Journal of Agricultural Education, 61(2), 238-248
https://doi.org/10.5032/jae.2020.02238

A Multi-State Evaluation of Secondary Agricultural Education Students' Performance on Industry-Based Standards

A. Preston Byrd[1], Stacy K. Vincent[2], Joan Mazur[3], Kang Namkoong[4]

Abstract

This examination of secondary agricultural education students' performance was used to determine if students could perform up to industry standards. In this study, the industry standard were blueprints created by engineers at the National Institute for Occupational Safety and Health. Students had to fabricate a Cost-effective Roll-Over Protective Structure (CROPS) to be placed on a tractor within their community. All the pieces of the CROPS were inspected by an outside consultant with experience with inspecting projects and visual inspection of welds. It was found that students struggled the most with fabricating the axel brackets. The axel brackets required the most drilled holes and cuts of all the pieces therefore creating more areas where mistakes could be made. Students fabricated the vertical support tubes with the most accuracy. According to the Data-Driven Decision Model (DDDM), teachers analyzed student work, provided feedback, and need to incorporate this new knowledge into their future instruction to increase the accuracy of their students' fabrication skills. Teacher trainers are recommended to incorporate this performance data into the summer training to better prepare teachers. The inclusion of teaching strategies need to be created for secondary teachers such as peer evaluation of measurements prior to drilling and cutting.

***Keywords*:** student performance; industry standards; inspection; secondary students; multi-state evaluation

Author's Note: This publication or project was supported by SCAHIP through Grant 6U54OH007547. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIOSH/CDC.

Introduction

Once a student graduates and enters the workforce, are they ready for the daily requirements of a job? Educational institutions strive to provide academic, technical, and employable skills to prepare students for careers after secondary education (Dibenedetto & Myers, 2016). The expectation of students is to successfully transition after the completion of their secondary education; however, the measurement of the successful transition are limited to the simple affirmation of the transition being obtained with limited to no assessment. Per Lynch (2000), 50% of students in college fail to obtain a degree. Unfortunately, students are entering the

1 A. Preston Byrd is an assistant professor of Agricultural Education in the Department of Agricultural Sciences at Clemson University, 253 McAdams Hall, Clemson, SC 29634. apbyrd@clemson.edu.
2 Stacy K. Vincent is an associate professor of Agricultural Education in the Department of Community and Leadership Development at University of Kentucky, 505 W.P. Garrigus Building, Lexington, KY 40546. stacy.vincent@uky.edu
3 Joan Mazur is professor of Curriculum and Instruction/Instructional Systems Design in the Department of Curriculum and Instruction at the University of Kentucky, 335 Dickey Hall, Lexington, KY 40506-0017, jmazur@uky.edu
4 Kang Namkoong is an assistant professor in the Department of Communication at the University of Maryland, 2126 Skinner Building, College Park, MD 20742. namkoong@umd.edu

workforce, considered by their school as successfully transitioning, with insufficient knowledge and skills needed to be productive workers (Gardner & Liu, 1997); thus, leading to collaborative work of industry leaders, educators, and policy makers to correct this unpreparedness of graduating students (Dibenedetto & Myers, 2016).

Over the last decade, one method for measuring successful transition that is becoming more popular is the inclusion of industry-based certifications, also referred to as IBCs (Wilcox, 2006). The premise behind IBCs is to prove that students have met a predetermined level of mastery or competence within a subject (Church, 2007). IBCs come from a push by many states for Career and Technical Education (CTE) programs to align with industry and professional standards (Church, 2007). Many certifications exist that can be obtained through CTE courses and many companies provide a certification examination (Foster & Pritz, 2006; Wilcox, 2006). One such organization that is used nationwide to create and administer the certification exams is the National Occupational Competency Testing Institute (NOCTI) (Foster & Pritz, 2006). NOCTI examinations have further added creditability by matching their test items to other national standards across the core academic areas such as math, science, and language arts. These certifications are based on several principles one which is quality. Quality of these certifications refer to how tightly aligned the certification is tied to industry standards which are highly valued by employers.

