SAFETY EDUCATION FOR WOMEN IN AGRICULTURE

HONORS THESIS

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By

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ABSTRACT

A void in safety education exists; seldom is hands-on safety education designed specifically for women. In the United States, women make up a significant portion of farmers with exposure to the same threats of occupational injuries and fatalities as their male counterparts. The body of research not only included designing safety curriculum specifically for women but also testing its effectiveness in the classroom or learning environment. The researcher began by exploring high injury-causing agents in agriculture and identifying a nationally-recognized curriculum to create lessons. The researcher gained validity and reliability by pilot testing the curriculum at Women in Agriculture Extension events, Chapter FFA events, and among preservice agricultural educators. These lessons were then distributed to agricultural and extension educators in Ohio to teach the content to their students or clientele. After teaching the material, the instructors completed a ten-question survey evaluating each lesson plan they taught.

Eleven instructors taught sessions involving 243 student participants. Instructors identified themselves as OSU Extension educators, agricultural educators, pre-service agricultural educators, and one university professors. Lessons were taught at 9 high school FFA chapters in Ohio and one university in Iowa. The lessons titled Reaction Time (n=6) and Why it Matters (n=4) were taught the most times and with the most participants, with 118 students and 125 students respectively. The lessons titled Decoding Colors (n=1), Operating the Tractor with a Loader (n=1), and Making 3-Point Hitch and Drawbar Connections (n=1) were taught the least with the least number of students. Decoding Colors was taught to 18 students while Operating the Tractor with a Loader and Making 3-Point Hitch and Drawbar Connections were taught to 5 students each.

The results found instructors strongly agreed or agreed that each lesson included an engaging interest approach (99.9%) and was well organized and relevant to learners (99.9%). Instructors strongly agreed or agreed that the lessons used multiple strategies to engage learners (84.5%); provided a complete list of teaching materials (92.2%); included an accurate time in which it took to present the lesson (61.4%); and the course content was based on current, up-to-date information (92.2%). Finally, instructors strongly agreed or agreed that the content in the lessons was interesting and relevant for a range of participants' ability and prior background knowledge (92.2%).

The curriculum evaluation established all educators found the curriculum to be a valuable training for their students. Through these conclusions the researcher demonstrated two objectives: (1) Develop train-the-trainer style agricultural safety curriculum to be used by agricultural science and extension educators. (2) Evaluate the created curriculum on accessibility and ease of utilization. The researcher adjusted the lessons based on educators' recommendations and made the curriculum available to a larger audience.

INTRODUCTION

The 2012 census reported 969,672 women farmers in the United States, accounting for 30% of the nation's farmers (United States Department of Agriculture, 2014). Similar to their male counterparts, women farmers are at high risk for tractor and machinery incidents because occupational injuries do not discriminate on the basis of gender.

Rarely is safety education offered exclusively to women audiences. Within Ohio, female-based education is predominantly focused on farm economics. The researcher worked to create curriculum in the areas of injury agent awareness and statistics, tractor operation, tractor parts identification, personal protective equipment, reaction time, and more. The researcher's efforts were intentionally designed for female farm owners, managers or workers to provide them with the knowledge, skills, and confidence to succeed in their occupation. A secondary audience to benefit from this curriculum consisted of high school students enrolled in agricultural education programs.

LITERATURE REVIEW

Women in Agriculture

According to the most recent United States census, there were 969,672 female farmers in 2012 (United States Department of Agriculture, 2014). Nationally, this amounted to 30% of all U.S. farmers with a higher concentration in the Northeast, Southwest, and Western states. Texas had the most female farmers. Arizona showed the highest proportion of female farmers; nearly half (45%) of Arizona's farmers were female. In the state of Ohio there were 31,413 women farmers, which comprised 28% of all farmers in the state. Ohio women farmers farmed 3,883,067 acres or 13.5% of Ohio land (Women in Agriculture, 2012).

Females showed a significant portion of leadership on the farm in the form of principal operators. A principal operator is responsible for the farm's everyday functions and tasks. Of all

female farmers, 288,264, or nearly 30%, were principal operators, at an average age of 60.1 years (United States Department of Agriculture, 2012).

Women principal operators have a large financial impact on the United States economy. In 2012 alone, women principal operators sold $12.9 billion in agricultural products with $6.9 billion in livestock and $6.0 billion in crops sales. Female principal operators represented 3.3% of total U.S. agriculture sales. Female principal operators farmed 62.7 million acres, or 6.9%, of the total U.S. farmland, although farms with female operators typically had fewer acres than farms overall. Approximately 25% of women farmers in 2012 specialized in combination crop farming with the largest categories including: beef cattle, ranching, and combination livestock farming, including horse farming (United States Department of Agriculture, 2012). In 2012, Ohio women farmers had a $230.1 million economic impact on the state (Women in Agriculture, 2012).

Women in agriculture face unique challenges and often their needs are overlooked (Hyde, 2017). Therefore, women in agriculture often feel as if they are not respected as farmers and are not taken seriously (Hyde, 2017). In the United States, a typical farm operation is likely to model traditional family structures in assignment of roles, where a man serves as the head of the farm, and a woman is the bookkeeper and caretaker of children. To help empower women farmers, Annie's Project was created to provide business risk management education for women in agriculture (Hyde, 2017). This program has six educational sessions including topics from five risk areas: financial risk, human resource risk, legal risk, market risk, and production risk (Annie's Project, 2019). However, the emphasis is on farm economics and bookwork (Hyde, 2017). Very few efforts have been made to create agricultural safety education primarily for women (Hyde, 2017).

