7/36.84	5/26.32	1/5.26
Communications	0/0.00	2/10.53	0/0.00	7/36.84	6/31.58	4/21.05

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 86

Respondents with over 20 Years Experience Teaching IAM Perceptions of Introductory Agricultural Mechanics Courses as a Good Context for Teaching Selected Academic Disciplines (*f*/%)

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Science	0/0.00	1/7.14	2/14.29	2/14.29	9/64.29	0/0.00
Technology	0/0.00	3/15.00	0/0.00	7/35.00	10/50.00	0/0.00
Engineering	0/0.00	0/0.00	2/10.00	9/45.00	9/45.00	0/0.00
Mathematics	0/0.00	0/0.00	0/0.00	3/15.00	11/55.00	6/30.00
English	0/0.00	2/10.00	0/0.00	12/60.00	6/30.00	0/0.00
Communications	0/0.00	0/0.00	1/5.00	9/45.00	10/50.00	0/0.00

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 87

All Respondents Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	18/19.35	16/17.20	14/15.05	17/18.28	17/18.28	11/11.83
Equipment to teach integrated STEM	16/18.82	25/29.41	15/17.65	14/16.47	10/11.76	5/5.88
Technology to allow students to design projects	13/14.13	25/27.17	12/13.04	23/25.00	13/14.13	6/6.52
Equipment to allow students to build projects	11/11.96	8/8.70	6/6.52	21/22.83	33/35.87	13/14.13
Space to allow students to evaluate and test student designed projects	17/18.28	14/15.05	11/11.83	16/17.20	23/24.73	12/12.90

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 88

Respondents Currently Teaching IAM Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	11/16.92	12/18.46	8/12.31	14/21.54	13/20.00	7/10.77
Equipment to teach integrated STEM	9/15.00	17/28.33	11/18.33	13/21.67	7/11.67	3/5.00
Technology to allow students to design projects	9/14.06	17/26.56	8/12.50	18/28.13	10/15.63	2/3.13
Equipment to allow students to build projects	6/9.38	4/6.25	4/6.25	16/25.00	25/39.06	9/14.06
Space to allow students to evaluate and test student designed projects	10/15.38	9/13.85	6/9.23	14/21.54	19/29.23	7/10.77

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 89

Respondents Not Currently Teaching IAM Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	7/25.00	4/14.29	6/21.43	3/10.71	4/14.29	4/14.29
Equipment to teach integrated STEM	7/28.00	8/32.00	4/16.00	1/4.00	3/12.00	2/8.00
Technology to allow students to design projects	4/14.29	8/28.57	4/14.29	5/17.86	3/10.71	4/14.29
Equipment to allow students to build projects	5/17.86	4/14.29	2/7.14	5/17.86	8/28.57	4/14.29
Space to allow students to evaluate and test student designed projects	7/25.00	5/17.86	5/17.86	2/7.14	4/14.29	5/17.86

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 90

Male Respondent's Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	11/15.49	12/16.90	12/16.90	14/19.72	14/19.72	8/11.27
Equipment to teach integrated STEM	11/17.19	19/29.69	12/18.75	11/17.19	7/10.94	4/6.25
Technology to allow students to design projects	10/14.29	19/27.14	9/12.86	18/25.71	9/12.86	5/7.14
Equipment to allow students to build projects	8/11.43	4/5.71	6/8.57	15/21.43	27/38.57	10/14.29
Space to allow students to evaluate and test student designed projects	12/16.90	10/14.08	7/9.86	13/18.31	19/26.76	10/14.08

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 91

Female Respondent's Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	7/31.82	4/18.18	2/9.09	3/13.64	3/13.64	3/13.64
Equipment to teach integrated STEM	5/23.81	6/28.57	3/14.29	3/14.29	3/14.29	1/4.76
Technology to allow students to design projects	3/13.64	6/27.27	3/13.64	5/22.73	4/18.18	1/4.55
Equipment to allow students to build projects	3/13.64	4/18.18	0/0.00	6/27.27	6/27.27	3/13.64
Space to allow students to evaluate and test student designed projects	5/22.73	4/18.18	4/18.18	3/13.64	4/18.18	2/9.09

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 92

University Certified Respondents Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	12/15.00	13/16.25	12/15.00	17/21.25	16/20.00	10/12.50
Equipment to teach integrated STEM	10/13.89	21/29.17	13/18.06	14/19.44	9/12.50	5/6.94
Technology to allow students to design projects	8/10.13	22/27.85	12/15.19	19/24.05	12/15.19	6/7.59
Equipment to allow students to build projects	6/7.50	7/8.75	6/7.50	17/21.25	31/38.75	13/16.25
Space to allow students to evaluate and test student designed projects	10/12.50	12/15.00	9/11.25	16/20.00	21/26.25	12/15.00

