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Effectiveness of Utilizing an Evidence Based Safety Curriculum to Increase Student Knowledge

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Abstract

The purpose of this study was to determine the effectiveness of utilizing an evidence based, "Train the Trainer" approach to increase the safety knowledge and awareness of secondary students. Participating teachers attended a 10-hour, inquiry-based summer training workshop utilizing National Safe Tractor and Machinery Operations Program (NSTMOP) materials focusing on roll-over protection structures, mini-tilt table construction, and on-farm tractor risk assessments. Teachers incorporated workshop lessons into existing curricula. Students completed pretests prior to instruction and posttests after instructional units were delivered. A total of 118 students provided completed pre- and posttests, with most students identifying as male and more than half enrolled in ninth grade. Wilcoxon Sign-Rank test showed students' posttests were statistically significantly ($Z = -5.22$, $p < .001$) higher than pre-tests. Student performance in this study suggests the Fair Labor Standards Act exemption provided for youth between the ages of 14 and 15 years old who have completed specific safety training needs to be revisited. Additionally, increasing the age restriction for hazardous occupations in agriculture would be consistent with other industries. In order for students to learn agricultural safety in the classroom setting, teachers participating in this study may consider preparation and continuing education programs that incorporate more production-based experiences focused on safety.

Keywords

safety curriculum; student knowledge; inquiry-based; professional development

Introduction/Theoretical Framework

On average, statistical estimates have indicated that 45 children are injured and another three die in an agricultural-related incident every day in the United States (Wright et al.,

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2013). The National Institute for Occupational Safety and Health (NIOSH) reported 121,252 injuries to youth who lived on, worked on, or visited farms in the United States from 2001-2014, consequently denoting this special population at high risk for non-fatal and fatal injuries (NIOSH, 2014). More specifically, the majority of these agricultural-related youth injuries occurred to males between the ages of 10 and 15 years (Hendricks et al., 2018). A more recent injury review (Weichelt et al., 2019) concluded agricultural- related youth injuries and fatalities are still a persistent problem, with most injuries being classified as non-occupational and the most frequent injury sources as vehicles (including tractors and all-terrain vehicles) and machinery.

As youth working in agriculture continue to be susceptible to agricultural hazards (Hard & Myers, 2006; Hendricks et al., 2018; Marlenga et al., 2001; NIOSH, 2014; Weichelt et al., 2019), student leadership organizations have been recommended to serve as an intervention to reduce childhood agricultural injuries (Jepsen, 2012; Myers, 2002; National FFA, 2014; NIOSH, 2014; Sanderson et al., 2010). Prevention strategies that integrate established safety training curriculum are lacking. A potential pathway to reducing agricultural related youth injuries could reside in school-based agricultural education programs as they are uniquely poised to address the critical issue of agricultural youth safety by disseminating effective safety education curriculum to secondary students. Yet questions remain about teachers' preparation as school-based agricultural teachers have often expressed a continued need for professional development related to safety education (Lawver et al., 2016; McKim & Saucier, 2011; Saucier et al., 2014; Shultz et al., 2014).

Several studies have documented professional development opportunities as effective means of increasing teacher self-efficacy and competence (McKim & Velez, 2017; Overbaugh & Lu, 2008; Tschannen-Moran & McMaster, 2009), which can create greater opportunities for the provision of quality teaching provided to students (Chandrashekar et al., 2017). Professional development opportunities can vary widely and supporting research has been inconsistent and often contradictory (Guskey, 2003). Further, engagement in and reasoning for pursuit of professional development opportunities seemingly change according to teacher life cycle stage. The beginning stages of an educator's career have often been characterized as ones of discovery and survival (one to three years) (Huberman, 1989), potentially limiting the prioritization of professional development. Whereas, mid- career educators have "stabilized" (four to six years) and demonstrate confidence in teaching, which allows them to experiment with curriculum, seek new strategies, and attend professional development events (Burke et al., 1987; Huberman, 1989; NAAE, 2015). Teachers' overall safety knowledge has been shown to increase as they gain more teaching experience (Pate et al., 2019).