Risks of Agriculture

Agriculture has a long history of being recognized as the most hazardous industry in the United States. Because injuries and incidents are non-discriminatory of gender, age or other demographics, all populations are advised to take precautionary measures while working in agriculture.

Within the Agriculture, Forestry, and Fishing industry, the production agriculture sector accounted for approximately 70.3% of the 3,299 work deaths between 2003 and 2007. Nearly 900 of these incidents involved farm tractors, with 43% being from tractor overturns. Between 1992 and 2005, 7,571 farmers and farm workers died from injuries while working on the farm. The leading cause of occupational fatalities on U.S. farms during this time were tractors (37%), other machinery (18%), and trucks (10%). Of the 2,795 tractor related deaths, 1,411 (50.4%) were due to tractor overturns (Murphy, Myers, McKenzie, Cavaletto, May, & Sorensen, 2010).

The 3E Model of agricultural safety is used by injury specialists to help reduce injuries and fatalities (Jepsen, 2018). The 3Es represent engineering, enforcement, and education. Engineering deals with the design of agricultural equipment or a farmstead system in order to reduce or eliminate the hazard altogether. Enforcement includes rules which may be federal or state laws, or simply shop or farm rules. Finally, education is recommended for any person operating heavy machinery or partaking in possibly hazardous tasks (Jepsen, 2018). Education is often the first of the 3Es to be implemented to combat agricultural injuries and fatalities.

In 2017, the National Children's Center for Rural and Agricultural Health and Safety by the National Institute of Occupational Safety and Health reported that one child died every three days due to an agricultural-related incident. Furthermore, every day about thirty-three children were injured in agriculturally-related incidents. For working youth, tractors were the leading

source of fatalities with all-terrain vehicles (ATVs) coming in second. The center determined that reading about injuries, keeping children away from tractors, and keeping young children out of the worksite would be effective strategies to help prevent injuries among the 893,000 youth that live on farms (The National Children's Center for Rural and Agricultural Health and Safety, 2017).

Legislation for Inexperienced Students and Youth

The Fair Labor Standards Act under the United States Department of Labor outlined eleven tasks that were classified as dangerous for youth employment in agriculture. Since 1970, this has been known as the Agricultural Hazardous Occupations Orders (AgHOs). The AgHOs contained the following categories: tractor, general machinery, specialized machinery, livestock, woodlot, ladder and scaffold, transport, toxic atmosphere, chemicals, blasting, and fertilizers (U.S. DOL, 2007). The United States Department of Labor identified three exemptions to the federal rule including:

(1) Youth working on an operation owned by their parent or legal guardian with unrestricted employment opportunities (AgHOs 1-11)

(2) Youth enrolled in a high school agricultural education program are permitted to be employed, providing that certain documentation requirements are met (AgHOs 1-6)

(3) Youth who complete an education training program, commonly known as tractor and machinery certification course, offered through the federal Extension service or by agricultural education are eligible for employment (AgHOs 1-2).

Need for Safety Education

Tractor safety education is a cornerstone program within agricultural safety because tractors have always been a major source of farm-based injuries. Tractor safety education and

training is very common among farm and ranch owners, hired adult farm laborers, and hired adolescent farm laborers. While each aforementioned population has its own needs, much of the educational materials overlap and provide a blanket education for each population category. Electronic media in the form of interactive computer training and videos remain popular for farm safety education because of their easy access and far reach. However, face to face training is a popular form of agricultural safety education through agricultural educators and extension educators (Murphy et al., 2010).

Tractor safety education programs. There are three nationally recognized agricultural safety programs to teach tractor and machinery operation. These include: the Hobar Manual, the National Safe Tractor and Machinery Operation Program, and Gearing Up for Safety: Production Agricultural Safety Training for Youth. These safety education programs are tailored toward youth and were designed to be easily taught by curriculum instructors. These instructors can read the materials and teach them right away in their learning environment. In addition to these educational resources, there are also two clearinghouses that specifically provide safety education materials. The National Agricultural Safety Database (NASD) and the Safety in Agriculture for Youth (SAY) are the two largest repositories for agricultural safety educational materials.

The Safe Operation of Agricultural Equipment, more commonly known as the Hobar Manual, met federal regulations for training youth to work in agricultural occupations. Although the content is dated, the Hobar Manual consisted of eleven units that made up a 24-hour training program. Topics in the training included: maintenance and safety checks, starting and stopping tractors, tractor safety on the farm, tractor safety on the road, and safety standards for agricultural tractors and implements. Each unit included a student worksheet and a sheet with questions that

related to the unit topic (Finney Company, 2010). Prior to 2000, this was the primary curriculum that satisfied the Hazardous Occupation Orders (AgHOs). Due to the Hobar Manual's nation-wide popularity and success, many states based their own state-specific training from this manual.

Gearing Up for Safety: Productional Agricultural Safety Training for Youth is a computer-based curriculum aimed to develop skills that youth need to be safe operators of agricultural tractors and other machinery (Tormoehlen, Field, Fox, Personett, Vollmer, & Ortega, 2003). The program is comprised of twelve units of education that can be broken down into one hundred seventy competencies. Through this program, students learn competencies related, but not limited to agricultural tractors and machinery safety, general farm safety, and tips for first aid (Tormoehlen, Field & Ortega, 2004). The Gearing Up for Safety program matched the farm tractor and machinery certification courses as prescribed by the Department of Labor's Hazardous Occupations Order (Tormoehlen, Field & Ortega, 2004).

