
DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the
Graduate School of The Ohio State University

By
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ABSTRACT

A mixed-mode, descriptive study was conducted on the U.S. Department of Labor’s (DOL) Tractor and Machinery Certification Program. Legislated by the Fair Labor Standards Act, the Hazardous Occupations Order in Agriculture (HOOA) was enacted in 1968 as a public policy measure to reduce the number of injuries to youth on farms. An educational exemption allows youth 14 and 15 years of age to work for hire after they successfully completed a Tractor and Machinery Certification program.

Utilizing a multi-dimensional approach, the research provided an empirical examination of the national certification program. Federal databases were queried and reported for youth enrollment status from 1999-2003. Representative stakeholders of the DOL program participated in eight U.S. regional focus groups to provide baseline information about the trainings conducted in their geographic area. A national panel of experts was convened through a modified-Delphi process to identify educational goals, curriculum objectives, and core competencies. Two independent surveys were conducted, one with state program leaders in Extension and State Departments of Education, and one with local course instructors in Extension and secondary education vocational agricultural programs. The triangulation of population-based surveys added strength to the qualitative data sets.
While there is support for the DOL program, it has limited national availability. The central, midwest region of the U.S. is the predominant area to offer the program. Extension offers the program at a higher reported frequency than vocational agricultural programs, and the full Tractor and Machinery Certification program is the prevailing type, and instructors reported a weighted mean average of approximately 30 instructional hours, which is higher than the legislative requirements.

Educators strongly believed the training was beneficial to students. They also felt the program had potential to attract new audiences in landscaping and horticultural services. Overall, instructors believed the top three issues that would increase the effectiveness of the DOL program included community awareness, employer support, and access to teaching resources. Issues that closely followed included enforcement of the legislation, in-service training for instructors, and additional learning activities for students.

There was widespread agreement that the two administrative agencies identified in the HOOA, Cooperative Extension Service and vocational agricultural programs, should remain the sole agencies responsible for certification. However, opinions of focus group participants, program leaders, and community course instructors identified additional organizations and agribusinesses qualified to teach. These include Farm Bureau, equipment dealers, technical colleges, insurance companies, farm safety coalitions, rural volunteers, and farmers.

Results supported a standardized curriculum and testing program with core-content competencies. A list of 117 competencies was identified by a national panel of experts, with 73.5% of those rated by community instructors as highly or critically
important for youth to learn. Creating a national competency-based curriculum would eliminate regional differences and assist community instructors with instruction and testing.

In addition to a competency-based educational program, focus group participants and community course instructors supported the need for additional teaching aids; these included hands-on activities, videotapes, student workbooks, and DVD’s. No stakeholder group supported the certification program being offered as a complete self-study program. However, findings did support portions of the certification program capable of being offered as a self-study program.

Community course instructors did not believe experience alone should be enough to teach Tractor and Machinery Certification to youth. The majority believed instructors should be expected to complete a formal training program.

As the first national study of its kind, the descriptive research in this report sets a baseline for future evaluation studies of the DOL program. This is a crucial step in the evaluation process to assist national policy makers, occupational safety specialists, agricultural researchers, and curriculum developers for future decision-making and resource allocation.
Dedicated to my husband Jim

and to my children Cheyenne and Sierra

who made selfless sacrifices during my graduate work.

I also dedicate this to my parents Ron and Sherry Maurer

who taught me through their own actions that with hard work
and perseverance, I could achieve anything that I set out to accomplish.
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special thanks goes to Dennis Murphy and Gary Erisman; I consider you part of my pseudo advisor team. I have always valued your guidance, support, and casual joking; yes, I am sure I would have been done by now if I had studied under you.

To the OSU Safety Group. The dynamics varied over the years, the faces changed, the grants came and went, the outreach activities and conferences took us to many foreign places (sometimes without leaving Ohio), and yet the friendship and camaraderie was always remarkable. You have become my extended family and I have appreciated the opportunity to work with you and learn from you. Thanks for your support and assistance in whatever capacity you may have played during my graduate studies.

I am fortunate to have a mom and dad who encouraged me to believe I could do whatever I set my heart and mind to accomplish. This has been anything but a typical college experience, and my educational journey has had its share of twists and turns. Yet, it was always my parents who were cognizant of my dreams and believed beyond all doubts that I could go the distance. Yes, my path has been complicated with a career and a family of my own, and my program of discipline did not end in the field that I originally intended. Looking back I see that God has played an amazing role in fulfilling my life in very unexpected ways. And now standing at the end of this era, on graduation day, they will call this graduate “doctor.”

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# TABLE OF CONTENTS

Abstract ................................................................. ii  
Dedication ................................................................. v  
Acknowledgments ......................................................... vi  
Vita ............................................................................... ix  
List of Tables ................................................................. xv  
List of Figures ................................................................. xviii

Chapters:

1 Introduction ............................................................... 1  
   Statement of the Problem ........................................... 8  
   Purpose of the Study ................................................. 8  
   Objectives of the Study ............................................. 9  
   Definition of Terms .................................................. 10  
   Limitations of the Study ........................................... 11  
   Basic Assumptions ................................................... 12  
   Significance of the Study .......................................... 14  

2 Review of Literature ................................................... 18  
   The Hazardous Occupations of Agriculture .................. 19  
      The Injury Rate of Hired Labor Forces in Agriculture .... 20  
      The Agents of Injury in Agriculture ......................... 22  
      The Magnitude of Youth Injuries in Agriculture .......... 24  
      The Cultural Acceptance of Children in the Agricultural  
      Workplace .......................................................... 26  
   Approaches of Injury Prevention in Agriculture ............ 28  
      The Public Health Approach .................................. 29  
      The Industrial Safety and Health Approach ............... 31  
      The Public Policy Approach .................................. 34
Research Design ................................................................. 209
  Objective 1 ................................................................. 209
  Objective 2 ................................................................. 210
  Objective 3 ................................................................. 211
  Objective 4 ................................................................. 211
  Collection of Objectives 5, 6, 7, and 8 .............................. 212
Summary and Discussion of Findings ............................... 213
  Objective 1 ................................................................. 213
  Objective 2 ................................................................. 216
  Objective 3 ................................................................. 221
  Objective 4 ................................................................. 225
  Objective 5 ................................................................. 227
  Objective 6 ................................................................. 230
  Objective 7 ................................................................. 233
  Objective 8 ................................................................. 242
Implication of the Conceptual Framework ......................... 247
Recommendations ........................................................... 254
Conclusion ....................................................................... 257