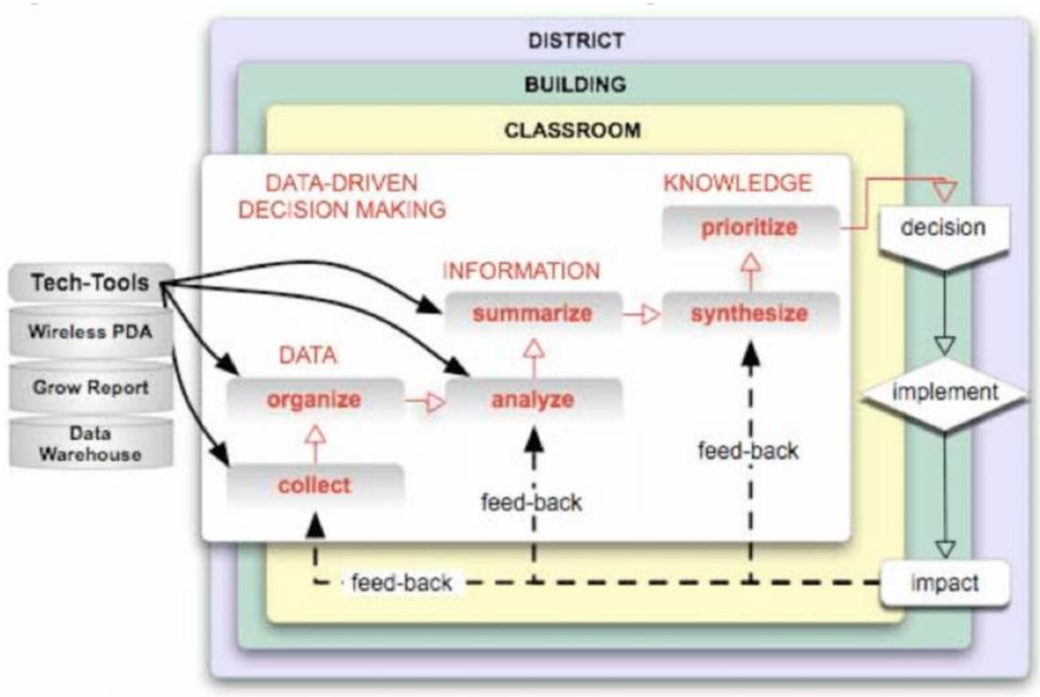
IBCs also utilizes an outside evaluation system to determine the level of skill and knowledge acquired according to the standardized skill and known objectives (Wilcox, 2006). The examinations which are based on industry standards are used to assess standards-based knowledge and associated skills. The IBCs help educators build the content knowledge among their students in order for them to meet an entry level industry standard upon graduation. In return, the student obtains an edge in the job market and increase their marketability among industry (Foster & Pritz, 2006). According to Wilcox (2006), these credentials are nationally portable and not just tied to local industry. In addition, Dibenedetto and Myers (2016), acknowledged that the industry certifications provided new opportunities for underserved and underprivileged youth that would not desire the obtainment of a post-secondary education.

Most states have implemented the utilization of IBCs as the end of pathway examinations in CTE courses. States that started the technique were Virginia, Pennsylvania, Georgia, Texas, and Louisiana (Foster & Pritz, 2006, Wilcox, 2006). Although there is not a universal technique or practice, most states assess IBCs at the junior and senior level (Wilcox, 2006).