The National Safe Tractor and Machinery Operation Program (NSTMOP) came about at a similar time as the Gearing Up for Safety. It was developed under the Hazardous Occupations Safety Training in Agriculture (HOSTA) (Murphy, 2019). By successfully completing this certification program, youth ages 14-15 can legally operate farm tractors and other machinery for hire of which they otherwise would not legally be allowed due to the Hazardous Occupations Order in Agriculture (AgHOs) (Murphy, 2019). The NSTMOP was funded by the United States Department of Agriculture, National Institute of Food and Agriculture and was designed in collaboration with Pennsylvania State University, The Ohio State University, and the National Safety Council (Murphy, 2019). The National Safe Tractor and Machinery Operation Program consists of seventy-seven task sheets, a written test that covers minimum core content areas, and

a driving skills test. Implemented in 2001, the first instructors wishing to train using this resource attended a two-day "train the trainer" workshop to become familiar with the content and materials. Then, the individuals returned to their home state to train other trainers and help deliver this curriculum to learning audiences (Murphy et al., 2010). The NSTMOP is a 24-hour training for learners that includes six training modules followed by a fifty-question written knowledge test (Murphy, 2019). With a passing score of 70% and demonstration that students can safely operate agricultural machinery, students receive a certificate that allows them to work for hire in agriculture (Murphy, 2019).

The largest collection of educational resources is the National Agricultural Safety Database (NASD) which serves as a clearinghouse or repository of information. The NASD contains interactive training materials, fact sheets, brochures, pamphlets, videos, and more. While many online agricultural safety materials are found within this database, learners can also receive information about on-site educational training. These trainings provide information about tractor safety from cooperative extension specialists, state Farm Bureau committees, NIOSH Centers for Agricultural Disease and Injury Research, Education, and Prevention, and specialty organizations for children such as the former Farm Safety 4 Just Kids and Progressive Agriculture Safety Day (Murphy et al., 2010).

The Safety in Agriculture for Youth (SAY) is a project whose objective is to develop a one-stop shop for agricultural safety and health content designed specifically for youth (SAY, 2015). Beyond lists of programs, the SAY Clearinghouse shows the alignment of these agricultural safety and health curricula to the Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards (SAY, 2015). Such standards are used by high school and middle school agricultural educators to ensure they are providing a wholesome education to their

students in the AFNR class. By having access to resources already aligned to AFNR standards, agricultural educators can be sure they are making good use of their time and resources by using materials within the SAY Clearinghouse (SAY, 2015).

Curriculum development for inexperienced students and youth. Per the AgHOs second exemption, one example of a high school agricultural education program is the National FFA Organization. This organization is a national agricultural-based student group with 669,989 members aged 12-21 in 8,630 chapters in all fifty states, Puerto Rico, and the U.S. Virgin Islands (National FFA Organization, 2019). FFA is often where students gain experience working in agricultural settings as a part of their Supervised Agricultural Experience (SAE) as some experiences may be hazardous, such as working around machinery and handling pesticides (Pate, Lawver, & Sorensen, 2016). It was determined that FFA students participate in the following tasks most often as a part of their Supervised Agricultural Experiences: ATV/UTV operation, tractor operation, assist tractor operation, animal husbandry, PTO implement, breeding livestock, front-end loader, herding livestock, assist machinery operation, and machinery operation (Mann, 2017). It is evident that FFA students participate in agricultural tasks that are deemed hazardous by the Agricultural Hazardous Occupations Order but are exempt due to being enrolled in a high school agricultural education program and permitting that certain documentation requirements are met.

A challenge facing secondary and postsecondary career and technical education is the development of relevant curriculum for their programs for education within the classroom (Jacobs, 2004). Along with designing curriculum to meet state and national standards, educators are often focused on promoting positive youth development. Positive youth development is a naturally occurring, never-ending process that uses principles and practices to enhance growth

(Hamilton, Hamilton & Pittman, 2004). Throughout the process, positive youth development leads to the Five C's: competence, character, connections, confidence, and contribution (Hamilton et al., 2004). The Five C's are composed of qualities that are desirable for future employers of the youth and provide an advantage for the youth as they enter the workforce later in life (Hamilton et al., 2004). Positive youth development is often fostered through experiential learning. Experiential learning is a process of providing an engaging experience followed by structured reflection and further and future application (Baker, Robinson, & Kolb, 2012). Students who partake in experiential learning have increased motivation, knowledge, retention, and developed life skills following the implication of experiential learning in their lives. It is estimated that if every class is taught using an experiential learning method, even if it is just one unit, the teachers will see positive changes in student engagement (Mowen & Harder, 2005). Experiential learning is often so pivotal in students' educational experiences due to its tendency to incorporate higher level tasks on Bloom's Taxonomy. Bloom's Taxonomy is a hierarchy of cognitive levels, beginning with rote memorization (remember) and ending with producing new work (create) (McDaniel, 2018). The middle levels are: understand, apply, analyze, and evaluate (McDaniel, 2018). Bloom's Taxonomy is used to develop lesson plans because of its usefulness in organizing a lesson's objectives to relate to the learning standards. In turn, this allows the instructor to plan for and instruct a lesson appropriately, assign valid assessments, and ensure that instruction and assessments are in line with the lesson's objectives (McDaniel, 2018). Using Bloom's Taxonomy to capitalize on experiential learning opportunities and promote positive youth development are a few tools that curriculum developers can use to create solid work.

STATEMENT OF THE PROBLEM

General repeated exposure to agricultural equipment, especially to at-risk populations such as elderly, youth, and inexperienced workers, can cause injury or be fatal. Not only these aforementioned populations, but all agricultural workers need to recognize hazards to prevent themselves or others from becoming injured. There is a need for educational resources as a part of the 3E Model of agricultural safety, but especially for educational resources tailored specifically toward women agricultural operators and youth agricultural workers.