List of References ........................................................... 259

Appendices ................................................................. 273
  A Focus Group Pre-Screening Script ................................. 273
  B Focus Group Participant Invitation Letter ...................... 276
  C Focus Group Moderator Guide ..................................... 278
  D Focus Group Participant Exit Questionnaire .................. 280
  E Modified-Delphi Panel of Experts ................................. 282
  F Modified-Delphi Panel Letter of Welcome ...................... 284
  G Modified-Delphi Panel Email Announcement .................... 286
  H Modified-Delphi Round 1 .......................................... 288
  I Modified-Delphi Round 2 .......................................... 292
  J Survey for State Program Leader ................................. 294
  K State Program Leaders’ Invitation Letter ...................... 298
  L State Program Leaders’ Welcome Greeting to Electronic Survey 300
  M State Program Leaders’ Invitation Reminder Letter .......... 302
  N Community Course Instructors’ Survey .......................... 304
  O Community Course Instructors’ Invitation Letter ............ 333
<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Community Course Instructors’ Welcome Greeting to Electronic Survey</td>
<td>335</td>
</tr>
<tr>
<td>Q</td>
<td>Community Course Instructors’ Reminder Letter</td>
<td>337</td>
</tr>
<tr>
<td>R</td>
<td>Availability of Tractor Safety Training Reported by State Program Leaders</td>
<td>339</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>EEF Curriculum Participation by States According to the USDA-CREES 4-H Program Leaders for the Years 1999 - 2003.</td>
<td>111</td>
</tr>
<tr>
<td>4.2</td>
<td>Tractor Certification Annual Enrollment According to the USDA-CSREES Farm Safety Database for the Years 1999 – 2003.</td>
<td>114</td>
</tr>
<tr>
<td>4.3</td>
<td>Categories of Participants by Zones.</td>
<td>119</td>
</tr>
<tr>
<td>4.4</td>
<td>Occupation of Focus Group Participants.</td>
<td>120</td>
</tr>
<tr>
<td>4.5</td>
<td>Initial Results to Delphi Question 2.</td>
<td>144</td>
</tr>
<tr>
<td>4.6</td>
<td>Final Results to Delphi Question 2.</td>
<td>146</td>
</tr>
<tr>
<td>4.7</td>
<td>Student Competencies for Tractor Operation as Identified by the Modified Delphi Technique.</td>
<td>148</td>
</tr>
<tr>
<td>4.8</td>
<td>Student Competencies for Machinery Operation as Identified by the Modified Delphi Technique.</td>
<td>151</td>
</tr>
<tr>
<td>4.9</td>
<td>Student Competencies for General Safety and Health Topics as Identified by the Modified Delphi Technique.</td>
<td>152</td>
</tr>
<tr>
<td>4.10</td>
<td>U.S. Regions Offering Tractor Certification Programs and Issue DOL Certificates of Training as Reported by State Program Leaders.</td>
<td>156</td>
</tr>
</tbody>
</table>
4.11 U.S. Regions Offering Tractor Certification Programs Without Issuing DOL Certificates of Training as Reported by State Program Leaders.

4.12 U.S. Regions Supporting DOL Training Programs as Reported by State Program Leaders.

4.13 U.S. Regions Teaching General Tractor and Machinery Safety Programs as Reported by State Program Leaders.

4.14 Overall Response Rate of Course Instructors by Geographic Region.

4.15 Overall Response Rate of Course Instructors by State.

4.16 Course Instructors’ Experience and Tenure in Agricultural Occupations.

4.17 Administering Agency of the Tractor and Machinery Certification Program.

4.18 Type of DOL Certification Course Offered Most Often by Community Instructors.

4.19 Type of DOL Certification Course Offered by Geographic Region.

4.20 Amount of Instructional Hours Teaching DOL Certification Programs.

4.21 Primary Course Book Used to Teach Tractor and Machinery Safety to Youth.

4.22 Supplemental Resources Used to Teach Tractor and Machinery Safety to Youth.

4.23 Teaching Aids Identified as Most Effective for Student Learning.
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>The triadic variables of the epidemiological triangle.</td>
<td>29</td>
</tr>
<tr>
<td>2.2</td>
<td>The public health approach to injury prevention</td>
<td>30</td>
</tr>
<tr>
<td>2.3</td>
<td>An ecological pyramid representing the Three E’s of Safety</td>
<td>32</td>
</tr>
<tr>
<td>2.4</td>
<td>Conceptual framework of the Hazardous Occupations Order in Agriculture</td>
<td>67</td>
</tr>
<tr>
<td>3.5</td>
<td>Geographic zones established for focus groups</td>
<td>81</td>
</tr>
<tr>
<td>4.6</td>
<td>USDA-CSREES database comparisons between 4-H and AGNR</td>
<td>116</td>
</tr>
<tr>
<td>4.7</td>
<td>States and territories grouped by focus group zones</td>
<td>118</td>
</tr>
<tr>
<td>4.8</td>
<td>List generated by focus group participants identifying tasks,</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>agricultural equipment, and safety topics that are not currently listed in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the Hazardous Occupations Order in Agriculture</td>
<td></td>
</tr>
<tr>
<td>4.9</td>
<td>Number of accumulative years instructors reported teaching tractor</td>
<td>168</td>
</tr>
<tr>
<td></td>
<td>and machinery safety programs</td>
<td></td>
</tr>
<tr>
<td>4.10</td>
<td>Teaching aids identified as most effective for student learning,</td>
<td>176</td>
</tr>
<tr>
<td></td>
<td>comparison of DOL and non-DOL instructors</td>
<td></td>
</tr>
</tbody>
</table>
4.11 Age distribution of students enrolled in tractor and machinery safety programs, as reported by community course instructors ............... 188

5.12 Conceptual framework of the Hazardous Occupations Order in Agriculture ................................................................. 248
Agriculture is an industry dependent upon cultivation of the land and raising of livestock. The agricultural industry is a broad multi-disciplinary field that encompasses production agriculture, forestry, and fishing. In the past 30 years, agriculture has undergone rapid transformation; there has been an increase in mechanized systems, the use of technology, and a thrust for more efficient practices. Large-scale producers have eroded the family farm structure of generations past. However, one trend remains the same. Agriculture continues to rank as one of the top three hazardous industries in the United States (USDOL, 1999). The National Safety Council reported an average of 730 farmers and ranchers died in work-related activities during the year 2002, while another 150,000 suffered disabling injuries (National Safety Council, 2003). And the injury toll for young people is just as saddening; over 100 youth die and 23,000 are seriously disabled each year on America’s farms during work-related activities (Rivara, 1997). According to Crowe (1995), youth working in agricultural environments are at higher risk than their urban employed counterparts. Similarly, Hard, Myers, Snyder, Casini, Morton, Cianfrocco, and Fields (1999) reported the fatality rate for young agricultural workers at 12 per 100,000 workers, compared to that of the national youth fatality rate of
4.4 deaths per 100,000 workers.