Conceptual Framework

Over the last decade, industries and school infrastructures have transitioned to using Data-Driven Decision Making (DDDM) to influence decisions within their respective institutions. Using data to drive decisions provides a quantifiable trail for decision makers to follow an understanding of progress or regression in their fields. Data-Driven Decision Making pertains to the systematic collection, analysis, examination, and interpretation of data to inform practice and policy in educational settings (Mandinach, 2012). Mandinach believed that it was no longer acceptable to simply use anecdotes, gut feelings, or opinions as the basis for decisions. DDDM provides educators the opportunity to synthesize student information in one form or another to improve classroom instruction and ultimately the educational performance of students (Wohlstetter et al., 2008).

Figure 1
Conceptual Framework for Data-Driven Decision Making



Note: Reprinted with permission from A Conceptual Framework for Data-Driven Decision Making by E. B. Mandinach, M. Honey, D. Light, and C. Brunner. Copyright 2008 by Teachers College Press

DDDM has a continuum that allows data to be transformed and utilized to inform practice and policy. Along this continuum there are three levels data, information, and knowledge (Mandinach, 2012; Marsh et al., 2006). The initial level of data is where individuals collect all the data in its raw form and organize it in some manner. In the information level, the organized data is given context to help glean different trends from the data so that performance can be summarized. In the final level, knowledge, the performance summaries are synthesized and prioritized to allow individuals to make decisions to impact practice and policy. According to Marsh, Pane and Hamilton (2006) some of the possible decisions could address assessing progress toward goals such as a teacher assessing student performance to identify areas of remediation or to identify enhancements to improve outcomes within industry settings. Once the decisions have been implemented they will be examined to determine the impact which will start another reiteration of the DDDM process (Mandinach, 2012).

DDDM has help guide this study with the creation of the evaluation instrument in a way that we can utilized the data collected to make informed decisions on how to improve the fabrication of CROPS projects. This led to the creation of the evaluation scale, which helps determine where mistakes are made during the fabrication process. As a research team, we evaluated the results and were able to put them into context of what changes we needed to make to better prepare students to accurately fabricate CROPS projects. These data based decisions will help direct changes needed in the three-day teacher training, for example providing more hands-on experience, resources for teachers, and laboratory management strategies to be utilized during the implementation of the fabrication process.

Purpose and Objectives

The purpose of this study is to examine secondary agricultural education students' accuracy to fabricate a Cost-effective Rollover Protective Structures based on industry standards set by the National Institute for Occupational Safety and Health (NIOSH), a branch of the Center for Disease Control. The study aligns with the American Association for Agricultural Education National Research Agenda Priority Area 3: Sufficient scientific and professional workforce that addresses the challenges of the 21st century (Roberts et al., 2016). From the purpose, the following objectives were created.

1. Based upon the industry-based standards set by the National Institute for Occupational Safety and Health, describe the accuracy in the students' fabrication component of the CROPS curriculum project.
2. Based upon the industry-based standards set by the National Institute for Occupational Safety and Health, describe the weld accuracy in the students' fabrication component of the CROPS curriculum project.

Methods

The study is part of an overarching five-year project funded by the National Institute for Occupational Safety and Health, a branch of the Center for Disease Control and Prevention. The project encompasses ten states, primarily in the Southeast region of the United States. Rural secondary agricultural education classrooms in resource-depleted communities serve as the target population of the project. For the benefit of the reader, the following study was conducted during Year 1 of the five-year undertaking.

Secondary agricultural education students were assessed using industry-based standards through the process of fabricating a Cost-effective Roll-Over Protective Structure (CROPS) to be placed on a tractor within their community. The industry standard that was used as the basis of the assessment was the CROPS blueprints created and tested by mechanical engineers from the National Institute for Occupational Safety and Health (NIOSH) Division of Safety Research and Protective Technology Branch (NIOSH, 2016). The blueprints are in accordance with the Society of Automobile Engineers (SAE) industry standard performance test SAE J2194. There are four blueprints available on the NIOSH website which include the following tractor models: Ford 3000 series, Ford 4000 series, Ford 8N, and Massey Ferguson 135 series. Each blueprint has a list of tractor models within each series that the CROPS will fit. Table 1 outlines the total number of tractor models the schools fabricated for their community during the Year 1 project.