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 93

Industry or Alternatively Certified Respondents Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	4/40.00	3/30.00	2/20.00	0/0.00	1/10.00	0/0.00
Equipment to teach integrated STEM	4/40.00	4/40.00	1/10.00	0/0.00	1/10.00	0/0.00
Technology to allow students to design projects	3/30.00	3/30.00	0/0.00	3/30.00	1/10.00	0/0.00
Equipment to allow students to build projects	4/40.00	1/10.00	0/0.00	3/30.00	2/20.00	0/0.00
Space to allow students to evaluate and test student designed projects	5/50.00	2/20.00	1/10.00	0/0.00	2/20.00	0/0.00

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 94

Science Certified Respondent's Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	9/18.37	8/16.33	6/12.24	11/22.45	10/20.41	5/10.20
Equipment to teach integrated STEM	8/17.39	13/28.26	5/10.87	12/26.09	5/10.87	3/6.52
Technology to allow students to design projects	6/12.50	14/29.17	6/12.50	12/25.00	8/16.67	2/4.17
Equipment to allow students to build projects	5/10.20	5/10.20	5/10.20	8/16.33	19/38.78	7/14.29
Space to allow students to evaluate and test student designed projects	7/14.29	8/16.33	6/12.24	9/18.37	13/26.53	6/12.24

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 95

Non-Science Certified Respondent's Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	9/20.93	8/18.60	8/18.60	6/13.95	6/13.95	6/13.95
Equipment to teach integrated STEM	8/21.05	12/31.58	10/26.32	2/5.26	4/10.53	2/5.26
Technology to allow students to design projects	7/16.28	10/23.26	6/13.95	11/25.58	5/11.63	4/9.30
Equipment to allow students to build projects	6/14.29	3/7.14	1/2.38	13/30.95	13/30.95	6/14.29
Space to allow students to evaluate and test student designed projects	10/23.26	5/11.63	5/11.63	7/16.28	10/23.26	6/13.95

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 96

Teachers with One to Five Years of Experience Teaching IAM Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	8/29.63	4/14.81	3/11.11	3/11.11	5/18.52	4/14.81
Equipment to teach integrated STEM	7/29.17	7/29.17	2/8.33	3/12.50	4/16.67	1/4.17
Technology to allow students to design projects	6/22.22	5/18.52	3/11.11	7/25.93	4/14.81	2/7.41
Equipment to allow students to build projects	6/23.08	1/3.85	1/3.85	5/19.23	10/38.46	3/11.54
Space to allow students to evaluate and test student designed projects	8/29.63	3/11.11	1/3.70	5/18.52	7/25.93	3/11.11

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 97

Teachers with Six to 10 Years of Experience Teaching IAM Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	3/20.00	3/20.00	0/0.00	4/26.67	3/20.00	2/13.33
Equipment to teach integrated STEM	3/21.43	4/28.57	2/14.29	2/14.29	2/14.29	1/7.14
Technology to allow students to design projects	2/13.33	5/33.33	1/6.67	3/20.00	3/20.00	1/6.67
Equipment to allow students to build projects	0/0.00	3/20.00	1/6.67	3/20.00	6/40.00	2/13.33
Space to allow students to evaluate and test student designed projects	1/6.67	5/33.33	2/13.33	0/0.00	6/40.00	1/6.67

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 98

Teachers with 11 to 20 Years of Experience Teaching IAM Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	3/15.00	4/20.00	3/15.00	4/20.00	4/20.00	2/10.00
Equipment to teach integrated STEM	3/16.67	7/38.89	3/16.67	3/16.67	1/5.56	1/5.56
Technology to allow students to design projects	3/15.00	5/25.00	2/10.00	6/30.00	3/15.00	1/5.00
Equipment to allow students to build projects	3/15.00	2/10.00	0/0.00	5/25.00	6/30.00	4/20.00
Space to allow students to evaluate and test student designed projects	3/15.00	1/5.00	3/15.00	4/20.00	5/25.00	4/20.00

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 99

Teachers with More than 20 Years of Experience Teaching IAM Perceptions of their School Laboratories Adequacy Relating to STEM Integrated Introductory Mechanics Courses

Facilities Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Space to teach integrated STEM	1/5.00	2/10.00	5/25.00	5/25.00	4/20.00	3/15.00
Equipment to teach integrated STEM	0/0.00	3/16.67	5/27.78	5/27.78	3/16.67	2/11.11
Technology to allow students to design projects	0/0.00	6/31.58	5/26.32	4/21.05	2/10.53	2/10.53
Equipment to allow students to build projects	0/0.00	0/0.00	3/15.00	6/30.00	7/35.00	4/20.00
Space to allow students to evaluate and test student designed projects	2/10.00	2/10.00	2/10.00	7/35.00	3/15.00	4/20.00