Unlike other occupations, farming attracts and includes family members of all ages. For the most part, the home-site is the work-site, and it is difficult for the farm family to define where the backyard ends and the barnyard begins. Parents, wanting to install a work ethic at an early age, often rely upon experience as the source of their children’s best-taught lessons. While role modeling their parents and other authority figures, it is possible for youth to adopt unsafe work habits (Darraugh, Stallones, Sample, & Sweitzer, 1998; Kidd, Townley, Cole, McKnight, & Piercy, 1997). Adolescents often work in agricultural operations with minimal supervision where their tasks involve handling livestock and operation of heavy machinery; in many of these occupational situations the youth have received little training (Marlenga, Pickett, & Berg, 2002; Runyon & Zakoes, 2000).

On January 1, 1968, the United States Department of Labor (DOL) promulgated the Hazardous Occupations Order in Agriculture (HOOA), in an effort to control the number of youth working in dangerous work environments. This legislation made it unlawful for persons younger than 16 years of age to be employed in agricultural operations. Because of its strict wording, the legislation was met with much opposition; consequently the law was amended in June 1968 to allow 14- and 15-year-old youth to perform certain tasks, provided they completed a prescribed course of safety instruction. That training has become popularly known as the Tractor and Machinery Certification program.

Two independent agencies were identified in the legislation as sources for the training, the vocational agriculture school-based programs and the federal Extension 4-H programs. Within each agency’s certification program, legislation outlined the number of instructional hours required for certification. The vocational agricultural program required
15 hours training in Tractor Certification and 25 hours training for the Tractor and
Machinery Certification. The Extension program required 10 hours training for the Tractor
Certification and 24 hours training for the Tractor and Machinery Certification course. The
comprehensive program was divided into components to emphasize approximately 10
hours training in tractor operation, 10 hours training in machinery operation, and the
remaining 4 hours training in general farm safety topics.

The law specified that all students, regardless of the training agency in which they
were enrolled, demonstrate knowledge and performance before certification was issued.
The students were to pass a written exam on tractor and machinery safety as well as a skill
exam, where students showed their ability to drive a tractor with a two-wheeled trailed
implement on a test course.

Shortly after the inception of HOOA, the training materials identified in the
legislation for the Extension program were unavailable. Tractor Manuals 1 - 4 (1963)
were no longer printed and distributed by National 4-H Council or the Standard Oil
Company, and subsequently were removed from circulation. Likewise, the vocational
agricultural training program in Safe Farm Machinery Operation, outlined in Special
Paper No. 8 (April 1969) by Michigan State University, was archived. Two agricultural
engineers, Thomas Silletto and Dale Hull, wrote the handbook, Safe Use of Agricultural
Equipment (1976), as a replacement manual for the outdated set of courses; their manual
was deemed appropriate to satisfy the safety training curriculum specified in the federal
code. While there have been slight revisions from the original version, the handbook has
again slipped into an antiquated condition. Some may argue that basic safety messages
remain constant through time, yet it is difficult to engage youth with a safety manual that
simply does not reflect the industry’s widespread use of technology or the diversity of modern tractors and machinery. Educational technology has advanced as rapidly as farm tractors, leaving students and educators alike with outdated slide sets and student handbooks written over 30 years ago.

The first evaluation of the Ohio Tractor and Machinery Certification program was by Emory and Ferguson (1980). This study found a statistical difference on demonstrated safety behaviors between students who completed the tractor safety course and those who were not enrolled in the program. However, there were some instances where behavioral change by students was not evident after taking the Tractor Certification and/or Tractor and Machinery Certification course. In 1993, Yarosh evaluated the Ohio course’s educational components and made recommendations for improvement of both the teaching materials and delivery methods. Similar to the Emory and Ferguson study, the Yarosh report also documented gaps in behavior change of youth after completing the courses. In a more recent study, Wilkins (2001) attempted to estimate enrollment potential; the results revealed only 1% of Ohio’s youth who qualified for the Tractor Certification and/or Tractor and Machinery Certification programs were actually enrolled in the course. This low percentage of student participation indicated multiple concerns for safety education specialists. First, there was an obvious gap in program awareness, which could also result in low program availability or flat out lack of program availability. Concurrently, the study demonstrated the need for revised curriculum objectives to match youths’ educational and employment objectives.

Besides Ohio, other states have performed internal evaluations of their tractor and machinery certification programs. In an evaluation of Wisconsin’s certification courses,
Wilkinson, Schuler, and Skjolaas (1993) found the youth involved in the safety training were more likely to carry extra riders on tractors as well as operate tractors without Roll-Over Protective Structures (ROPS). Their findings were corroborated by parent testimony; less than two-thirds of the youths’ parents felt that the program helped improve the safety behaviors of their children.

An Indiana study conducted by Carrabba, Field, Tormoehlen, and Talbert (2000) measured the impact of the Indiana 4-H Tractor Program on such variables as safe tractor operating behavior and safety attitude. Their results showed a perceived and demonstrable positive influence on Indiana 4-H Tractor Program participants, as well as an increased ability to recognize hazards and self-report close call incidents. Both state studies cited the need for additional research to understand the complex issues involved with young farm workers and their perceptions of safe behaviors. The Indiana report made a strong recommendation for curriculum updates and additional training and resources for volunteer leaders. The Wisconsin study recommended a standardization of the program as well as increased training opportunities for the instructors. The findings from these limited state studies suggest the need for a national program evaluation.