Table 1
CROPS Fabricated by Tractor Model, Year 1 (n = 11)

Tractor Model	*f (%)*
Ford 3000 Series	4 (37%)
Ford 4000 Series	3 (27%)
Ford 8N Series	2 (18%)
Massey Ferguson 135 Series	2 (18%)

Secondary agricultural education programs in three rural Appalachian states were selected due to the number of continued roll-over accidents with a total of 10 schools participating. The participating schools represented the following states: Kentucky, North Carolina, and Tennessee. Programs were selected through a selection criteria which consisted of a) recommended by state staff and/or university faculty as a proficient teacher in agricultural mechanics; teaching at the school for at least four years; an agricultural mechanics course set to be offered the following academic year; located in the Appalachia or Delta Region; a reported tractor fatality occurred in the county within the last two-years; and teacher was willing to attend a three-day training on a pre-developed and award winning curriculum project (Mazur et al., 2015), which included the process of constructing the Roll-Over Protective Structure. Once a teacher met the criteria, the school district was contacted to ascertain permission to participate in the project.

Preparation of teachers

The researchers provided a three-day training prior to the start of secondary schools beginning. The purpose was for teachers to engage in the entirety of the curriculum as well as an immersion exercise in the laboratory, which served as the formative assessment of the state-mandated standards. One of the objectives from the three-day training was to assist the teachers in the fabrication and the standards prior to classroom implementation. Prior to the orientation, the secondary teachers sought farmers from their community whom own and utilize a tractor that is recognized as eligible for CROPS.

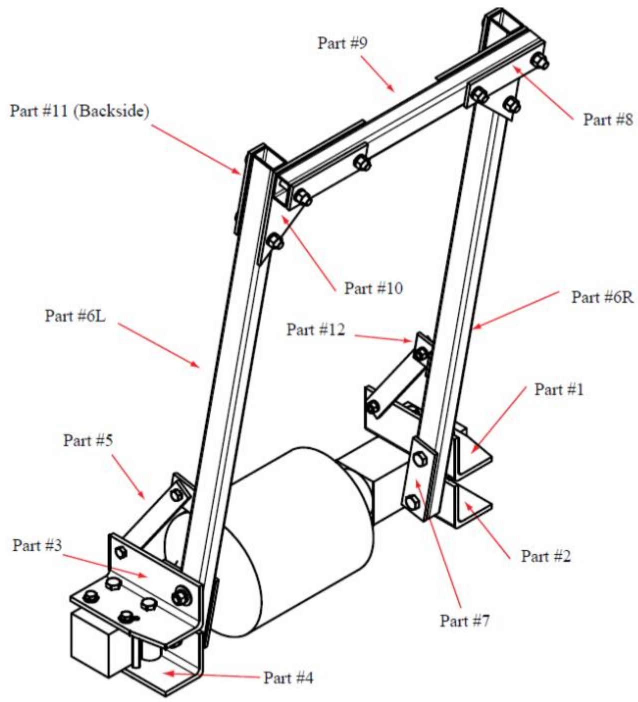
Curriculum Implementation

During the school year, the secondary teachers were shipped all the base materials needed to teach the CROPS curriculum, including fabrication materials. The base materials included up to 20' sections of metal based on the model tractor CROPS blueprints being used, grade 5 and 8 bolts, flat and locking washers, and nuts. Upon completion of the CROPS projects, the agricultural educators would contact the research team to schedule an inspection. The assessment of the students' abilities to perform at an entry level industry standard was conducted by an outside evaluator. The outside evaluator was an agricultural mechanics professor with a background in inspecting agricultural mechanics fabrication projects and visually inspecting welds. The evaluator has had experience learning from Certified Welding Inspectors (CWI) and Certified Welding Educators (CWE) in evaluating welds. The evaluator has also been trained to ultrasonically evaluate welds.