Despite career stage, one distinguishable characteristic of effective professional development has been consistently noted. Literature has revealed effective professional development should enhance teachers' content and pedagogical knowledge to better understand the content they teach and the ways students learn (Desimone, 2009; Guskey, 2003). Further, Ingvarson et al. (2005) suggested professional development was most effective at improving teacher and student efficacy when structured in an active learning environment, experiential in nature, and intricately tied to the problems and skills students most commonly face.

Regardless of approach, professional development should focus on closing the presumed linkages between professional learning strategies and student outcomes (Ingvarson et al., 2005), including those in safety education.

An increasingly common area of scientific exploration has been the evaluation of increased injury rates by examining the relationship between injuries and students' attitudes or perceptions of safety. When students appear to have favorable safety attitudes, fewer injuries and serious incidents have been reported (Lawver & Fraze, 1995). Favorable student attitudes and consequent improved learning have been reported to possess direct ties to positive teacher attitude (Mensah et al., 2013). Recognizing teachers learn similarly to students and participate through active engagement development to internalize new ways of thinking (Swan et al., 2013), professional development has the potential to alter teachers' knowledge and thinking, which in turn can alter practice and ultimately improve students' learning of safety (Kennedy, 2016). Interactive experiential learning approaches have been mentioned among the essential elements to improving student learning, specifically to the safety and health discipline (Torres, 2007). Therefore, if we want to reduce injuries and improve safety awareness attitudes of students, teachers should focus on educating students on ways to apply their theoretical safety processes through incorporation of experiential learning (Jin & Nakayama, 2013).

This study utilized experiential learning theory to conceptualize the linkages among student and teacher attitude, learning, and experience (Jin & Nakayama, 2013; Kennedy, 2016; Torres, 2007). Kolb's (1984, p. 38) experiential learning theory (ELT) stated, "Learning is the process whereby knowledge is created through the transformation of experience." Several key theorists (Dewey, 1934, 1938, 1958; James, 1890; Rogers, 1961) have built upon the ELT working definition of learning as the "process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p. 38). Capitalizing on these transformational experiences is pivotal in safety education since highly engaging experiences are considerably more effective than less engaging ones when hazardous event/exposure severity is high (Burke et al., 2011).

Kolb (1984) characterized experiences as occurring in a cyclical fashion (Figure 1) as students engage in concrete experiences (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE) (Kolb, 1984). Kolb (1984) focused on experiential instruction being characterized as a continuous learning process, a process requiring the resolution of conflicts, a holistic process of adapting, and that learning involves transactions between the person and environment that creates knowledge. These transactions between learner, experience and environment have proven significant within safety education as Stuart's (2014) findings illustrated learners with prior experience required a change in their attitude which was achieved through practical laboratory environments, while learners with no experience were often intimidated by a laboratory's learning environment.

Similar to the foundation of Kolb's (1984) ELT, inquiry-based learning can be defined as a process of discovering new causal relations, with learners formulating hypotheses and testing them though experiments and/or observations (Pedaste et al., 2012). Inquiry-based learning served as a conceptual framework for the professional development experience described in this study due to its emphasis on active participation and the learner's responsibility for discovering new knowledge (de Jong & van Joolingen, 1998). Although inquiry-based learning models may vary slightly from one to another, Pedaste et al.'s (2015) review of descriptions and definitions of inquiry phases led to a new inquiry-based learning framework that included five general inquiry phases: *Orientation, Conceptualization, Investigation, Conclusion*, and *Discussion*.

In an effort to improve students' learning of safety by altering teachers' knowledge and thinking (Kennedy, 2016), the professional development experience described in this study closely followed the inquiry-based learning framework (Pedaste et al., 2015) by orientating an initial focus on stimulating learner interest and curiosity in safety education. A problem statement was then conceptualized, and learner curiosity was turned into action to respond to the problem statement. With the goal of reducing agricultural-related youth injuries by capitalizing on the learners' experiences, final conclusions were drawn and set the foundation of communication, reflection, and action.