Since legislation, the two educational agencies identified in the Hazardous Occupations Order have undergone curriculum transformation. Today’s agricultural classroom reflects national and state school reforms that emphasize academic achievement, and as a result, have curriculum concentrated on science, biology, and mathematic skills that enable students to prepare for postsecondary education (Lynch, 1997; OVAE, 2004). As the traditional agricultural program evolved into a broad-based agricultural science curriculum, accommodations for technology, biotechnology, and
environmental concerns also evolved. The combination of increased agricultural science programs, along with fewer agricultural production operations in the community, left the Tractor and Machinery Certification program struggling to keep its place in the classroom.

Similar to the classroom evolution, Extension education and research efforts have also been forced to evaluate their effectiveness in addressing public concerns and solving agricultural-based problems. A significant challenge facing the Extension profession is its lack of identity with the general public (Warner & Christenson, 1984). In 1989, a National Initiative Task Force on Youth-at-Risk recommended that Extension educators rethink the way they do business and work more effectively to address the needs of today’s adolescents. So while new initiatives in watershed management, genetically modified organisms (GMO’s), and precision agriculture have supported the need for continued Extension programming, it was at the sacrifice of reducing traditional agricultural programs in basic animal husbandry, plant production, and mechanical engineering. The tractor project was one of the cornerstone curricula of the mechanical engineering program.

Perhaps the most significant impediment within the agricultural education system is the fact that the general public is several generations removed from the farm. Across the U.S., fewer people are intimately familiar with an agrarian lifestyle. In 1930, the United States was at its highest capacity for total number of reported farms, with nearly 7 million reported to the Census of Agriculture. Between 1940 and 1970, rural America began changing at a drastic rate. Since the 1970’s there has been a general stabilization of farm numbers, and these numbers have been decreasing slightly each year; according
to the 1997 Census data, approximately 1.9 million farms still exist (USDA NASS, 1997a).

Concurrent with the decline of farm operations, the farm workforce has changed and declined over the years. In 1980, farmers comprised 43% of America’s workforce, yet today this number is less than 1.9% (USDA, 2000). As generations become further removed from production agriculture, their level of direct, personal experience may influence their knowledge and interest in traditional farming practices. Perhaps the relevance for teachers to teach and students to learn safe tractor operation skills is obsolete. But then again, the injury data speak louder than the population justification to continue the safety education efforts.

Safety is as much an attitude as it is a practice. Changing safety behaviors implies modifying a person’s lifestyle. For the teachers of agricultural safety programs to be successful in promoting behavior change, they need up-to-date teaching resources and activities that motivate and facilitate the learning processes (Yarosh, 1993). Equally important, teachers may require additional training in agricultural practices as it relates to basic machine operation and maintenance. The fundamental components of a tractor and machinery safety program are teaching resources and effective teaching pedagogy. Consequently, both of these areas may need to undergo transformation in order to promote the learning process and encourage behavior change in safer tractor and machinery operation.
Statement of the Problem

The national Tractor and Machinery Certification program has been in existence since 1968 with little to no maintenance. Having a program in place does not ensure behavior change, and what is even more evident with this program, having the training available does not ensure participation. While no formal investigation has ever been undertaken by the Department of Labor or Federal Extension Service in over 30 years, this study is underway to examine the nation’s Tractor and Machinery Certification program and chart a course for future curriculum and certifying processes.

Purpose of the Study

The national Tractor and Machinery Certification program is unique to the geographic region in which it is taught. Likewise, each instructor, regardless of locale, offers his or her own influences to the teaching pedagogy. Such variability makes a comprehensive evaluation effort even more complex. However, understanding the fundamentals of this widely adaptive program is a crucial step in the evaluation process. Policy makers and agricultural safety specialists must have insights into the program structure and knowledge of the number of participants the program serves in order for future decision making or resource allocation to occur. It is also crucial to understand the number and type of instructors offering the course in the community as well as their perceptions of the program. To provide this baseline information, the researcher will be guided by the following list of research objectives.
Objectives of the Study

The objectives of the study were to:

1. Determine the program’s youth enrollment status over a five-year period, as reflected in the USDA-CSREES reporting system;

2. Identify attributes of the Tractor and Machinery Certification program offered in various geographic regions and stakeholders’ perspective on the need for program improvement;

3. Describe perceived objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by a panel of experts;

4. Quantify the number of instructors offering the program in each state according to their certifying agency: USDA-CSREES Extension Service and the United States Department of Education vocational agricultural programs;

5. Describe the type of certification, Tractor or Tractor and Machinery, offered by the certifying agency including the number of educational hours: 10-, 15-, 24-, or 25-hours;

6. Identify teaching methods and curriculum resources used in the certification program by community-based instructors;

7. Examine community instructors’ perceptions and management styles of the Tractor and Machinery Certification program; and

8. Determine perceived program objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for
youth to be certified after participation in such a program, as identified by community-based instructors.

Definitions of Terms

The following terms are defined operationally as they were used in the context of this study.

**Curriculum** – the comprehensive elements of instruction within units of study, including: the teaching methods employed by the instructors; suggested evaluation criteria to measure student achievement; and any rationale to support the need for student learning. Posner (1992) classifies this type of curriculum as the *operational curriculum*, where the instructional activities are “embodied in actual teaching practices and tests” (p. 12).

**DOL program** – youth certification program defined by the Department of Labor and identified in the Code of Federal Regulations as a course designed to teach students safe tractor operation. An abbreviation for the United States Department of Labor Tractor and Machinery Certification program.

**Instructor** – a person who has been involved in teaching all or part of a tractor and machinery certification program.

**Program evaluation** – a process used to determine the worth or value of a program by comparing evidence of what the program ‘is’ with criteria as to what the program ‘should be’ (Steele, 1970).

**Stakeholder** – a person with direct interest, involvement, or investment in training youth for agricultural employment.
**State Program Leader** – a state-level administrator affiliated with either Extension or a State Department of Education who provides leadership to agricultural education and/or safety programs. These administrators may oversee a state’s curriculum, be responsible for educator in-service training, and/or provide support, either implicitly or explicitly, for safety instruction offered at the local level.

**Tractor Certification program** – defined by the Code of Federal Regulations as a course designed to teach students safe tractor operation.