Instrumentation

The evaluator utilized the CROPS blueprints to create an evaluation instrument served to evaluate the students' ability to accurately fabricate the CROPS in accordance to NIOSH's industry-based standards. The evaluation instrument, driven by the DDDM framework, was approved by the National Institute for Occupational Safety and Health, including the engineers who designed and tested the blueprints. Based upon the project constructs, established by NIOSH engineers, the plans were divided into three separate sections: axel mounting components (part numbers 1, 2, 3, 4, 5, and 7); vertical support components (part numbers 6, 8, 9, 10, and 11); and welded components (part number 12) for inspection and reporting purposes (for a visual of part numbers, see Figure 1). To determine intrarater reliability, the researcher randomly selected three of the participating schools to facilitate a test-retest. The schools were selected in North Carolina, Kentucky, and Tennessee. Following the test-retest, the researcher obtained an intrarater reliability score of 0.88 (K = 0.88). Kappa statistics are commonly used to evaluate the same observer's ratings at multiple time points for nominal-level items. The Kappa scores range from -1 to 1 with higher scores reflecting the greater agreement. A Kappa score that is within the range of 0.80-1.00 is considered *almost perfect*, as determined by Landis and Koch (1977). According to Moskal and Leydens (2000), an intrarater reliability score provides context to the test-retest, but it doesn't address that steps were taken to assure similar external factors were constant each time an evaluator uses an instrument. As a result, the researcher had all fabricated CROPS to be laying at the center of the agricultural mechanics shop and not painted. In addition, the instructor and students were to be silent during inspection.

Figure 2
Ford 3000 Series Drawing of Completed CROPS Project



Note. Adapted from the blueprints for Cost-effective Rollover Protective Structure (CROPS) for Wheeled Agricultural Tractors Ford 3000 series Technical Drawings retrieved from: https://www.cdc.gov/niosh/topics/aginjury/crops/pdfs/ford-3000/Ford-3000-Technical-Drawings.pdf

The inspection factors included correct overall measurement of the part being fabricated, correct placement of drilled holes, correct placement of a welded bracket, visual inspection of welds, and correct torque applied to mounting bolts. The checklist was separated by 1/16" increments of >1/4, >3/16" <1/4", >1/8" <3/16", >1/16" <1/8", <1'16" to evaluate the overall measurement of the CROPS parts (N = 15), placement of drilled holes, and the welded bracket. The largest increment off from the blueprints was marked on the designed evaluation instrument. Like industry standards, if one part of a component is off the whole component would be rejected until the part was refabricated. As set by NIOSH, any part with an evaluation greater than 3/16" was rejected and did not meet the industry standard. The same rejection measurement was applied drilled holes as well as the measurement of the two welded brackets.

Visual inspection of the welds looked for any discontinuities and utilizing a fillet gauge to measure leg length and face fill. The welds must have leg lengths of at least 3/16" to pass inspection and be the full length of the piece. Welds were also inspected for visual discontinuities such as porosity, undercut, and lack of fusion. Dependent on the size of the discontinuity present the weld could not meet the industry-based standard. The bolt torque was checked with an appropriate torque wrench. For parts that had to be refabricated or rewelded programs either completed the task the day of inspection or the evaluator came back after the piece(s) were corrected to meet the industry standard set; however the results of this study is based upon the initial findings.

Results

Objective one sought to describe the students’ abilities to fabricate the CROPS based on the industry standard of the related NIOSH blueprints. The results are broken up into three sections including axel mounting components, vertical support components, and welded components. Overall, most mistakes in fabrication of the CROPS projects were found within the axel mounting components. It was found that the parts with the least amount of fabrication needed were the most accurately made by the secondary agricultural education students. Table 2 illustrates the abilities of students to fabricate the axel mounting components.