Purpose/Objectives

Education research has several strong theories for student learning but lacks well-developed ideas on how teachers learn or how to help teachers incorporate new ideas into practice that ultimately influence student outcomes (Kennedy, 2016). The purpose of this study was to determine the effectiveness of utilizing an evidence based, train the trainer approach to increase the safety knowledge and awareness of secondary students. The study was part of a larger project tasked with developing and evaluating an agricultural machinery safety curriculum through teacher trainings utilizing inquiry- based activities (Pate et al., 2019). This information could help contribute to current research exploring effective professional development strategies that affect student learning as outlined in the 2016-2020 American Association of Agricultural Education's (AAAE) National Research Agenda Priority 4: Meaningful, Engaged Learning in All Environments (Edgar et al., 2016). This study's research objectives included:

1. Describe selected demographic characteristics of school-based agricultural education students whose teachers participated in an agricultural safety professional development.

2. Determine the effect of a train the trainer agricultural safety education professional development program on school-based agricultural education students' knowledge of tractor and machinery safe operation.

3. Explore potential associations among selected demographic characteristics changes in students' knowledge of safe tractor and machinery operation.

Methods/Procedures

Design

Due to ethical considerations and requirements for human subject research protocol, the study design followed a modified pretest-posttest approach that would ensure the protection of the youth involved. A pretest-posttest design has been documented as a justifiable method to evaluate the experimental implementation phase of positive youth development projects (Shek, 2013). A convenience sample of students whose teachers had participated in a previous, specified agricultural safety professional development workshop were recruited to participate.

Teacher Professional Development Intervention

School-based agricultural teachers were recruited from Montana and South Dakota to participate in a 10-hour summer teacher training workshop. Teachers were asked to register for the workshop on a voluntary basis and participation was via a “first-come, first-serve” process. To increase participation, incentives were provided to the first 50 registered participants (Dillman et al., 2009). Incentives primarily comprised of safety materials and supplies, which included tractor power take-off safety guards, warning labels, personal protective equipment, and supervisor safety toolboxes. Flash drives loaded with workshop curriculum were also provided to participating teachers. Additional incentives included professional development credit towards licensure and safety educational resources for students. The human subject research protocol was reviewed and approved under Utah State University’s Institutional Review Board protocol 10514. An Institutional Review Board reliance agreement was established and approved between Montana State University and South Dakota State University with Utah State University as the institution of record. Informed consent forms were provided to teachers and subsequently to their respective students.

The 10-hour workshop was developed using National Safe Tractor and Machinery Operations Program (NSTMOP) materials and the Safety in Agriculture for Youth Supervised Agricultural Experiences Risk Assessment Resource Guide. A lesson plan was developed that included two large group activities and rotations between three small groups, inquiry-based activities. During the summer of 2017, the two seminars occurred separately and were hosted at different times. To ensure fidelity of the training, a university teacher educator from each state was trained to present the workshop (Pate et al., 2019). Participating teachers began by completing a large group activity followed by completion of three inquiry-based rotation activities:

1. NIOSH Cost Effective Roll-over Protection Structures (CROPS)
2. Penn State University’s Extension mini-tilt table construction
3. Supervised Agricultural Experience On-Farm Tractor Risk Assessment

After completing the small group rotation modules, teachers were brought back together to conclude the workshop with a final large group activity. During this concluding activity, teachers were asked to incorporate workshop lessons into their existing curricula and have their participating students complete a pretest prior to instruction and a posttest after instructional units were delivered.

Student Population and Sample

During the 2017-2018 academic year, a convenience sample of students whose teachers participated in the Montana and South Dakota trainings was sought for this study. To be included in the study, students needed to be enrolled in a course taught by a participating teacher and be between the ages of 14-18 years old. Students were provided an informed consent/assent form to review with their parent or legal guardian. Students and parents who agreed to participate sent a copy of the signed informed consent/assent form back to the researchers. A total of 318 students agreed to participate and provided test data, but 200 students submitted incomplete tests or did not meet requirements (younger than inclusion age of 14-18 years old) to be included for the research and were removed from the data set. A total of 118 students (37.1%) provided a complete pre- and posttest and were included in the analysis. Attempts to contact teachers were made to recruit students into the study. However, due to the anonymous nature of data collection required by human subjects' research protocol, collection of student exams precluded follow-up of absent or non-responding students (Johnson et al., 2015) and thereby limits generalizability of results.