PURPOSE AND OBJECTIVES OF THE PROJECT

The purpose of this research was to design female-friendly agricultural safety education for women in agriculture and young agricultural workers. The primary goal of the project was to build confidence in learners' knowledge about agriculture safety hazards and their abilities to safely operate farm machinery. To meet this goal, the researcher developed two main objectives:

(1) Develop train-the-trainer style agricultural safety curriculum to be used by agricultural science and extension educators.

(2) Evaluate the curriculum based on the trainer's ability to access and utilize the lessons, along with their modifications of the particular lessons.

METHODOLOGY

The research followed a two-phase process. The first phase was curriculum development. In phase 1, the researcher designed the curriculum that was to be evaluated. The second phase was curriculum implementation and evaluation. In phase 2, instructors taught the designed curriculum and provided evaluations of specific lessons for the researcher.

Research Design: Phase 1: Curriculum Development

The researcher first reviewed the agricultural safety statistics and identified high injury-causing agents in agriculture. After investigation, the researcher found that tractors and other large farm machinery were clearly the highest injury-causing agents in agriculture.

Utilizing the information found, the researcher identified a nationally recognized curriculum to use as a reference source in designing lessons: The National Safe Tractor and Machinery Operation Program (NSTMOP).

Lesson topics. The researcher used prior knowledge learned as an agriscience education student and the NSTMOP to design 13 lesson plans with hands-on, engaging activities. The lesson plan template that the researcher used can be found in Appendix 2. The lessons were designed for educators to grab and use in their typical educational setting. See Figure 1 for the lesson plan topics.

Lesson Plan Topics

Why It Matters: Introduction to Machinery Operation and Safety	Jumper Cables
Reaction Time	Operating the Tractor
Personal Protective Equipment	Operating the Tractor with a Loader
Hand Signals	3-Point Hitch or Drawbar Connections
Tractor Parts Identification	Hydraulics
Decoding Colors	Making Power Take-Off Connections
Instrument Panel and Operation Symbols	

Figure 1: Lesson Plan Topics

Validity. The researcher determined internal and external validity of the lesson plans and their evaluation through a series of pilot testing. There were several events in which the lessons

were pilot tested before allowing access by Ohio State Extension Educators and Ohio State Agricultural Safety Program Professionals.

- January 25, 2018: One Ohio State Agricultural Safety Program Professional taught 16 individuals at the Shearer Equipment Day in Wooster, Ohio.
- February 21, 2018: Three Ohio State Agricultural Safety Program Professionals taught 25 individuals at the Midwest Women in Agriculture Conference in Muncie, Indiana.
- October 24 – 27, 2018: Two Ohio State Agricultural Safety Program Professionals taught 2,200 high school FFA members at the National FFA Convention held in Indianapolis, Indiana.

The curriculum was also pilot tested using a train-the-trainer session. Seven preservice agricultural educators attended the session to learn more about the curriculum and how it would be implemented into their student teaching classrooms. Comments by preservice agricultural education students were used to improve curriculum activities.

Research Design: Phase 2: Curriculum Implementation and Evaluation

Sample: curriculum educators. Curriculum educators were identified through two emailing lists. The first was a list of all Ohio State University county Extension Educators, while the second was a list of all agricultural educators in the state of Ohio. The email list of OSU educators was accessed on The Ohio State University Extension website. The email list of agricultural educators was accessed on the Ohio FFA website. The researcher drafted and sent curriculum interest letters via the aforementioned email listservs to all Ohio State extension educators and Ohio agricultural educators. The researcher expected a sample size of 25 total individuals to utilize and evaluate the curriculum.

The researcher also completed an oral presentation at the 2018 International Society of Agricultural Safety and Health Conference. At the conference, educators in attendance were willing to pilot test the curriculum. One instructor who was interested in teaching the curriculum identified themselves as a university professor and an Iowa resident.

Sample: student participants. The curriculum educators were responsible for delivery of these educational activities to their typical students or clientele. The participants were identified as any individual that the educator would teach in their typical work setting. It was estimated that educators would teach 5 to 25 participants in any given session. Therefore, it was estimated that if all 25 of the curriculum instructors taught 1 session with an average of 20 participants, the possible number of student participants could be estimated at 500.

Curriculum implementation. If educators were interested in accessing the curriculum materials and participating in the research, they signed a consent form attached to the initial curriculum interest email. Interested educators returned the signed consent forms to the researcher. Once educators replied with a signed consent form, the researcher allowed educator access to the curriculum via an online platform: Google Drive. Educators, now with access to lesson materials, taught the curriculum to students. Students were identified as any learner that the educator would teach within their typical educational setting. Within one month of the lesson plan delivery, instructors completed a ten-question lesson evaluation survey and returned it to the researcher. Educators had two options in completing this evaluation; they could either print, fill it out, and scan the document back to the researcher or they could follow an online link to complete the survey via Qualtrics®. Find a detailed list of phases 1 and 2 in Figure 2.