Table 2

Inspection Frequencies and Percentages of the Axel Mounting Components (N = 11)

	>1/4”	>3/16” <1/4”	>1/8” <3/16”	>1/16” <1/8”	<1/16”
	Unacceptable		*Acceptable*		
Part	*f(%)*	*f(%)*	*f(%)*	*f(%)*	*f(%)*
Top Right Axel Bracket					
- Piece Specification	1 (9%)	1 (9%)	2 (18%)		6 (54%)
- Hole Placement	1 (9%)		2 (18%)	2 (18%)	4 (36%)
Bottom Right Axel Bracket					
- Piece Specification		1 (9%)	3 (27%)		5 (45%)
- Hole Placement	1 (9%)	1 (9%)		3 (27%)	4 (36%)
Top Left Axel Bracket					
- Piece Specification	2 (18%)		1 (9%)	1 (9%)	6 (54%)
- Hole Placement	1 (9%)		3 (27%)		5 (45%)
Bottom Left Axel Bracket					
- Piece Specification	2 (18%)		3 (27%)	1 (9%)	4 (36%)
- Hole Placement				4 (36%)	5 (45%)
Vertical Tube Bolted Brace					
- Piece Specification			1 (9%)	1 (9%)	9 (82%)
- Hole Placement			1 (9%)	2 (18%)	7 (64%)
Right Bottom Vertical Tube Backing Plate					
- Piece Specification				2 (18%)	8 (72%)
- Hole Placement				3 (27%)	6 (54%)
Left Bottom Vertical Tube Backing Plate					
- Piece Specification				2 (18%)	8 (72%)
- Hole Placement				3 (27%)	6 (54%)

Note: N = 11. Not all projects were completed at the time of inspection; frequencies of each piece may not equal 11.

Within the vertical support components, the most variation of accuracy can be seen with the crossbar and corner plates. The most accurately made pieces within the vertical support components were the right and left vertical tubes. Most of the parts were within 1/8” accuracy of the NIOSH blueprints. The accuracy frequencies for the vertical support components can be seen in Table 3.

Table 3

Inspection Frequencies and Percentages of the Vertical Support Components (N = 11)

	>1/4”	>3/16” - <1/4”	>1/8” - <3/16”	>1/16” - <1/8”	<1/16”
	Unacceptable		*Acceptable*		
Part	*f(%)*	*f(%)*	*f(%)*	*f(%)*	*f(%)*
Right Vertical Tube					
- Piece Specification				1 (9%)	10 (91%)
- Hole Placement				4 (36%)	6 (54%)
Left Vertical Tube					
- Piece Specification			1 (9%)	1 (9%)	9 (81%)
- Hole Placement				4 (36%)	6 (54%)
Right Crossbar Backing Plate					
- Piece Specification				2 (18%)	9 (81%)
- Hole Placement			2 (18%)	2 (18%)	6 (54%)
Left Crossbar Backing Plate					
- Piece Specification		1 (9%)		2 (18%)	8 (72%)
- Hole Placement		1 (9%)	1 (9%)	1 (9%)	7 (63%)
Crossbar					
- Piece Specification				4 (36%)	6 (54%)
- Hole Placement	1 (9%)		3 (27%)	1 (9%)	5 (45%)
Right Corner Plate					
- Piece Specification			1 (9%)		9 (81%)
- Hole Placement	2 (18%)				8 (73%)
Left Corner Plate					
- Piece Specification	2 (18%)		1 (9%)		9 (81%)
- Hole Placement				1 (9%)	7 (64%)
Top Vertical Backing Plate					
- Piece Specification	1 (9%)				9 (81%)
- Hole Placement	1 (9%)			2 (18%)	6 (54%)
Right Vertical Tube Brace					
- Piece Specification	1(9%)		1(9%)	1(9%)	7(64%)
- Hole Placement				3(27%)	7(64%)
Left Vertical Tube Brace					
- Piece Specification					
- Hole Placement			1 (9%)	1 (9%)	8 (72%)
				3 (27%)	7 (64%)

Note: Not all projects were completed at the time of inspection; frequencies of each piece may not equal 11.