Instrumentation

A paper-based instrument was used to collect test results and demographic information from participating students. A pretest of 50 multiple choice and true/false NSTMOP exam questions were randomly generated from the Penn State University NSTMOP instructor curriculum resources. The instructional curriculum and exam items were evaluated by agricultural safety educators and determined to meet content validity (Garvey et al., 2008). The posttest was constructed to be an equivalent from using pretest items with re-ordered questions and answer choices to limit participants' sensitization to the instrument (Ary et al., 2010). Additionally, to reduce testing effect, teachers were instructed to wait an interval of one month between administering student pretest and posttests. One point was recorded for each correct answer. Prior to beginning instruction, students completed the written NSTMOP exam to establish knowledge of tractor and machinery operation safety. Exam items were developed by experts and were evaluated to be content and face valid (Garvey et al., 2008). These exam items are used for national student certification. A reliability coefficient for the exam was documented to be .60 (Pate et al., 2019). The standard minimum passing score for the written NSTMOP exam is 70% or higher. The maximum possible score for the pretest and posttest was 50. Post-hoc reliability analyses for student exams for the pretest and posttest yielded alpha coefficients of 0.67 and 0.76, respectively. When tests are used as a group assessment for the purposes of programmatic decision-making, researchers have recognized acceptable levels of reliability include .60 or greater (Weiner, 2003). We deemed the exam a reliable measure of students' tractor and machinery safety knowledge.

Analysis

Test scores and demographic variables were entered into and analyzed through IBM SPSS version 25. Descriptive statistics for participating students' demographics were reported and included frequencies, percentages, means, and standard deviations. Means and standard deviations were reported for participants' tests scores. Non-parametric tests were used to determine significant differences between students' test performance before and after the training. The Wilcoxon Sign-Rank test was used to determine if there was a statistically significant difference between participants' pretest and posttest scores (Gall et al., 2007). To identify associations between demographic variables and pass/fail test scores, the following assumptions were met for Chi-square test of association, all expected cell counts were greater than one and at least 80% of cells expected count were greater than five (Leedy & Ormrod, 2019). Since Fair Labor Standards allow youth 16 years and older to perform hazardous occupations as a hired employee for a production-based agriculture operation, categorical variables were collapsed based on theoretical association (Agresti, 2013) as labor standard exemptions are only provided for youth who are 14-15 years old.

Results/Findings

The purpose of objective one was to describe select demographic characteristics of school-based agricultural education students whose teachers participated in an agricultural safety professional development program. Sixty percent ($n = 71$) of students self-identified as male and 51.7% ($n = 61$) were enrolled as a ninth grader. The average student age was 15.4 ($SD = 1.3$) and 16 students did not report their age. A complete detail of participating student demographic characteristics is provided in Table 1.

As displayed in Table 2, objective two sought to determine the effect of a train the trainer agricultural safety education professional development program on school-based agricultural education students' knowledge of safe tractor and machinery operation. One measure of effectiveness was the evaluation of students' pre- and posttests. The maximum score for pre- and posttests was 50. Students' overall pretest average was 31.8 ($SD = 5.3$) and the overall posttest average was 35.2 ($SD = 6.2$). A Wilcoxon Sign-Rank test was used to determine if test scores differed significantly between pre- and posttest. Students scored significantly higher ($Z = -5.22$, $p < .001$) on the posttest. Additionally, pretest and posttest correlations were significant ($p < .01$) and positive ($r = .41$).