PHASE 1: CURRICULUM DEVELOPMENT

(1) Reviewed the agricultural safety statistics to identify high injury-causing agents in agriculture

(2) Utilized a nationally recognized curriculum as a reference source: National Safe Tractor and Machinery Operation Program (NSTMOP)

(3) Designed thirteen lesson plans from content within NSTMOP

(4) Tested internal and external validity of lesson plans

PHASE 2: CURRICULUM IMPLEMENTATION AND EVALUATION

(1) Obtained permissions from the Institutional Review Board on December 3, 2018; The Ohio State University's OHRP Federalwide Assurance #00006378

(2) Accessed the Ohio State University Extension and Ohio Agricultural Educators email lists

(3) Sent curriculum interest letters to all Ohio State Extension Educators and Ohio Agricultural Educators

(4) Obtained signed consent forms from educators interested in participating in the research

(5) Allowed instructor access to lesson plans via online platform: Google Drive

(6) Instructors taught lessons to students

(7) Within one month following lesson implementation, instructors completed evaluation survey via print and scan document or submitted an online Qualtrics® form

(8) Data collection ceased on March 29, 2019

(9) Researcher analyzed data from the instructor evaluations

(10) Researcher adjusts curriculum as necessary per the evaluation results

(11) Researcher makes the curriculum available to a larger group

Figure 2: Outline of Study Protocol

Instrumentation survey. Following the delivery of each particular lesson, curriculum instructors completed a ten-question evaluation in order to assess the lesson's quality. The first seven questions on the evaluation asked information via Lickert scale, each with a space offered for comments. The Lickert scale questions asked for information such as: lesson relevancy and engagement, effectiveness of attention grabber, utilization of multiple education strategies, lesson organization, comprehensive list of materials, accurate representation of time needed to present, and course content validity The final three questions on the curriculum instructor evaluation were open-ended and asked instructors to state 1) the value of the training program 2) if there were any pieces of the lesson that the instructor struggled to present, and 3) any other comments that would be valuable to the researcher. Exact language of all questions are listed in Figure 3.

Survey validity and reliability. The instructor evaluation established content validity as it was reviewed by two education specialists at The Ohio State University. Reliability was established through pilot testing the instrument with seven preservice agricultural education students. Comments by preservice agricultural education students were used to improve the evaluation instrument.

The completed survey and all research protocols were reviewed by The Ohio State University Institutional Review Board. The study was given exempt status in expedited category #7 and The Ohio State University's OHRP Federalwide Assurance #00006378.

Curriculum analysis. Data collection ceased on March 29, 2019, and soon thereafter, the researcher analyzed data from the educator evaluations. The survey was administered using Qualtrics®. Descriptive statistics were conducted and reported for each question on the survey including frequencies, means, and standard deviation.

Question Number	Question
1	The content is interesting and relevant for a range of participants' ability and prior background knowledge.
2	The lesson uses an effective attention grabber to engage the participants.
3	Multiple strategies were used to engage participants. The strategies not only lead to knowledge of content but also the development of problem-solving skills.
4	The information in this lesson plan is well-organized and constructed. It appeals to multiple learning styles.
5	A complete list of materials needed for the lesson was provided.
6	The estimated time needed to present the lesson is accurate.
7	The course content was based on current, up-to-date information.
8	Do you feel you offered a valuable training program for your participants? Which areas were most valuable for their understanding?
9	Were there portions of the lesson plan that you struggled to present? Include lesson content, the type of equipment used for demonstrations, the activities developed.
10	Are there any other comments that would be useful feedback for the curriculum developer?

Figure 3: Instrumentation Survey Questions

RESULTS

A total of 55 instructors responded to the listserv invitation. The instructors identified themselves as OSU Extension educators, agricultural educators, pre-service agricultural educators and one university professor. A total of 34 individuals (61.8% response rate) completed a consent form and therefore were given access to the curriculum materials via Google Drive. When data collection ended on March 29, 2019, 11 individuals (32.3% response rate) taught sessions involving 243 student participants; the breakdown of individuals taught was

136 males and 107 females, as referenced in Table 1. In total, the curriculum had an overall reach of 2,500 individuals over three states: Ohio, Indiana, and Iowa.

Table 1
Breakdown of Curriculum Reach

Location of Educational Event	Number of Students	Males	Females	Age of Students
Wayne County, Ohio - FFA Tractor Safety	45	25	20	14-19
University of Iowa	5	1	4	22 +
National Trail High School	75	35	40	14-16
Liberty Center High School	39	24	15	14-17
Alexander High School	20	14	6	15-18
Warren High School	-	-	-	-
North Union High School	17	8	9	17-18
Liberty Benton High School	13	9	4	14-16
Northridge High School	17	9	8	16-18
Marysville High School	12	11	1	15-18
Total	243	136	107	14-22+

All lessons were scored via Lickert scale questions using the following key: 1=strongly disagreed, 2=disagreed, 3=neither disagreed nor agreed, 4=agreed, 5=strongly agreed. Per the instructor evaluations, all instructors (n=11) agreed per a short-answer that the curriculum was a valuable training program for their students. These instructors also strongly agreed (30.7%) or agreed (69.2%) that each lesson included an engaging interest approach and all lessons were well organized and relevant to learners (strongly agreed: 61.5%, agreed: 38.4%). Instructors strongly agreed (30.7%) or agreed (53.8%) that the lessons used multiple strategies to engage learners, provided a complete list of materials to teach the lessons (strongly agreed: 46.1%, agreed: 46.1%), and included an accurate time in which it took to present the lesson (strongly agreed:

15.3%, agreed: 46.1%). Instructors strongly agreed (76.9%) or agreed (15.3%) that the course content was based on current, up-to-date information. Finally, instructors strongly agreed (69.2%) or agreed (23.0%) that the content in the lessons was interesting and relevant for a range of participants' ability and prior background knowledge. Raw data for each survey question is reported in Appendix 1.

Reaction time (n=6) and Why it Matters (n=4) were the two most popular lessons with the most sessions taught. They were also the lessons that involved the most students, as 118 students were taught Reaction Time and 125 students were taught Why It Matters. As evidenced in Table 2, evaluators of Reaction Time found that the lesson attained students' interest and was relevant (4.67). Reaction Time was also well-organized with a suitable structure (4.83) and had an accurate list of all materials it would take to teach the lesson (4.67). Why It Matters also had a favorable structure and was well-organized (4.75). The lesson had a complete list of materials (4.67), was relevant and interesting (4.67), and had an engaging interest approach (4.50).