**Tractor and Machinery Certification program** – defined by the Code of Federal Regulations as a course beyond the Tractor Certification course with additional hours of instruction in safe machinery operation.

### Limitations of the Study

There are always inherent risks when collecting data from stakeholders, administrators, and instructors of educational curriculum; the validity of these data may be limited. The following limitations were considered in this study.

1. Stakeholders involved in focus group interviews may not have been a representative sample of the population knowledgeable of the Tractor and Machinery Certification program.

2. The Delphi technique limited the possible representativeness of the certification program in that it utilized an expert panel of safety professionals.

3. Respondents to the survey instrument sent to state program leaders may not have an accurate understanding of the types of Tractor and Machinery Certification programs in their state, or be familiar with the program at all.
4. Respondents to the survey instrument sent to community instructors may not have been a representative population of educators offering Tractor and Machinery Certification programs.

Basic Assumptions

The major assumption with the Tractor and Machinery Certification program is that youth continue course enrollment at a similar rate to that of a previous era. Based on several state studies and USDA-CSREES data systems, the student participation rate is sporadic and shows a slight decline. With less than 2% of America’s population involved in production agriculture, there are simply less opportunities for youth to work on agricultural operations; the steady shift towards corporate farming is also a factor discouraging youth employment. However, there is an increase in this nation’s number of horticultural operations (USDA NASS, 1997b). Since the Standard Industry Codes (SIC) for the “green industry” are included in the Agricultural Sector, any employed youth 14 to 15 years of age should receive Hazardous Occupations training from a certified agency. Oddly, the youth employed in orchards, nurseries, and u-pick operations do not make the connection between the traditional tractor certification course and their horticultural employment (Wilkins, 2001). This is a mismatch between the youth eligible for program enrollment and the type of curriculum being offered. Of course the hiring company is also accountable to the federal labor law, and from an employer’s perspective, there is a lack of understanding of the equipment young people can operate and the type of training required before employment. So until there are
industry-wide changes in the child labor laws, there will remain a need for Tractor and Machinery Certification programs.

Another assumption with the Tractor and Machinery Certification program is the idea that instructors, nationwide, match their course content to legislative requirements of a 10-, 15-, 24-, or 25-hour program. Several studies indicate variance in hours of instructional time and deviation from outlined hours distinguishing between Tractor and Tractor and Machinery Certification courses. It is not uncommon for an instructor to report shortening the training program, often ignoring the 4-hour general farm safety requirement or skipping over instructional units of lower interest. The “full-plate syndrome” is frequently identified by educators as a reason to abbreviate the coursework; there are usually other influences competing for the educators’ time. With such a small number of youth actually in need of the certification, the educator will concentrate the majority of agricultural training to meet a broader range of students. However when programs are offered, the most commonly stated reason for skipping through the outline is based on the youth’s prior experience working with agricultural equipment. Ironically, this is the reason the program is in place: to reduce unsafe tractor operation behaviors based on inappropriately trained young people.

The final assumption that must be considered is the overall lack of funding originally established by the Department of Labor and/or USDA-CSREES to maintain a program of this size. With minimal operating dollars, and no direct funding to support personnel, it is difficult for each state to provide proper educational material in a multitude of formats to match the needs of youth and agricultural employers in different geographical regions. As Departments of Education and State Extension systems strive
to stay afloat in today’s economy, emphasis on tractor training is not always a priority. Without federal training dollars to provide the necessary sponsor support to sustain the mandated legislation, it is unlikely that state budgets are healthy enough to bear the deficit.

Significance of the Study

In the 37 years since legislation (Hazardous Occupations Order in Agriculture) went into effect, serious deficiencies have occurred in the quality of the training and the system by which agencies properly document certification. Confusion currently exists among instructors who do not understand the training guidelines and cannot access up-to-date training materials. Frustration exists for youth who desire to attend certifiable programs in or near their communities but cannot locate them. And just as concerning, agricultural safety leaders at national and state levels do not have a grasp on the content of the training and the extent to which it is being conducted.

The focus of this study is to subjectively and objectively describe the current situation of the Tractor and Machinery Certification courses offered in the United States. It is expected that the outcomes of this effort will result in a better understanding of the number of youth certified on an annual basis, the type of certification program offered to youth, the number and type of instructors teaching the program, the management styles of local programs, and the type of curriculum utilized. At the time of this writing, new national tractor and machinery certification curricula are being funded in the United States, one through the National Institute for Occupational Safety and Health (NIOSH) and the other through USDA-CSREES. By establishing a point of reference of youth enrollment and instructor demographics (pre- 2005), it will be possible to effectively
evaluate any new curriculum or training guidelines established by future efforts. It is also important to have an understanding of how instructors manage their local program and identify any potential barriers for offering a certification course; this knowledge will assist governmental decision-makers with accurate information in times of legislative actions.

In terms of developing curriculum, no national standards exist for what constitutes a sound educational program in tractor and machinery certification. To address this gap in the literature, several attempts have been made, and only a few have been published. Each of the nationally funded tractor training programs underwent an initial process to identify course competencies prior to the development of their materials. The NIOSH-sponsored program utilized a Nominal Group process with a panel of agricultural representatives to identify youth competencies (Ortega, Tormoehlen, Field, Balscheid, & Machtmes, 2003), and the USDA-CSREES sponsored project convened a panel of higher education agricultural safety specialists to identify minimum core content areas for training.

The methods in this research project utilized a comparable process of identifying competencies as the other two approaches, with slight variation. A modified-Delphi technique utilized a panel of experts to generate an initial list of competencies youth would develop as a result of participation in the Tractor and Machinery Certification program. The list of competencies was then transposed onto a rating scale to be validated by educational instructors from both Extension and agricultural education around the United States. The benefit of this two-stage, national approach is that it sought identification of youth competencies as well as consensus of such competencies by two
primary groups, the curriculum developers and the curriculum instructors. While it is noted that program participants (i.e., the youth) would also be a likely source of validation, it was not highly regarded as essential input. Studies have shown youth are not the best decision makers when it comes to personal safety issues; this phenomenon was demonstrated in the Ortega et al. (2003) study when teachers consistently ranked and prioritized competencies higher than the students.