To provide further context to changes in school-based agricultural education students' knowledge of safe tractor and machinery operation, each NSTMOP test question was analyzed according to content as it pertained to workshop focus. Of the posttest questions, the most frequent question answered incorrectly by students was: Loads should only be attached to the following: a) 3- point hitch, b) axle, c) drawbar, or d) all of the above ($f = 78$, 66.1%). The second most frequent question answered incorrectly was: Government regulations of work hazards and risks is evident at all levels of farm work: a) true or b) false ($f = 74$, 62.7%). The third most incorrectly answered question was: Throttle controls next to the tractor seat increase engine speed when moved: a) rearward and downward, b) rearward and upward, c) forward or upward, d) forward or downward ($f = 68$, 57.6%). The fourth most incorrectly answered question was: What percent of tractor-related fatalities are a result from tractor overturns a) 1%, b) 25%, c) 50 %, d) 75% ($f = 62$, 52.5%).

The third objective was to explore potential associations among selected demographic characteristics and changes in students' knowledge of safe tractor and machinery operation. Two categories were created for grade levels: under-class (9^{th}-10^{th} grade) and upper-class (11^{th}-12^{th} grade). There were 79 students (66.9%) classified as under-class and 39 students (33.1%) as upper-class. Under-class students averaged 30.7 (*SD* = 5.59) on the pretest and 35.0 (*SD* = 6.76) on the posttest, while upper-class students averaged 34.2 (*SD* = 3.91) and 36.0 (*SD* = 4.73) on the pre- and posttests, respectively. A passing score for NSTMOP test is considered a 70.0% (35 out of 50 questions). An ordinal variable was generated for passing test scores and coded as zero for scores < 70 % and one for scores ≥ 70%. There was no significant association between students' gender and passing the pretest ($\chi^2(1) = 0.82$, p = .775) or posttest ($\chi^2(1) = 0.17$, p =.680).

A categorical variable was generated as an indicator for meeting the age exemption requirement of the Fair Labor Standards Act. This variable was coded as zero for ages between 14 and 15 years old ("under-class student") and one for ages ≥ 16 ("upper-class student"). For the student age category 14- 15 years old, the average pretest score was 30.3 (*SD* = 5.61) and the average posttest score was 35.0 (*SD* = 7.12). For the student age category ≥ 16 years old, the average pretest score was 34.3 (*SD* = 4.1) and the average posttest score was 37.0 (*SD* = 4.62). Table 3 provides a summary of test differences by student age. There was a statistically significant association between students' age category and passing the pretest ($\chi^2(1) = 10.1$, p = .001, φ = .315). Students who indicated an age of 16-18 years old were more likely to pass the pretest than students who indicated being 14-15 years old. There was no significant association between students' age category and passing the posttest ($\chi^2(1) = 0.74$, p = .390).

Teachers who participated in the train the trainer workshop had an average of 14.7 years of teaching experience (*SD* = 9.79). This variable was collapsed as ordinal and renamed "Teacher Life Cycle Stage" with 1-5 years of teaching experience classified as a beginning teacher, 6-15 years as mid- career, and 16 or more years as a veteran. Thirty-three (28.0%) students were taught by beginning teachers, 26 students (22.0%) were taught by mid-career teachers, and 59 students (50.0%) were taught by veteran teachers. Using the Chi-square test of association, pretest and posttest scores were compared between under- and upper-class students across teacher life cycle stages. Between under- and upper- class students of beginning teachers, there were no significant differences on pretest ($\chi^2(1) = 0.448$, p=.503) or posttest passing scores ($\chi^2(1) = 0.203$, p =.653). Between under- and upper-class students of mid-career teachers, there were no significant differences on pretest passing scores ($\chi^2(1) = 3.328$, p=.068). However, upper-class students of mid-career teachers were significantly more likely to have a passing score on the posttest than under-class students ($\chi^2(1) = 3.914$, p = .048, φ = .388). Upper-class students of veteran teachers were significantly more likely to have a passing score on the pretest than under-class students ($\chi^2(1) = 5.501$, p = .019, φ = .305). Between under- and upper-class students of veteran teachers, there were no significant differences on posttest passing scores ($\chi^2(1) = 0.325$, p=.569). Table 4 provides test differences of under- and upper-class students by teacher life cycle category.