As referenced in Table 3, Personal Protective Equipment (n=3), Hand Signals (n=3), and Hydraulics (n=3) were the second most popular lessons. Personal Protective Equipment was interesting and relevant (4.67). The interest approach for Personal Protective Equipment was rated as "average" (4.00). The lesson was taught to 97 students. Hand Signals received a rating of 4.33 for all categories: lesson interest and relevancy, interest approach, multiple teaching strategies, lesson organization and structure, and the complete list of materials. Hand Signals was taught to 34 students. Hydraulics was relevant and interesting to students (4.67) and had favorable structure and organization (4.67). The lesson scored lower in the complete materials list category (3.33). The hydraulics lesson was taught to 39 students.

Table 2
Most Popular Lessons

		Q 1– Lesson Interest/ Relevancy		Q 2 – Interest Approach		Q 3 – Multiple Teaching Strategies		Q 4 – Lesson Organization/ Structure		Q 5 – List of Materials was Present	
Lesson Name	Students (#)	M	SD	M	SD	M	SD	M	SD	M	SD
Reaction Time (n=6)	118	4.67	0.47	4.50	0.50	4.17	0.90	4.83	0.37	4.67	0.47
Why It Matters (n=4)	125	4.50	0.50	4.00	0.00	3.75	0.83	4.75	0.43	4.50	0.50

Note. M = Mean. SD = Standard Deviation. Lickert Scale ranges from 1 (Strongly Disagree) to 5 (Strongly Agree).

Table 3
Second Most Popular Lessons

		Q 1– Lesson Interest/ Relevancy		Q 2 – Interest Approach		Q 3 – Multiple Teaching Strategies		Q 4 – Lesson Organization/ Structure		Q 5 – List of Materials was Present	
Lesson Name	Students (#)	M	SD	M	SD	M	SD	M	SD	M	SD
Personal Protective Equipment (n=3)	97	4.67	0.47	4.00	0.00	4.33	0.47	4.33	0.47	4.33	0.47
Hand Signals (n=3)	34	4.33	0.47	4.33	0.47	4.33	0.47	4.33	0.47	4.33	0.47
Hydraulics (n=3)	39	4.67	0.47	4.00	0.00	4.00	0.00	4.67	0.47	3.33	0.94

Note. M = Mean. SD = Standard Deviation. Lickert Scale ranges from 1 (Strongly Disagree) to 5 (Strongly Agree).

The third most taught lessons were Tractor Parts Identification (n=2), Instrument Panel and Operation Symbols (n=2), Jumper Cables (n=2), Tractor Operation (n=2), and Making Power Take-Off Connections (n=2). Tractor Parts Identification employed multiple teaching strategies (4.50) and included all lesson materials (4.50). The lesson was well organized and had a favorable structure (4.50). Tractor Parts Identification was also interesting and relevant (4.50) to the 80 students it was taught to. The Instrument Panel and Operation Symbols lesson had an engaging interest approach (4.50) and included an accurate list of all materials it would take to teach the lesson (4.50). Instrument Panel and Operation Symbols was averagely interesting and relevant to students (3.00). It was taught to 23 students. Jumper Cables was interesting and relevant (4.50). Instructors "agreed" (4.00) that Jumper Cables had an appealing interest approach, used multiple teaching strategies, was well organized, and had an accurate list of all materials needed. Jumper Cables was taught to 23 students. Tractor Operation was interesting and relevant (4.50) and employed multiple teaching strategies (4.50). The lesson had a good organization and structure (4.50) and included a list of all materials needed to teach the lesson (4.50). The tractor operation lesson was taught to 80 students. Finally, Making Power Take-Off (PTO) Connections was well organized (4.50) and included a complete list of materials (4.50). The lesson was interesting and relevant (4.50) and included multiple learning strategies for students (4.50). Making PTO Connections was taught to 80 students. See figures in Table 4.

The least popular lessons were Decoding Colors (n=1), Operating the Tractor with a Loader (n=1), and 3-Point Hitch and Drawbar Connections (n=1). Because these lessons were taught the least, they were also taught to the least number of students, as referenced in Table 5.

Table 4
Third Most Popular Lessons

		Q 1– Lesson Interest/ Relevancy		Q 2 – Interest Approach		Q 3 – Multiple Teaching Strategies		Q 4 – Lesson Organization/ Structure		Q 5 – List of Materials was Present	
Lesson Name	Students (#)	M	SD	M	SD	M	SD	M	SD	M	SD
Tractor Parts ID (n=2)	80	4.50	0.50	4.00	0.00	4.50	0.50	4.50	0.50	4.50	0.50
Instrument Panel/ Operation Symbols (n=2)	23	3.00	1.00	4.50	0.50	4.00	0.00	4.00	0.00	4.50	0.50
Jumper Cables (n=2)	23	4.50	0.50	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00
Tractor Operation (n=2)	80	4.50	0.50	4.00	0.00	4.50	0.50	4.50	0.50	4.50	0.50
PTO Connections (n=2)	80	4.50	0.50	4.00	0.00	4.50	0.50	4.50	0.50	4.50	0.50

Note. M = Mean. SD = Standard Deviation. Lickert Scale ranges from 1 (Strongly Disagree) to 5 (Strongly Agree).