It was in the 1960’s that the concept of mixed method research became acknowledged (Tashakkore & Teddlie, 1998). Mixed methods combined different qualitative and quantitative approaches within the same research design, and often within multiple phases. The use of these combined approaches in program evaluation is natural and intuitive (Witkin & Altschuld, 1995). However, it is also a rigorous approach, requiring the researcher to become more than a casual practitioner of either strategy.

There were two basic reasons that this study was built on the foundations of mix-mode research strategies. First, descriptive research required a broad net, and could not be adequately performed with a single approach. Understanding the state of a national certification program was a complex issue, one that deserved the attention of a multifaceted strategy. The researcher wished to accurately portray the incidence, distribution, and characteristics of the Tractor and Machinery Certification program so future generations might understand the national program exactly how it is today.

Another necessity for utilizing the mix-mode technique was simply to address the void of current literature in the area of tractor certification. Documented studies were limited in quantity and scope; the majority of past evaluation efforts were concentrated in a single geographical area and not comprehensive for the nation. Through exploratory
research, mixed method designs can form an infrastructure for understanding and addressing the needs of the Tractor and Machinery Certification program. By documenting the complexity of the problem from multiple data sources, these results will provide a foundation from which to build future research questions.

More than a statistical representation of certification status, mixed method approaches allowed the personal testimonies to be incorporated into a structured process, useful in documenting the evidence. The combination of quantitative and qualitative processes was beneficial for the researcher to understand and report the program’s status in the U.S. As such, the research process consisted of four distinct phases and is chronologically outlined as follows:

March – April 2002       Focus Group Interviews
March – April 2003       Delphi Technique
June – September 2004    Inquiry of state program leaders
March – June 2005        Investigation of program instructors

Simultaneous to these investigation phases, annual enrollment reports published by USDA-CSREES were monitored. The entire process -- collected from a variety of sources -- guided the researcher through inductive reasoning, where observations and patterns emerged.

It is appropriate that this research establish a benchmark for the current state of the national program. With little empirical evidence available and new curricula replacing the existing outdated publication, it is important to have a point of reference established for the DOL program. From this baseline, future program investigations will be able to measure change in enrollment and document effectiveness of newly designed curricula.
Agriculture, youth, and safety are three paramount words for safety and health professionals. On America’s farms, nearly 1.3 million children live, work, and play; in addition to these, another half million are employed as hired farm labor (Myers & Hendricks, 2001). Although the exact number of youth exposed to agricultural hazards varies from year to year, it is known that a multitude of opportunities exist for young people to come into close contact with occupationally dangerous environments. For obvious reasons, youth are on the farm: (a) they live on a farm or ranch; (b) they visit relatives and friends who are farm residents; (c) they live in a rural area where they interact with neighboring agricultural activities; (d) they volunteer for, or are hired for farm work; or (e) they accompany their parents to an agricultural worksite. There are also subtle ways youth are exposed to agricultural environments: (a) they participate in u-pick farming activities with their families; (b) they attend and participate in rural sports including rodeos and tractor pulls; or (c) they enjoy recreational activities on farms, including horseback riding, all-terrain vehicle (ATV) trail rides, and social hayrides. With so many at risk, and with much opportunity to experience risk, it is not surprising that a major public safety reform was launched.
The purpose of the literature review is to provide a theoretical underpinning of past legislative and research efforts to support the premise of this study. While a current and comprehensive study of the national Tractor and Machinery Certification program is not available, there have been several attempts to measure and document local programs. It is possible to look at educational and legislative strategies as well as program development models to investigate various components of program planning, implementation, and evaluation. But foremost in concern lies the underlying premise of the Tractor and Machinery Certification Program: it is an educational exemption of the child labor laws to allow youth to perform work in hazardous occupations. The following discussion summarizes the salient findings and conclusions offered by these studies.

The Hazardous Occupation of Agriculture

The agricultural industry is a broad, multi-disciplinary field that encompasses production agriculture, horticulture and specialty crops, turfgrass, forestry, and fishing. In the past 30 years, agriculture has undergone rapid transformation; there has been an increase in mechanized systems, use of technology, and a thrust for more efficient practices. Despite the myriad of change, one trend remains the same. Mortality and morbidity statistics in agriculture remain in the highest classifications of any industry (National Safety Council, 2002); in any given year, agriculture ranks in the top three most hazardous industries, next to mining and construction. The National Safety Council reported an average of 730 farmers and ranchers died in work-related activities during the year 2002, while another 150,000 suffered from disabling injuries (National Safety Council, 2003).
The three primary sources of agricultural work force data are the Bureau of Labor Statistics’ Current Population Survey (CPS), the USDA National Agricultural Statistics Service (NASS), and the Census of Agriculture. Data within these survey systems are derived from different population samples, but are representative of the agricultural population. Because of their diverse sampling techniques, definition of workers, and timeline of collection efforts, each report will have slight variations. The Census reported higher numbers of agricultural workers than the CPS or NASS systems, estimating the hired labor force in agriculture operations at 3.35 million in 1997 (USDA ERS, 1999). Most of these workers (2.46 million) were part time in nature, working less than 150 days during the year. The CPS report identified 3.3 million workers for the same time period (BLS, 2002), while the NASS survey acknowledged only 1.24 million (USDA NASS, 2000). It is noted the actual statistic may have varied between reports, however, the reports showed similarity in that there was a general decline in the number of agricultural workers, and an increase in the number of agricultural service workers.

Injury rates among hired farm workers were higher than that of farm operators and family members. CPS data reported hired farm workers experienced an occupational fatality at a rate of .30 per 1,000 workers and an injury rate of 44.2 per 1,000 workers. This was compared to the farm operator’s fatality rate of .27 per 1,000 workers, and an injury rate of 11.4 per 1,000 workers. Fatality rates for farm operators and family members were the highest in Indiana, Ohio, Pennsylvania, and Tennessee as compared to all state fatality data, while fatality rates for hired workers were highest in Arizona, Arkansas, California, and North Carolina (USDA ERS, 2004).
Similar to the shortfalls of determining occupational fatalities, interpretations of labor force statistics should be viewed with a skeptical eye; occupational labor forces are only calculated for employed persons 15 years and older. However, children less than 15 years of age are known to work, especially in agriculture. A study conducted by Myers and Hendricks (2001) estimated 32,800 injuries occurred to youth less than 20 years of age during 1998; of these injuries, 7% occurred to hired farm labor. A larger proportion of these injuries, approximately 72%, occurred to youthful farm residents.