Note. As measured on a 6-point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 100

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for All Respondents (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	5/5.75	14/16.09	17/19.54	24/27.59	23/26.44	4/4.60
Teaching students to explore their own ideas will make my students more employable.	2/2.25	2/2.25	5/5.62	25/28.09	43/48.31	12/13.48
Teaching students to design solutions to problems will make my students more employable.	2/2.22	0/0.00	4/4.44	15/16.67	44/48.89	25/27.78
Teaching students to be a productive part of a team will make my students more employable.	2/2.27	0/0.00	1/1.14	9/10.23	41/46.59	35/39.77
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	2/2.25	0/0.00	2/2.25	13/14.61	40/44.94	32/35.96
My introductory curriculum ties mechanical skills to scientific processes.	1/1.14	10/11.36	15/17.05	26/29.55	30/34.09	6/6.82
My introductory curriculum allows students to explore, design, and solve real-world problems.	1/1.14	3/3.41	14/15.91	33/37.50	27/30.68	10/11.36
My introductory curriculum routinely requires the use of mathematics.	1/1.14	3/3.41	8/9.09	22/25.00	37/42.05	17/19.32
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	2/2.25	4/4.49	11/12.36	25/28.09	36/40.45	11/12.36
Agricultural mechanics courses integrated with science content will make my students more employable.	2/2.25	3/3.37	9/10.11	21/23.60	41/46.07	13/14.61

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 101

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Respondents Currently Teaching IAM (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	3/5.00	12/20.00	11/18.33	15/25.00	17/28.33	2/3.33
Teaching students to explore their own ideas will make my students more employable.	1/1.64	2/3.28	3/4.92	17/27.87	34/55.74	4/6.56
Teaching students to design solutions to problems will make my students more employable.	1/1.61	0/0.00	3/4.84	10/16.13	31/50.00	17/27.42
Teaching students to be a productive part of a team will make my students more employable.	1/1.64	0/0.00	1/1.64	6/9.84	29/47.54	24/39.34
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	1/1.61	0/0.00	2/3.23	9/14.52	29/46.77	21/33.87
My introductory curriculum ties mechanical skills to scientific processes.	0/0.00	7/11.29	13/20.97	21/33.87	17/27.42	4/6.45
My introductory curriculum allows students to explore, design, and solve real-world problems.	0/0.00	2/3.23	9/14.52	28/45.16	17/27.42	6/9.68
My introductory curriculum routinely requires the use of mathematics.	0/0.00	3/4.84	6/9.68	13/20.97	27/43.55	13/20.97
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	1/1.61	3/4.84	9/14.52	20/32.26	24/38.71	5/8.06
Agricultural mechanics courses integrated with science content will make my students more employable.	1/1.61	2/3.23	7/11.29	17/27.42	29/46.77	6/9.68

Note. As measured on a 6-Point Likert Scale with 1 = *“Strongly Disagree”* and 6 = *“Strongly Agree”*

Table 102

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Respondents Not Teaching IAM (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	2/7.41	2/7.41	6/22.22	9/33.33	6/22.22	2/7.41
Teaching students to explore their own ideas will make my students more employable.	1/3.57	0/0.00	2/7.14	8/28.57	9/32.14	8/28.57
Teaching students to design solutions to problems will make my students more employable.	1/3.57	0/0.00	1/3.57	5/17.86	13/46.43	8/28.57
Teaching students to be a productive part of a team will make my students more employable.	1/3.70	0/0.00	0/0.00	3/11.11	12/44.44	11/40.74
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	1/3.70	0/0.00	0/0.00	4/14.81	11/40.74	11/40.74
My introductory curriculum ties mechanical skills to scientific processes.	1/3.85	3/11.54	2/7.69	5/19.23	13/50.00	2/7.69
My introductory curriculum allows students to explore, design, and solve real-world problems.	1/3.85	1/3.85	5/19.23	5/19.23	10/38.46	4/15.38
My introductory curriculum routinely requires the use of mathematics.	1/3.85	0/0.00	2/7.69	9/34.62	10/38.46	4/15.38
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	1/3.70	1/3.70	2/7.41	5/18.52	12/44.44	6/22.22
Agricultural mechanics courses integrated with science content will make my students more employable.	1/3.70	1/3.70	2/7.41	4/14.81	12/44.44	7/25.93