The researcher was unsure why these particular lessons were taught the least, however, the inability to gain access to some lesson materials is one hypothesis. Decoding Colors was taught to 18 students. The lesson was "average" (4.00) for lesson interest and relevancy, interest approach, multiple teaching strategies, organization and structure, and list of materials. Operating a Tractor with a Loader was taught to 5 students during its 1 session. This lesson was interesting and relevant (4.00) and used multiple teaching strategies (4.00). It also included a complete list of materials (4.00) and had an engaging interest approach (4.00). Making 3-Point

Hitch and Drawbar Connections was also taught to 5 students during its session. Making 3-Point Hitch and Drawbar Connections scored "average" (4.00) for lesson interest and relevancy, interest approach, multiple teaching strategies, organization and structure, and list of materials.

Table 5
Least Popular Lessons

		Q 1– Lesson Interest/ Relevancy		Q 2 – Interest Approach		Q 3 – Multiple Teaching Strategies		Q 4 – Lesson Organization/ Structure		Q 5 – List of Materials was Present	
Lesson Name	Students (#)	M	SD	M	SD	M	SD	M	SD	M	SD
Decoding Colors (n=1)	18	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00
Operating Tractor with Loader (n=1)	5	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00
3-Point Hitch (n=1)	5	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00

Note. M = Mean. SD = Standard Deviation. Lickert Scale ranges from 1 (Strongly Disagree) to 5 (Strongly Agree).

Two instructors did not teach the curriculum, but instead provided a comprehensive review of all lessons within the curriculum. The instructors' data is averaged per the Lickert scale question format:

1. The content was interesting and relevant for a range of participants' ability and prior background knowledge (3.5).
2. The lesson used an effective attention grabber to engage the participants (4.0).

3. Multiple strategies were used to engage participants. The strategies not only lead to knowledge of content but also the development of problem-solving skills (3.5)
4. The information in this lesson plan was well-organized and constructed. It appealed to multiple learning styles (2.5).
5. A complete list of materials needed for the lesson was provided (4.0).
6. The estimated time to present the lesson was accurate (3.0).
7. The course content was based on current, up-to-date information (4.0).

Qualitative Comments in Support of Curriculum

Per the instructor evaluations, the researcher found many comments in support of the curriculum. In terms of the curriculum's value, one evaluator said, "The lessons were designed in a way that allowed me to relate the instruction to real life events. These events provided students the opportunity to engage in real-life actions and safety precautions that are required by employers and laws. This created a profound amount of applicable conversations that students will use in their future careers in agricultural roles and beyond." One instructor commented on the academic value to their students, and said, "The students' vocabulary expanded during the activities."

Many instructors enjoyed the straight-forward approach of each lesson plan, with one evaluator saying, "All [lessons] were simple, straight forward, and easy to present." Many instructors liked the style of the activities within the lessons, mentioning, "The hands-on learning experiences were extremely valuable for the students. Students developed a deeper, conceptual understanding of the content when they engaged in experiential learning. The more active learning strategies were more engaging for the students," and "The examples and activities were

really meaningful for the students. The activities were interesting, and it allowed the students to get up and move a little in the lesson while also being real examples."

Offering Constructive Improvement to Curriculum

Instructors had valuable suggestions for improvement for the curriculum. Some instructors struggled with a lack of students' previous background knowledge on the topics. One instructor said, "The only part I struggled with were students' lack of agriculture knowledge. For example, I discussed square bailing hay and use that example to explain several safety precautions. However, all of the students were unaware of the process required to square bale hay. So, I had to find videos to show students the process we were explaining. Once understood, students were able to apply the safety topics being discussed."

Some suggestions from instructors were to provide more materials within each lesson plan. One instructor mentioned, "Provide links to OSU safety videos that are currently created so that instructors do not have to search for these videos…I feel that this will greatly help the cause of preparing students to become more well versed in the areas of agricultural safety," while another instructor says, "A sample male and female coupler and hoses/lines were not listed on the materials list [for the hydraulics lesson]. It would be beneficial to have one in class to show students how hoses of implements are connected to the tractor or source of power. It would also be beneficial to show them a sample hydraulic line, and even a damaged line. This would add visuals to aid in the learning of the content."

Many instructors found the time estimated to complete the lesson was inaccurate as this time was an approximation on the researcher's behalf and could easily be skewed. The number of students being taught, the amount of previous background knowledge students have, and the

amount of questions students ask during the lesson are just a few factors that would impact the time the lesson would take to teach.

CONCLUSIONS

Creating educational materials for tractor and machinery was the goal of this undergraduate research project. Through the two program objectives, program development and program evaluation were demonstrated. Fifty-five Extension educators, agricultural educators, preservice teachers, and university professors from Ohio, Indiana, and Iowa expressed interest in the program. Thirty-four educators (61.8% response rate) completed consent forms and therefore gained access to curriculum. Eleven individuals (32.3% response rate) taught sessions involving two hundred forty-three students. Most sessions were taught within high school FFA chapters while one session was taught in a university. Two instructors did not teach the curriculum, but rather read and reviewed it via an evaluation survey.

The results determined that the instructors who taught the curriculum found it a valuable training tool for their learning audiences. According to the instructor evaluations, it was determined that each lesson:

- Used multiple strategies to engage learners (84.5%)
- Was interesting and relevant for a range of participants' ability and prior background knowledge (92.2%)
- Included an engaging interest approach (99.9%)
- Was well organized and relevant to learners (99.9%)
- Provided a complete list of materials to teach the lessons (92.2%)
- Included an accurate time in which it took to present the lesson (61.4%)
- Was based on current, up-to-date information (92.2%)

Per recommendations from all instructors, the researcher adjusted the curriculum as necessary. Finally, the researcher made the curriculum available following the evaluation period on The Ohio State University Agricultural Safety and Health website and the SAY Clearinghouse.