In the agricultural industry, child labor issues are viewed differently than in other U.S. occupations. One of the most enjoyed privileges of farm families is the legislative exemption on the youth’s age or assigned task if the youth is performing work on a family-owned farm (Hazardous Occupations in Agriculture, 1990). Many farm parents view work as a mechanism to instill a work ethic, build character, and teach real-world life lessons (Greenberger & Steinberg, 1986). Parents, wanting to instill a work ethic at an early age, often rely upon experience as their children’s best-taught lessons. While role modeling their parents and other authority figures, it is possible for youth to adopt unsafe work habits (Darraugh et al., 1998; Kidd et al., 1997).

Having an understanding of the injury rates in the agricultural industry assists public health officials and occupational safety specialists follow trends and track populations for further surveillance. And while no individual data system is completely adequate, broad-based surveillance efforts are warranted measures for monitoring the health and well-being of society. A primary aspect of the surveillance process includes documenting the types of agents responsible for causing injury.
The Agents of Injury in Agriculture

Since the industrial revolution, the tractor has been identified as the leading cause of death for U.S. farmers. National Safety Council (2000) estimated 317 tractor-related deaths in 1998, with an annual fatality rate of 8.2 deaths per 100,000 tractors. During the years 1988-1998, the trend remained fairly constant, ranging between rates of 6.3 to 10.1 (NSC, 2000). A study by Myers and Snyder (1995) found approximately 4.8 million tractors being used in the U.S.; of these identified, only 38% had rollover protective structures (ROPS). Tractors manufactured during the 1950’s, 1960’s, and 1970’s were built without ROPS and are still used in high frequency for routine chores like mowing, loading, transporting materials, and supplying power for power take-off (PTO) driven machinery (Rautiainen & Reynolds, 2002). The Tractor Risk Abatement and Control Policy workshop, conducted in September 1992, identified the ROPS as the single best preventive measure to decrease tractor fatality rates (Donham, Osterberg, Myers, & Lehtola, 1997).

For youth populations, farm machinery hazards are the primary cause of farm-related fatalities (Rivara, 1985; Salmi, Weiss, Peterson, Spengler, Sattin, & Anderson, 1989; Schenker, Lopez, & Wintemute, 1995; Wilk, 1993). In cases involving tractor fatalities, rollovers and runovers were documented as the most frequently occurring type of event-causing death (Goodman, Smith, Sikes, Rogers, & Mickey 1985; Rivara, 1985; Schenker et al., 1995; Sheldon & Field 1992; Struttman, Spurlock, Pollock, Moon-Hampton, Browning, McKnight, & Finger, 1995). A study of Indiana and Wisconsin youth under the age of 18 years reviewed 460 cases of farm-related fatalities between the years 1970–1990, of which approximately half of those deaths were attributed to the
tractor (Sheldon & Field, 1992). The lack of ROPS use and the practice of carrying extra riders were additional causes of tractor-related injuries to the youth population (Wilkinson, Schuler, & Skjolaas, 1993).

Besides the tractor, other agents of injury to children in agriculture include farm machinery, livestock, structures, and falls (Purschwitz, 1990; Rivara, 1985; Stallones & Gunderson, 1994; Stueland, Layde, & Lee, 1991). While in an agricultural environment, children have similar exposures as other agricultural workers to vibration, noise, noxious gases, airborne irritants, stress, biological agents, and pesticides (National Committee for Childhood Agricultural Injury Prevention, 1996). Younger children are at risk of serious injury when they are: (a) left unsupervised during times of busy activity, (b) left in close proximity to unguarded or moving machinery, (c) accompany workers near moving farm machinery, or (d) are asked to perform a task inappropriate to their age (Pickett and Brison, 1995). Adolescent farm youth often work with minimal supervision where their tasks involve working with livestock and heavy machinery; in many of these occupational situations the youth have received little training (Marlenga, Pickett, & Berg, 2002; Runyon & Zakoes, 2000).

Understanding the types of injury agents prevalent within the agricultural industry is an important surveillance component. However, it is just as important for public health and safety specialists to understand the population at risk for injury and the distribution of such risk.
The Magnitude of Youth Injuries in Agriculture

Because agriculture is an industry that allows, and often encourages, young workers, the injury statistics reported by occupational national databases are often incomplete. As stated previously, the Bureau of Labor Statistics does not include workers under the age of 15 years in their occupational injury reports. Cognizant of this void, two popular childhood studies attempted to quantify agricultural fatalities and injuries to youth populations. Rivara (1997) reported 124 youth die and another 23,000 are seriously disabled each year on American farms. For youth under 20 years of age, Adekoya and Pratt (2001) reported 2,174 fatalities between the years 1982 and 1996, yielding an average annual agricultural death rate of 155. This same report found approximately two-thirds of all farm deaths occurred to young people under 15 years of age. The leading injury-causing agents in both reports were attributed to machinery, water, and animals.

More recently, Hendricks, Goldcamp, and Myers (2004) documented a decline in agricultural deaths between the years 1995 – 2000. Their report, based on 50 state vital statistical registries, documented 695 farm-related fatalities for youth under 20 years of age. The highest fatal age group was youths 16 to 19 years of age, which calculated to a rate of 10.4 annual fatalities per 100,000 youths. The fatality rate for youth under the age of 10 years was comparable at 10.1 fatalities per 100,000 youths. The age range of 10 – 15 years showed the lowest fatality rate of 7.1 per 100,000 youths.

According to classification codes on death certificates of 695 farm-related fatalities (Hendricks et al., 2004), the most prevalent causes of death were attributed to
machines (including farm tractors, trailers pulled by tractors on the farm, and equipment),
motor vehicles, and drowning. Of those deaths deemed as occupational-related, 94 cases
were involved in agricultural tasks, and of those, 45 (48%) were caused by machinery.

While the childhood agricultural mortality fatality rates have decreased, the
morbidity data has intensified (Rivara, 1997). With regards to non-fatal agricultural
injuries, teens experience the highest number of injuries compared to all other youth
categories (Myers & Hendricks, 2001). Castillo, Landen, and Layne (1994) calculated
adolescent injury rate to actual work exposure time and found adolescent injury rates
above those of adult rates in the same agricultural environment.