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 103

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Male Respondents (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	4/5.88	10/14.71	14/20.59	21/30.88	16/23.53	3/4.41
Teaching students to explore their own ideas will make my students more employable.	2/2.86	2/2.86	4/5.71	21/30.00	35/50.00	6/8.57
Teaching students to design solutions to problems will make my students more employable.	2/2.86	0/0.00	4/5.71	12/17.14	37/52.86	15/21.43
Teaching students to be a productive part of a team will make my students more employable.	2/2.90	0/0.00	1/1.45	9/13.04	34/49.28	23/33.33
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	2/2.86	0/0.00	2/2.86	11/15.71	33/47.14	22/31.43
My introductory curriculum ties mechanical skills to scientific processes.	1/1.43	8/11.43	10/14.29	19/27.14	26/37.14	6/8.57
My introductory curriculum allows students to explore, design, and solve real-world problems.	1/1.43	3/4.29	6/8.57	31/44.29	20/28.57	9/12.86
My introductory curriculum routinely requires the use of mathematics.	1/1.43	2/2.86	4/5.71	16/22.86	33/47.14	14/20.00
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	2/2.86	4/5.71	8/11.43	19/27.14	30/42.86	7/10.00
Agricultural mechanics courses integrated with science content will make my students more employable.	2/2.86	2/2.86	6/8.57	17/24.29	34/48.57	9/12.86

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 104

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Female Respondents (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	1/5.26	4/21.05	3/15.79	3/15.79	7/36.84	1/5.26
Teaching students to explore their own ideas will make my students more employable.	0/0.00	0/0.00	1/5.26	4/21.05	8/42.11	6/31.58
Teaching students to design solutions to problems will make my students more employable.	0/0.00	0/0.00	0/0.00	3/15.00	7/35.00	10/50.00
Teaching students to be a productive part of a team will make my students more employable.	0/0.00	0/0.00	0/0.00	0/0.00	7/36.84	12/63.16
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	0/0.00	0/0.00	0/0.00	2/10.53	7/36.84	10/52.63
My introductory curriculum ties mechanical skills to scientific processes.	0/0.00	2/11.11	5/27.78	7/38.89	4/22.22	0/0.00
My introductory curriculum allows students to explore, design, and solve real-world problems.	0/0.00	0/0.00	8/44.44	2/11.11	7/38.89	1/5.56
My introductory curriculum routinely requires the use of mathematics.	0/0.00	1/5.56	4/22.22	6/33.33	4/22.22	3/16.67
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	0/0.00	0/0.00	3/15.79	6/31.58	6/31.58	4/21.05
Agricultural mechanics courses integrated with science content will make my students more employable.	0/0.00	1/5.26	3/15.79	4/21.05	7/36.84	4/21.05

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 105

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Science Certified Respondents (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	2/4.35	9/19.57	8/17.39	10/21.74	15/32.61	2/4.35
Teaching students to explore their own ideas will make my students more employable.	0/0.00	1/2.13	2/4.26	14/29.79	24/51.06	6/12.77
Teaching students to design solutions to problems will make my students more employable.	0/0.00	0/0.00	3/6.25	9/18.75	22/45.83	14/29.17
Teaching students to be a productive part of a team will make my students more employable.	0/0.00	0/0.00	1/2.17	6/13.04	20/43.48	19/41.30
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	0/0.00	0/0.00	2/4.26	10/21.28	19/40.43	16/34.04
My introductory curriculum ties mechanical skills to scientific processes.	0/0.00	6/12.77	11/23.40	15/31.91	12/25.53	3/6.38
My introductory curriculum allows students to explore, design, and solve real-world problems.	0/0.00	2/4.26	10/21.28	18/38.30	13/27.66	4/8.51
My introductory curriculum routinely requires the use of mathematics.	0/0.00	2/4.26	6/12.77	15/31.91	15/31.91	9/19.15
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	0/0.00	2/4.26	6/12.77	18/38.30	16/34.04	5/10.64
Agricultural mechanics courses integrated with science content will make my students more employable.	0/0.00	3/6.38	7/14.89	11/23.40	20/42.55	6/12.77

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 106

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Non-science Certified Respondents (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	3/7.50	5/12.50	9/22.50	14/35.00	7/17.50	2/5.00
Teaching students to explore their own ideas will make my students more employable.	2/4.88	1/2.44	3/7.32	11/26.83	18/43.90	6/14.63
Teaching students to design solutions to problems will make my students more employable.	2/4.88	0/0.00	1/2.44	6/14.63	21/51.22	11/26.83
Teaching students to be a productive part of a team will make my students more employable.	2/4.88	0/0.00	0/0.00	3/7.32	20/48.78	16/39.02
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	2/4.88	0/0.00	0/0.00	3/7.32	20/48.78	16/39.02
My introductory curriculum ties mechanical skills to scientific processes.	1/2.50	4/10.00	4/10.00	10/25.00	18/45.00	3/7.50
My introductory curriculum allows students to explore, design, and solve real-world problems.	1/2.50	1/2.50	4/10.00	14/35.00	14/35.00	6/15.00
My introductory curriculum routinely requires the use of mathematics.	1/2.50	1/2.50	2/5.00	6/15.00	22/55.00	8/20.00
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	2/4.88	2/4.88	4/9.76	7/17.07	20/48.78	6/14.63
Agricultural mechanics courses integrated with science content will make my students more employable.	2/4.88	0/0.00	2/4.88	10/24.39	20/48.78	7/17.07