The second objective sought to examine the students' ability to accurately weld the specified parts together, as set by the industry-based standard. There are four fillet welds (tee position) that must be completed, according to NIOSH. These welds must be continuous (one solid bead) and have leg lengths of at least 3/16”. All the inspected welds had leg lengths of at least 3/16”. The inaccuracy of the students were present in creating a weld that went the full length of the weldment. All but one of the pieces were fabricated within 3/16” accuracy in regards to weld length and all welds passed visual inspection. There were four welds identified as unacceptable and were reconstructed because of the inaccuracy of the placement brace on the vertical tube. The accuracy of students’ welds and visual inspection results, as set by the NIOSH approved industry standard, are displayed in Table 4.

Table 4

Inspection Frequencies and Percentages of the Welded Components

	>1/4”	>3/16” <1/4”	>1/8” <3/16”	>1/16” <1/8”	<1/16”	Passed Inspection
	Unacceptable		*Acceptable*			
Part	*f(%)*	*f(%)*	*f(%)*	*f(%)*	*f(%)*	*f(%)*
Right Vertical Tube Welds						
- Leg length					8 (100%)	
- Weld length			6 (37%)	4 (25%)	6 (37%)	8 (100%)
- Inspection result						
Left Vertical Tube Welds						
- Leg length					8 (100%)	
- Weld length			4(25%)	6 (37%)	6 (37%)	8 (100%)
- Inspection result						

Conclusions, Discussion, and Recommendations

All participating had a pre-trained secondary agriculture teacher approved to teach the curriculum and identified as proficient in agriculture mechanics education. Each school successfully fabricated 1-2 CROPS for their community and most components of the CROPS projects met the industry standard put forth by the NIOSH blueprints on their first attempt.

When it comes to the three areas of the evaluation, the axel mounting brackets were the components where the most variation in the results occurred. The mounting brackets entail a variety of drill points, cuts, and designated tapped holes making the section the most complex pieces to fabricate. Based upon Data-Driven Decision Making (Mandinach, 2012), the conclusions infer that teachers were utilizing the data and information portions of the DDDM continuum. The teachers monitored student progress, data level, and gave feedback once they analyzed the students’ work, information level. With all the requirements of the piece if an individual is not conscientious and diligent in being precise with their work it is easy to make a mistake. It is recommended that teachers take their feedback and incorporate this knowledge into their future instruction to help illustrate to students that the axel brackets requires a high level of precision to accurately fabricate. Another recommendation is to incorporate this information about the level of difficulty of the axel brackets into future teacher trainings. Sharing this further ready the teachers to prepare their students. Teaching strategies that could also help increase the accuracy of the fabrication of the axel brackets need to be included in the teacher training such as allow students to work on sample pieces before cutting pieces for the final product or having students create a mockup of the placement of the required drill holes on paper.

The most accurately fabricated components were the vertical tubes, part 6L and 6R. One possible reason that these parts were the most accurate is that piece only had four holes drilled on either end of the tube. With the provided drill bit, students can drill two holes at one time making holes on either side of the tube to allow the required bolt to pass through. With less drilling required, the students may have less chance of making mistakes during the fabrication process. For the vertical tubes, students still need to be more precise in their placement of the drilled holes. According to DDDM (Mandinach, 2012), teachers need to incorporate this information into their instruction to further enhance their students' ability to accurately measure and place the drill holes to create a more highly accurate piece.