Limitations

There were several limitations to the research; the first being the lack of courses offered as a result of a shortened project timeline. Due to the short timeline between approval from the Institutional Review Board and the end of data collection, few instructors had time to implement the lessons into their curriculum. Likewise, extension educators did not schedule adult workshops with female farmers during the December to March time period due to the weather, although courses are scheduled for later in spring 2019. Therefore, most data collected is from high school agricultural educators who utilized high school classrooms to conduct their training and evaluations.

A second limitation was that the researcher could not collect student data on minors without additional parental consent. This objective was eliminated as a result of the shortened project timeline. Because obtaining this consent would also require consent from the Institutional Review Board and the process would be lengthy, the researcher decided to forego obtaining student data and focus solely on educator data for this particular study.

Implications for Women in Agriculture

Occupational injuries and fatalities do not discriminate against gender. For at risk populations such as young or inexperienced, elderly, and disabled workers, the need for precaution when working around heavy machinery is even greater.

Using the 3E model for safety, engineering, enforcement, and education are ways in which agriculturalists can help prevent injuries and fatalities related to working on the farm. In particular, education about agricultural safety can take many forms.

Throughout this study, it was evident that female agriculturalists feel most comfortable learning from another woman in agriculture. Many pilot sessions were taught in informal group-settings where there is an expectation set that there is no risk of asking a senseless question. Because of this, women in these settings feel more comfortable to open up about their insecurities with working around farm machinery. Because most of the women are at the same experience and knowledge level, it creates a safe space for these women to try something new.

In the future, more women in agriculture events should focus on teaching agricultural safety education in informal group settings. The value gained from these sessions is that no matter the age of the audience, the women can learn valuable agricultural safety information while feeling empowered in a more sensitive environment.

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APPENDICES

Appendix 1
Raw Survey Data

Lesson Plan	Sessions Offered (#)	Students (#)		Q 1 – Lesson Interest/ Relevancy	Q 2 – Interest Approach	Q 3 – Multiple Teaching Strategies	Q 4 – Lesson Organization/ Structure	Q 5 – List of Materials was Present	Q 6 – Estimated Time was Accurate	Q 7 – Lesson was Current/ Up to Date
Why It Matters	4	125	Mean	4.50	4.00	3.75	4.75	4.50	3.33	5.00
			S.D.	0.50	0.00	0.83	0.43	0.50	0.47	0.00
Reaction Time	6	118	Mean	4.67	4.50	4.17	4.83	4.67	4.00	5.00
			S.D.	0.47	0.50	0.90	0.37	0.47	0.89	0.00
Personal Protective Equipment	3	97	Mean	4.67	4.00	4.33	4.33	4.33	3.00	5.00
			S.D.	0.47	0.00	0.47	0.47	0.47	1.00	0.00
Hand Signals	3	34	Mean	4.33	4.33	4.33	4.33	4.33	4.50	4.00
			S.D.	0.47	0.47	0.47	0.47	0.47	0.50	1.41
Tractor Parts ID	2	80	Mean	4.50	4.00	4.50	4.50	4.50	4.00	5.00
			S.D.	0.50	0.00	0.50	0.50	0.50	0.00	0.00
Decoding Colors	1	18	Mean	4.00	4.00	4.00	4.00	4.00	-	5.00
			S.D.	0.00	0.00	0.00	0.00	0.00	-	0.00
Instrument Panel/ Operation Symbols	2	23	Mean	3.00	4.50	4.00	4.00	4.50	4.00	5.00
			S.D.	1.00	0.50	0.00	0.00	0.50	0.00	0.00
Jumper Cables	2	23	Mean	4.50	4.00	4.00	4.00	4.00	2.00	4.50
			S.D.	0.50	0.00	0.00	0.00	0.00	0.00	0.50
Tractor Operation	2	80	Mean	4.50	4.00	4.50	4.50	4.50	4.00	5.00
			S.D.	0.50	0.00	0.50	0.50	0.50	0.00	0.00
Operating Tractor with Loader	1	5	Mean	4.00	4.00	4.00	4.00	4.00	-	5.00
			S.D.	0.00	0.00	0.00	0.00	0.00	-	0.00
3-Point Hitch	1	5	Mean	4.00	4.00	4.00	4.00	4.00	-	5.00
			S.D.	0.00	0.00	0.00	0.00	0.00	-	0.00
Hydraulics	3	39	Mean	4.67	4.00	4.00	4.67	3.33	4.00	4.67
			S.D.	0.47	0.00	0.00	0.47	0.94	0.00	0.47
PTO Connections	2	80	Mean	4.50	4.00	4.50	4.50	4.50	4.00	5.00
			S.D.	0.50	0.00	0.50	0.50	0.50	0.00	0.00

Appendix 2
Sample Lesson Plan Template

SAFETY EDUCATION FOR
WOMEN IN *Agriculture*

I. Preparation	
Title:	
Length of Presentation:	
Question to be Answered:	
Equipment, Supplies, References & Other Resources:	
Pre-Preparation:	
Objective – After today's lesson, the students will be able to:	

II. Interest Approach
Why should I learn what you want to teach me today?

INSTRUCTOR DIRECTIONS (What will the instructor do?)	**CONTENT OUTLINE AND/OR PROCEDURES (What will the instructor say?)**

III. Presentation and Application What steps do we need to take to get there? How do I apply these points in my life?	
INSTRUCTOR DIRECTIONS	**CONTENT OUTLINE AND/OR PROCEDURES**

IV. Evaluation How will I know if we have arrived?	
INSTRUCTOR DIRECTIONS	**CONTENT OUTLINE AND/OR PROCEDURES**

V. Safety Messages What emphasis should be placed on safety during this lesson?
○

VI. References
○