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 107

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for University Certified Respondents (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	5/6.67	11/14.67	15/20.00	20/26.67	22/29.33	2/2.67
Teaching students to explore their own ideas will make my students more employable.	2/2.63	2/2.63	4/5.26	22/28.95	39/51.32	7/9.21
Teaching students to design solutions to problems will make my students more employable.	2/2.60	0/0.00	4/5.19	15/19.48	38/49.35	18/23.38
Teaching students to be a productive part of a team will make my students more employable.	2/2.67	0/0.00	1/1.33	9/12.00	37/49.33	26/34.67
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	2/2.63	0/0.00	2/2.63	13/17.11	36/47.37	23/30.26
My introductory curriculum ties mechanical skills to scientific processes.	1/1.32	8/10.53	13/17.11	24/31.58	25/32.89	5/6.58
My introductory curriculum allows students to explore, design, and solve real-world problems.	1/1.32	3/3.95	12/15.79	29/38.16	24/31.58	7/9.21
My introductory curriculum routinely requires the use of mathematics.	1/1.32	2/2.63	7/9.21	21/27.63	31/40.79	14/18.42
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	2/2.63	4/5.26	10/13.16	23/30.26	31/40.79	6/7.89
Agricultural mechanics courses integrated with science content will make my students more employable.	2/2.63	3/3.95	6/7.89	20/26.32	36/47.37	9/11.84

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 108

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Alternatively Certified Respondents (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	0/0.00	3/33.33	2/22.22	3/33.33	0/0.00	1/11.11
Teaching students to explore their own ideas will make my students more employable.	0/0.00	0/0.00	0/0.00	3/30.00	3/30.00	4/40.00
Teaching students to design solutions to problems will make my students more employable.	0/0.00	0/0.00	0/0.00	0/0.00	5/50.00	5/50.00
Teaching students to be a productive part of a team will make my students more employable.	0/0.00	0/0.00	0/0.00	0/0.00	3/30.00	7/70.00
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	0/0.00	0/0.00	0/0.00	0/0.00	3/30.00	7/70.00
My introductory curriculum ties mechanical skills to scientific processes.	0/0.00	1/11.11	2/22.22	2/22.22	4/44.44	0/0.00
My introductory curriculum allows students to explore, design, and solve real-world problems.	0/0.00	0/0.00	2/22.22	4/44.44	2/22.22	1/11.11
My introductory curriculum routinely requires the use of mathematics.	0/0.00	1/11.11	1/11.11	1/11.11	5/55.56	1/11.11
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	0/0.00	0/0.00	1/10.00	2/20.00	4/40.00	3/30.00
Agricultural mechanics courses integrated with science content will make my students more employable.	0/0.00	0/0.00	3/30.00	1/10.00	4/40.00	2/20.00

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 109

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Respondents with One to Five Years of Experience Teaching IAM (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	2/8.33	5/20.83	5/20.83	8/33.33	3/12.50	1/4.17
Teaching students to explore their own ideas will make my students more employable.	1/4.00	0/0.00	2/8.00	7/28.00	10/40.00	5/20.00
Teaching students to design solutions to problems will make my students more employable.	1/4.00	0/0.00	0/0.00	5/20.00	10/40.00	9/36.00
Teaching students to be a productive part of a team will make my students more employable.	1/4.17	0/0.00	0/0.00	2/8.33	8/33.33	13/54.17
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	1/4.17	0/0.00	0/0.00	3/12.50	7/29.17	13/54.17
My introductory curriculum ties mechanical skills to scientific processes.	0/0.00	3/12.50	5/20.83	7/29.17	7/29.17	2/8.33
My introductory curriculum allows students to explore, design, and solve real-world problems.	0/0.00	1/4.17	2/8.33	11/45.83	6/25.00	4/16.67
My introductory curriculum routinely requires the use of mathematics.	0/0.00	2/8.33	1/4.17	8/33.33	8/33.33	5/20.83
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	1/4.17	1/4.17	1/4.17	7/29.17	9/37.50	5/20.83
Agricultural mechanics courses integrated with science content will make my students more employable.	1/4.17	0/0.00	3/12.50	7/29.17	8/33.33	5/20.83