The welded component was consistently accurate in leg length but not in weld length. There could be several reasons why students did not complete welds to the full length of the piece. Such reasons could include the student was in a bad position to see where they were at the end of their weld, not using a new electrode to complete the weld, or being nervous while welding. Teachers are recommended to allow all students to practice welding a similar weldment prior to fabricating the welds on the CROPS project. Allowing students to practice would allow the teacher to follow DDDM (Mandinach, 2012), by analyzing each students' welds, provide feedback, and then incorporate this information into their instruction of future projects. In future teacher trainings, it is recommended to instruct teachers on possible strategies and hands-on practice to create a more accurate weldment in regards to weld length so they have experience they can share with their students.

Teachers should be fluent in the fabrication procedure and should allow students pieces to practice on before fabricating a final product. This could mimic the initial training employees would receive upon obtaining an industry related job. Teachers should also implement an internal inspection procedure throughout the process to ensure pieces and hole placements are correct. This would also mimic how an industry would monitor manufacturing lines. Since programs are only completing one or two projects at most implementing the steps that industry use in manufacturing may allow students to become readier for the workforce.

It is recommended to include a method of evaluation for the welds on the CROPS project to further validate the structural integrity of each weld. Since the projects are to be installed on a tractor upon completion destructive testing is not an option. Therefore, methods of non-destructive testing would be the only option such as Ultrasonic Testing or X-ray evaluation techniques. Researchers also recommend continuing the project to further validate this study's findings that secondary agricultural education students can fabricate a project to industry standards. It is also suggested that DDDM be utilized in other area of agriculture were IBCs are utilized to help better inform practices**.**

References

Church, W. M. (2007). Benefits of student certification: A study of automotive service managers. (Publication No. DP18895) [Doctoral dissertation, Virginia Polytechnic Institute and State University]. ProQuest Dissertations and Theses Global.

DiBenedetto, C. A., & Meyers, B. E. (2016). A Conceptual Model for the Study of Student Readiness in the 21st Century. *NACTA Journal, 60*(1a), 28-35.

Foster, J. C., & Pritz, S. G. (2006). The Certification Advantage. *Techniques: Connecting Education and Careers, 81*(1), 14-20.

Gardner, P. D., & Liu, W. Y. (1997). Prepared to perform? Employers rate work force readiness of new grads. *Journal of Career Planning and Employment, 57*(3), 32-56.

Landis, J. R., & Koch, G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159-174. https://doi:10.2307/2529310

Lynch, R. L. (2000). High school career and technical education for the decade of the 21st century. *Journal of Vocational Education Research, 25*(2), 155-198.

Mandinach, E. B. (2012). A Perfect Time for Data Use: Using DataDriven Decision Making to Inform Practice, *Educational Psychologist*, *47*(2), 71-85. https://doi:10.1080/00461520.2012.667064

Mandinach, E. B., Honey, M., Light, D., & Brunner, C. (2008). A conceptual framework for data-driven decision making. Edited by: Mandinach, E. B. & Honey, M. in *Data-driven school improvement: Linking data and learning*, 13-31. New York, NY: Teachers College Press.

Mazur, J., Vincent, S.K., Watson, J., & Westneat, S. (2015). Integrating cost-effective rollover protective ptructure installation in high school agricultural mechanics: A feasibility study. *Journal of Agromedicine, 20*(2), 149-159. https://doi.10.10801059924X.

Moskal, B. M., & Leydens, J. A. (2000). Scoring rubric development: Validity and reliability. *Practical Assessment, Research & Evaluation*, *7*(10), 71-81.

National Institute for Occupational Safety and Health (NIOSH). (2016). Agricultural Ssafety. Retrieved from: https://www.cdc.gov/niosh/topics/aginjury/crops/

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

Wilcox, D. (2006) The role of industry based certifications in career and technical education. *Techniques: Connecting Education and Careers, 81*(1), 21-23.

Wohlstetter, P., Datnow, A., & Park, V. (2008). Creating a system for data-driven decision-making: applying the principal-agent framework. *School Effectiveness and School Improvement*, *19*(3), 239-259. Retrieved February 13, 2017. doi: 10.1080/09243450802246376