Conclusions/Recommendations/Implications

We acknowledge our study has limitations associated with the research design, effecting generalizability. However, elements in the research protocol were followed to address extraneous variables. Teachers were asked to complete data collection within a month of the pre-test. This was to limit the effect of maturation. Re-ordering of the post-test questions and answer choices was done to limit the effect of instrument sanitization. The intent was not to generalize the results to all students, but to describe the population of students who participated in the safety curriculum. Caution should be taken to not generalize the results of this study to participants outside of the study.

Recognizing teachers learn similarly to students (Swan et al., 2013) and an effective way of improving teacher and student efficacy is through an experiential based, active learning environment (Ingvarson et al., 2005), the train the trainer professional development program examined in this study delivered curriculum through an inquiry-based approach in an attempt to determine its effectiveness in increasing the safety knowledge and awareness of secondary students. It is openly acknowledged that student performance cannot be definitively tied to teacher training in this study alone. However, the following discussion can provide insight regarding current connections and future areas of exploration.

The first research objective was to describe selected demographic characteristics of school-based agricultural education students whose teachers participated in an agricultural safety professional development. The typical student participating in our study was a self-identified 9th-grade male. NIOSH injury statistics reported most injuries occur to males between the ages of 10 and 15 years old (Hendricks et al., 2018). Marlenga et al. (2001) reported male youth were more likely to be assigned to tractors with implement operations and female youth were more often assigned to animal care. To further understand potential impacts, we recommend completing an experimental study to examine causal effects of a train the trainer professional development program among agricultural youth. Specifically, additional research should explore the impact of this training according to gender.

The second research objective sought to determine the effect of the train the trainer program on students' knowledge of safe tractor and machinery operation. The primary measure of effectiveness was the evaluation of students' pre- and posttests. Overall, school-based agricultural education student scores increased from pre- to posttest. The average test scores changed from failing on the pretest to passing on the posttest. However, students' average post-test scores were 70%, which was the cutoff for passing, indicating more work is needed to improve student learning.

Previously, Pate et al. (2019) documented one of the most incorrectly answered questions by teachers (f= 54, 49.1%, n = 110) after completing an agricultural safety professional development program was related to rear-rollovers and improper hitching. More than a quarter of teachers (28.1%, n =110) answered loads be attached to the three-point hitch (Pate et al., 2019). Similarly, the posttest question most incorrectly (f = 78; 66.1%) answered by students of these teachers dealt with rear-rollover tractor hazards due to improper hitching. In this study, more than a third of students (36.4%, f = 43, n= 118) answered loads be attached to the three-point hitch. Connecting this to Guskey's (2003) review, the enhancement of teachers' content and pedagogical knowledge would help teachers better understand the content they teach and improve student learning. We concluded that while the topic of side-rollover hazards was discussed in depth during the interactive session involving the mini-tilt table exercise, more targeted curriculum is needed for hitching and backing of equipment. A recommendation is to provide training for an additional round of professional development with teachers that includes an interactive module demonstrating angle of pull and a tractor's center of gravity.

The second most incorrectly answered posttest question ($f = 74$; 62.7%) dealt with government regulatory enforcement of safety standards. Several government agencies are involved in regulating different aspects of production agriculture (Occupational Safety and Health Administration, Environmental Protection Agency, and Food and Drug Administration). Students' potential lack of work experience, given their age, warrants additional learning activities be developed to improve their understanding of regulatory standards impacting their Supervised Agricultural Experiences activities.

The third most incorrectly answered posttest question ($f = 68$; 57.6%) dealt with tractor controls and their functions. This is likely due to the changes in standardization of tractor controls and color coding prior to 1969. Many older farm tractors are still used in production agriculture. Older tractors lack many standard safety features. Students should be encouraged to use modern tractors equipped with roll-over protection structures and seat belts, and tractors that have standardized controls for operation. An interactive activity to assist teachers and students in identifying tractor controls and remembering their function is recommended for future workshops with similar participant outcomes.