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 110

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Respondents with Six to 10 Years of Experience Teaching IAM (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	0/0.00	2/14.29	3/21.43	3/21.43	6/42.86	0/0.00
Teaching students to explore their own ideas will make my students more employable.	0/0.00	0/0.00	0/0.00	2/14.29	11/78.57	1/7.14
Teaching students to design solutions to problems will make my students more employable.	0/0.00	0/0.00	0/0.00	1/6.67	8/53.33	6/40.00
Teaching students to be a productive part of a team will make my students more employable.	0/0.00	0/0.00	0/0.00	0/0.00	9/60.00	6/40.00
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	0/0.00	0/0.00	0/0.00	0/0.00	9/60.00	6/40.00
My introductory curriculum ties mechanical skills to scientific processes.	0/0.00	2/13.33	4/26.67	4/26.67	3/20.00	2/13.33
My introductory curriculum allows students to explore, design, and solve real-world problems.	0/0.00	1/6.67	4/26.67	3/20.00	5/33.33	2/13.33
My introductory curriculum routinely requires the use of mathematics.	0/0.00	0/0.00	1/6.67	5/33.33	7/46.67	2/13.33
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	0/0.00	2/13.33	0/0.00	2/13.33	10/66.67	1/6.67
Agricultural mechanics courses integrated with science content will make my students more employable.	0/0.00	1/6.67	0/0.00	3/20.00	10/66.67	1/6.67

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 111

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Respondents with 11 to 20e Years of Experience Teaching IAM (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	0/0.00	4/20.00	3/15.00	5/25.00	7/35.00	1/5.00
Teaching students to explore their own ideas will make my students more employable.	0/0.00	2/10.00	2/10.00	6/30.00	8/40.00	2/10.00
Teaching students to design solutions to problems will make my students more employable.	0/0.00	0/0.00	1/5.00	5/25.00	9/45.00	5/25.00
Teaching students to be a productive part of a team will make my students more employable.	0/0.00	0/0.00	1/5.00	3/15.00	9/45.00	7/35.00
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	0/0.00	0/0.00	1/5.00	6/30.00	8/40.00	5/25.00
My introductory curriculum ties mechanical skills to scientific processes.	0/0.00	0/0.00	3/15.00	7/35.00	8/40.00	2/10.00
My introductory curriculum allows students to explore, design, and solve real-world problems.	0/0.00	0/0.00	3/15.00	9/45.00	5/25.00	3/15.00
My introductory curriculum routinely requires the use of mathematics.	0/0.00	0/0.00	3/15.00	4/20.00	7/35.00	6/30.00
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	0/0.00	0/0.00	5/25.00	5/25.00	8/40.00	2/10.00
Agricultural mechanics courses integrated with science content will make my students more employable.	0/0.00	1/5.00	3/15.00	5/25.00	8/40.00	3/15.00

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 112

Benefits of STEM Integration in Introductory Agricultural Mechanics Construct for Respondents with over 20 Years of Experience Teaching IAM (f/%)

Construct Statements	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
STEM can be integrated into introductory agricultural mechanics without loss of technical skills.	3/15.79	2/10.53	4/21.05	4/21.05	5/26.32	1/5.26
Teaching students to explore their own ideas will make my students more employable.	1/5.00	0/0.00	0/0.00	8/40.00	11/55.00	0/0.00
Teaching students to design solutions to problems will make my students more employable.	1/5.00	0/0.00	2/10.00	4/20.00	12/60.00	1/5.00
Teaching students to be a productive part of a team will make my students more employable.	1/5.26	0/0.00	0/0.00	3/15.79	11/57.89	4/21.05
Teaching students to reflect upon their experiences and make corrections in future experiences will make my students more employable.	1/5.00	0/0.00	1/5.00	3/15.00	12/60.00	3/15.00
My introductory curriculum ties mechanical skills to scientific processes.	1/5.00	4/20.00	1/5.00	7/35.00	7/35.00	0/0.00
My introductory curriculum allows students to explore, design, and solve real-world problems.	1/5.00	1/5.00	1/5.00	10/50.00	7/35.00	0/0.00
My introductory curriculum routinely requires the use of mathematics.	1/5.00	1/5.00	1/5.00	2/10.00	12/60.00	3/15.00
My introductory curriculum requires students to use technology (computers and/or equipment) relevant to the agricultural mechanics industry.	1/5.26	1/5.26	3/15.79	9/47.37	6/31.58	0/0.00
Agricultural mechanics courses integrated with science content will make my students more employable.	1/5.00	1/5.00	1/5.00	5/25.00	12/60.00	0/0.00

Note. As measured on a 6-Point Likert Scale with 1 = *"Strongly Disagree"* and 6 = *"Strongly Agree"*

Table 113

Conversion between Questionnaire Raw Scores and Percentile Scores for Stages of Concern

	Percentile Score						
Raw Score	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
0	0	5	5	2	1	1	1
1	1	12	12	5	1	2	2
2	2	16	14	7	1	3	3
3	4	19	17	9	2	3	5
4	7	23	21	11	2	4	6
5	14	27	25	15	3	5	9
6	22	30	28	18	3	7	11
7	31	34	31	23	4	9	14
8	40	37	35	27	5	10	17
9	48	40	39	30	5	12	20
10	55	43	41	34	7	14	22
11	61	45	45	39	8	16	26
12	69	48	48	43	9	19	30
13	75	51	52	47	11	22	34
14	81	54	55	52	13	25	38
15	87	57	57	56	16	28	42
16	91	60	59	60	19	31	47
17	94	63	63	65	21	36	52
18	96	66	67	69	24	40	57
19	97	69	70	73	27	44	60
20	98	72	72	77	30	48	65
21	99	75	76	80	33	52	69
22	99	80	78	83	38	55	73
23	99	84	80	85	43	59	77
24	99	88	83	88	48	64	81
25	99	90	85	90	54	68	84
26	99	91	87	92	59	72	87
27	99	93	89	94	63	76	90
28	99	95	91	95	66	80	92
29	99	96	92	97	71	84	94
30	99	97	94	97	76	88	96
31	99	98	95	98	82	91	97
32	99	99	96	98	86	93	98
33	99	99	96	99	90	95	99
34	99	99	97	99	92	97	99
35	99	99	99	99	96	98	99

Appendix 7: SPSS Syntax for SOC Profiles

SPSS Syntax used to convert SOC raw scores to scale scores and percentile scores. Headings for initial raw data need to conform to CBAM_X, where X is the statement number from the SOC. Missing values should be replaced prior to running this syntax.

```
COMPUTE Stage_0=CBAM_3 + CBAM_12 + CBAM_21 + CBAM_23 + CBAM_30.
VARIABLE LABELS Stage_0 'Stage 0: Unconcerned'.
EXECUTE.

COMPUTE Stage_1=CBAM_6 + CBAM_14 + CBAM_15 + CBAM_26 + CBAM_35.
VARIABLE LABELS Stage_1 'Stage 1: Informational'.
EXECUTE.

COMPUTE Stage_2=CBAM_7 + CBAM_13 + CBAM_17 + CBAM_28 + CBAM_33.
VARIABLE LABELS Stage_2 'Stage 2: Personal'.
EXECUTE.

COMPUTE Stage_3=CBAM_4 + CBAM_8 + CBAM_16 + CBAM_25 + CBAM_34.
VARIABLE LABELS Stage_3 'Stage 3: Management'.
EXECUTE.

COMPUTE Stage_4=CBAM_1 + CBAM_11 + CBAM_19 + CBAM_24 + CBAM_32.
VARIABLE LABELS Stage_4 'Stage 4: Consequence'.
EXECUTE.

COMPUTE Stage_5=CBAM_5 + CBAM_10 + CBAM_18 + CBAM_27 + CBAM_29.
VARIABLE LABELS Stage_5 'Stage 5: Collaboration'.
EXECUTE.
```

```
COMPUTE Stage_6=CBAM_2 + CBAM_9 + CBAM_20 + CBAM_22 + CBAM_31.
VARIABLE LABELS Stage_6 'Stage 6: Refocusing'.
EXECUTE.

RECODE Stage_0 (4=7) (5=14) (6=22) (7=31) (8=40) (9=48) (10=55) (11=61) (12=69) (13=75)
  (14=81) (15=87) (16=91) (17=94) (18=96) (19=97) (20=98) (3=4) (0 thru 2=Copy) (21 thru 35=99)
  INTO S0_Pct.
VARIABLE LABELS S0_Pct 'Stage 0: Percentile Score Unconcerned'.
Execute.

Recode Stage_1 (4=7) (5=14) (6=22) (7=31) (8=40) (9=48) (10=55) (11=61) (12=69) (13=75) (14=81)
  (15=87) (16=91) (17=94) (18=96) (19=97) (20=98) (3=4) (0 thru 2=Copy) (21 thru 35=99)
  INTO S1_Pct.
VARIABLE LABELS S1_Pct 'Stage 1 Percentile Score: Informational'.
Execute.

Recode Stage_2 (4=7) (5=14) (6=22) (7=31) (8=40) (9=48) (10=55) (11=61) (12=69) (13=75) (14=81) (15=87)
  (16=91) (17=94) (18=96) (19=97) (20=98) (3=4) (0 thru 2=Copy) (21 thru 35=99) INTO S2_Pct.
VARIABLE LABELS S2_Pct 'Stage 2 Percentile Score: Personal'.
Execute.

RECODE Stage_3 (0=2) (1=5) (2=7) (3=9) (4=11) (5=15) (6=18) (7=23) (8=27) (9=30) (10=37) (11=39)
(12=43) (13=47) (14=52) (15=56) (16=60) (17=65) (18=69) (19=73)
(20=77) (21=80) (22=83) (23=85) (24=88) (25=90) (26=92) (27=94) (28=95) (29=97) (30=97) (31=98) (32=98)
(33 thru 35=99) INTO S3_Pct.
VARIABLE LABELS S3_Pct 'Stage 3 Percentile Score: Management'.
Execute.
```