The third objective was to explore potential associations among selected demographic characteristics and changes in students' knowledge of safe tractor and machinery operation. Students who were 16 years old and older were significantly more likely to pass the pretest, but there was no significant association between student age categories and passing the posttest. We concluded all students, regardless of age, should complete some form of interactive tractor and machinery safety training. This was evident as pretest average scores for both age categories failed the test. After the training, average posttest scores for both age categories reached the passing mark of 70%. This finding has implications for the Fair Labor Standards Act concerning hazardous occupations in agriculture and young worker age restrictions. We recommend decision makers investigate the exemption provided for youth between the ages of 14 and 15 years old who have completed specific safety training. Specific implication would be to evaluate instructor training programs impact such as Gearing up and National Safe Tractor Operations program. Even when working for a parent or legal guardian, we suspect these youth lack the knowledge and skills to perform these hazardous tasks on the farm. When considering Kolb's (1984) experiential learning model, this group of students has not had enough concrete experience or abstract conceptualization to effectively engage in learning. Kolb characterizes experiential instruction as a continuous learning process, requiring the resolution of conflict, process of adapting, transaction between the person and environment in addition to creating knowledge.

The inclination that experiences of teachers may influence whether a student passes their pre- and posttests relates to Kolb's experiential learning model. Success on the posttest was seen when teaching experience and maturing students were connected. Students who had a beginning teacher were less likely to pass the pretest or posttest. However, upper-class students (11-12 grades) with mid-career teachers were significantly more likely to have a passing score on the posttest. Upper-class students (11-12 grades) with veteran teachers were more likely to have safety training and experiences that contributed to their preexisting safety knowledge. This is evident as upper-class students were significantly more likely to have a passing score on the pretests when working with veteran teachers. Mid-career and veteran teachers could have more exposure to agricultural experiences through professional development or life experiences, which allows them to incorporate personal knowledge into their teaching. Within the literature of teacher professional development, Guskey (2003) revealed the most frequently cited characteristics in the enhancement of teachers' content and pedagogical knowledge was better understanding the content they teach and the ways students learn. In addition, Ingvarson et al. (2005) suggested professional development is most effective at improving teacher and student efficacy when structured in an active learning environment that focuses on the problems and skills students most commonly face. Teachers without a production-based agricultural background may not have had exposure to tractors and/or agricultural safety, which could limit their ability to share relevant experiences. Teacher preparation and continuing education programs need to incorporate more production-based experiences for pre-service and in-service teachers. Teacher educators preparing professional development should consider how programming influences student learning and performance. An effort needs to be placed on having teachers focus on how delivery will influence student learning. From the time the professional development occurs until the time the curriculum is delivered in the classroom, the transferability of content can be limited. With the unforeseen circumstances a teacher may face, content delivery can be effected.

Based on the findings and conclusions of this study, future research should focus on the background, experiences, and training teachers have had and the outlets they sought to receive the professional development focused on agricultural safety. Additionally, research should focus on youth background and the safety measures implemented within SAEs. We recognize an increase in safety knowledge does not equate to performing appropriate safety behaviors. A qualitative field observational study is recommended to be conducted with these students to ascertain the impacts of these trainings on their performance of safety behaviors.