RECODE Stage_4 (0 thru 2=1) (3=2) (4=2) (5=3) (6=3) (7=4) (8=5) (9=5) (10=7) (11=8) (12=9) (13=11) (14=13) (15=16) (16=19) (17=21) (18=24) (19=27) (20=30) (21=33)

(22=38) (23=43) (24=48) (25=54) (26=59) (27=63) (28=66) (29=71) (30=76) (31=82) (32=86) (33=90) (34=92) (35=96) INTO S4_Pct.

VARIABLE LABELS S4_Pct 'Stage 4 Percentile Score: Consequence'.

Execute.

Recode Stage_5 (0=1) (1=2) (2=2) (3=3) (4=4) (5=5) (6=7) (7=9) (8=10)(9=12) (10=14) (11=16) (12=19) (13=22) (14=25) (15=28) (16=31) (17=36) (18=40) (19=44) (20=48)

(21=52) (22=55) (23=59) (24=64) (25=68) (26=72) (27=76) (28=80) (29=84) (30=88) (31=91) (32=93) (33=95) (34=97) (35=98) INTO S5_Pct.

VARIABLE LABELS S5_Pct 'Stage 5 Percentile Score: Collaboration'.

Execute.

RECODE Stage_6 (0=1) (1=2) (2=3) (3=5) (4=6) (5=9) (6=11) (7=14) (8=17) (9=20) (10=22) (11=26) (12=30) (13=34) (14=38) (15=42) (16=47) (17=52) (18=57) (19=60)

(20=65) (21=69) (22=73) (23=77) (24=81) (25=84) (26=87) (27=90) (28=92) (29=94) (30=96) (31=97) (32=98) (33 thru 35=99) INTO S6_Pct.

VARIABLE LABELS S6_Pct 'Stage 6 Percentile Score: Refocusing'.

Execute.

Appendix 8: Idaho Ag 130 Curriculum Units of Instruction

Ag 130 Introduction to Agricultural Mechanics (1999)

COURSE DESCRIPTION: A course designed to familiarize the student with the basic mechanical theory and skills. Students will develop skills in the following areas of Carpentry, Electricity, Plumbing, Fencing, Painting, Metal Working, and Welding processes. Emphasis will be placed on safety and proper use of tools and equipment.

Units of Instruction	Hours of Instruction	Minutes of Instruction
Safety	7.8	470
Hot Metal Working	7.8	470
Cold Metal Working	7.8	470
Tool Reconditioning and Maintenance	7.8	470
Plumbing	3.9	235
Rope Work	2.4	141
Fence Construction	2.4	141
Painting	3.1	188
Basic Electricity	7.8	470
Tool Identification	3.9	235
Basics of Welding	15.7	940
TOTAL TIME	70.5	4,230

Ag 130 Introduction to Agricultural Mechanics (2000)

130-A Shop Cleaning and Tool Storage
130-B Safety Practices in the Shop
130-C Measuring
130-D Drafting and Sketching
130-E Tool Safety, Use and Identification
130-F Tool Reconditioning and Maintenance
130-G Plumbing and Pipe Fitting
130-H Wood Working
130-I Bill of Materials
130-J Rope Work
130-K Hot and Cold Metal Work
130-L Fence Construction
130-M Concrete
130-N Fasteners
130-O Painting, Brush & Spray Gun
130-P Building Structures, Framing, and Rafter Cutting
130-Q Introduction to Electricity
130-R Electrical Wiring Practices
130-S Electrical Motors
130-T Servicing Small Engines
130-U Surveying
130-V Careers in Agricultural Mechanics
130-W Introduction to Oxyacetylene Welding and Cutting Skills
130-X Introduction to Arc Welding
130-Y Projects