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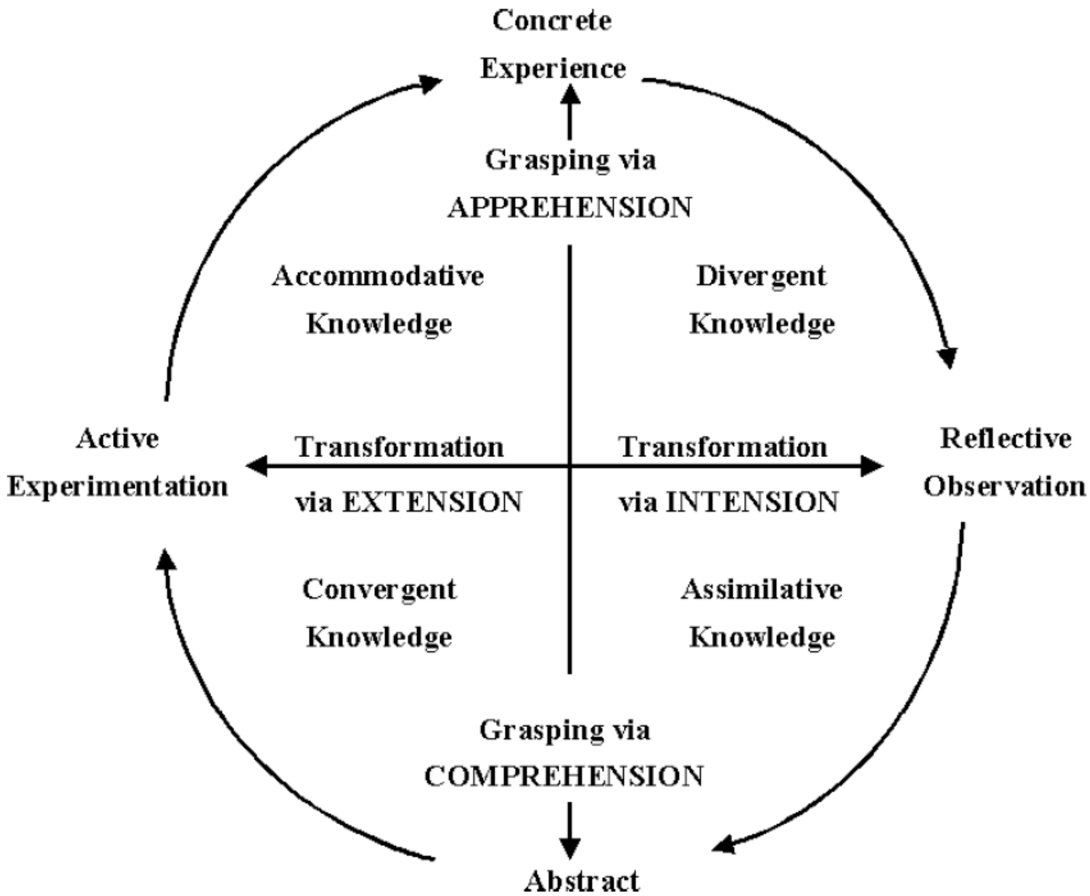

Figure 1. Model of Experiential Learning Process

Note. Reprinted from *Experiential Learning: Experience as the Source of Learning and Development* (p. 42), by David A. Kolb, 1984, Englewood Cliffs, NJ: Prentice- Hall, Inc. Copyright 1984 by Prentice-Hall, Inc.

Table 1

Student Demographic Characteristics (n = 118)

	f	%
Sex		
Male	71	60.2
Female	47	39.8
Grade Level		
9^{th}	61	51.7
10^{th}	18	15.3
11^{th}	15	12.7
12^{th}	24	20.3

Table 2

Students' Exam Results and Mean Difference

	Overall		
	n	***M*** [a]	**SD**
Pretest Score	118	31.8	5.3
Posttest Score	118	35.2	6.2
Test Difference	118	3.4	6.3

[a]Mean test difference was calculated by averaging the difference between students' pretest and posttest scores

Table 3

Mean Test Difference by Student Age Category (n = 102)

	Pretest		Posttest		Test Difference	
Age Category	***M***	***SD***	***M***	***SD***	***M*** [a]	***SD***
14-15 (*n* = 61)	30.3	5.61	35.0	7.12	4.9	6.5
≥ 16 (*n* = 41)	34.3	4.1	37.0	4.62	2.0	4.9

[a] Mean test difference was calculated by averaging the difference between students' pretest and posttest scores

Table 4

Students' pretest and posttest difference by teacher life cycle category.

	Beginning			Mid-career			Veterans		
Test Difference	***M*** [a]	***SD***	***n***	***M*** [a]	***SD***	***n***	***M*** [a]	***SD***	***n***
Under-Class Student	1.3	7.0	19	4.2	5.2	19	3.6	7.0	41
Upper-Class Student	5.6	6.8	14	3.0	4.6	7	2.6	4.9	18

[a] Mean test difference was calculated by averaging the difference between students' pretest and posttest scores