Comparing youth who perform work on farms to youth working in non-farm
occupations, Crowe (1995) documented that youth working in agricultural operations are
at higher risks than their urban counterparts. Cross-reference calculations of various
occupational fatality databases found the agricultural teens were three times more likely
to die on the job than the non-agriculture working teen (Hard et al., 1999); the fatality
rate reports showed a rate of 12 per 100,000 workers in young agricultural workers,
compared to that of 4.4 deaths per 100,000 workers in non-farm national youth fatality
rates.

It may be understandable why agriculture, with its complexity of tasks and
inclusion of multiple generations of workers, has higher injury and fatality rates as
compared to other occupational environments. The better question may be, “Why are
children permitted, even encouraged, to be in such a hazardous workplace?”
The Cultural Acceptance of Children in the Agricultural Workplace

Goodenow and Lawrence (2001) discussed a connection between the family’s economic position and the child’s work expectation. As young children grow and mature in the family structure, there are more expectations for the youth to participate in the work of the family. Prior to 1990, little empirical evidence was available for parents to evaluate the skills needed by children to perform tasks in agricultural environments. Cognizant of the high injury rates associated with children in hazardous occupational environments, researchers tried to understand the relationship between the parent’s need to instill a work ethic and the dangers of putting children at risk.

In their survey of Iowa farm families, Hawk, Donham, and Gay (1994) found a child’s first introduction to occupational exposures occurred at an early age (0-4 years), and children were operating machinery by themselves as early as 5-9 years. This study was based on a journalist’s article where farm children were reportedly exposed to tractor farm machinery at a very young age; this respected agricultural journalist reported 65% of farm boys operated a tractor by age 12 and 90% of farm boys and girls were allowed to ride a tractor with a parent by age 7–9 (Tevis & Finck, 1989).

Purschwitz (1990) attributed agricultural injuries to the unintended results of parental encouragement or expectation of participation in family-owned and operated farms. In a survey of Wisconsin dairy farmers, Lee, Jenkins, and Westaby (1997) found that farm fathers were very likely to allow their children under the age of 14 to be in high-risk environments, including driving a tractor, being a second rider on a tractor, and being closer than five feet away from a dairy cow’s hind quarter. Their study explained children were put into high-risk situations for two reasons: (a) the parents’ attitude
associated with the positive values of performing farm work and (b) the economic
necessity for children to perform work.

In 1999, the North American Guidelines for Children’s Agricultural Tasks
(NAGCAT) were published (Lee & Marlenga, 1999). Created as a tool to assist parents
and other adults to assign appropriate farm jobs to youth ages 7 to 18, NAGCAT was the
first comprehensive attempt to quantify the types of farm tasks youth were likely to
perform. The guidelines were developed with a consensus-based process that included a
project team of 15 experts from the U.S., Canada, and Mexico. This NIOSH-led
initiative sought information from a widespread source of farm parents, teen workers,
aricultural safety specialists, and child development specialists. With regards to safety,
the guidelines specifically discouraged all children and adolescents from (a) driving a
tractor with a second rider, (b) driving a tractor with another child in a passenger seat,
(c) driving a tractor in less than optimal conditions, (d) driving a tractor without ROPS or
a seatbelt, (e) operating old or unstable equipment, (f) hitching to fixed objects,
(g) refueling machinery, (h) being an operator and be responsible for two or more people,
and (i) entering confined spaces (Lee & Marlenga, 1999).

The complexity of the agricultural occupation involves a multitude of hazards, in
multiple environments, with a broad array of workers. Because youth often lack the
cognitive, physical, and psychological ability to recognize and react appropriately to
occupational dangers (Clark, 1994), young workers should receive special attention to
help reduce their exposure (Aherin & Todd, 1989). While attention can be provided in
numerous ways, it should be guided by theory and sound occupational safety principles.
To be effective in curbing injury, such strategies must be explicitly known and followed.
In the agricultural safety and health professions there is a general void of injury prevention theories to guide health prevention and health promotion efforts. However, there are two classic approaches used in other occupational injury prevention programs that have been adopted by agricultural safety professionals, the public health model and the industrial safety model. These approaches are an important foundation for two reasons. First, they help focus prevention efforts towards areas of high risk. Second, they help structure intervention strategies to reduce the common belief that accidents happen at random. For in nearly all incidents, there is a cause-effect relationship with 25% being attributable to mechanical failure and 75% attributed to human error (Murphy, 2003). Having a safety program based on theory is a sound professional practice, one that is based on plausible and sensible ideas of how injuries can be prevented (Murphy, 2003).

Approaches of Injury Prevention in Agriculture

Fundamentally, there are two different perspectives to hazard and injury prevention and control in agricultural safety: the public health approach and the industrial safety and health approach. Both models incorporate the interaction between people and their environment. While in-depth discussion of these approaches is beyond the scope of this particular study, it is necessary to understand the premise of both approaches as they affect the agricultural safety and health efforts practiced today.

In addition to these two models, a governmental approach to injury reduction in the workplace is incorporated through public policy. Utilization of this method in agricultural occupations has limited applications. However, it is included in this discussion as it affects certain practices and youth populations.
The Public Health Approach

The public health approach to injury prevention was derived from the science of epidemiology, or the study of injury and/or disease among populations (Friis & Sellers, 1999). A basic assumption in the science of epidemiology is that the occurrence of disease and injury is not a random event; Rothman (1986) proposed that a specific cause, designated by an event, condition, or characteristic, is essential for disease induction. The popular epidemiological triangle, depicted in Figure 2.1, represents the Mausner and Kramer (1985) model for describing the relationship between the injury agent, host, and environment. The epidemiology triangle is widely accepted in modern public health research as the common relationship between disease- and injury-causing variables.

![Figure 2.1: The triadic variables of the epidemiological triangle](image)

This theory of injury prevention makes the assumption that accidents are not random acts of God, nor are they coincidental episodes of luck, chance, or fate. As described in the 1989 national report *Injury Prevention: Meeting the Challenge*, injury occurrences are understandable, predictable, and preventable. Paralleling public health research and the evolution of accident control and prevention, injury law professionals
Christoffel and Teret (1993) have realized, “injury is a significant problem for public health” (p. 8). Not only do they address the fact that injuries are non-random in occurrence, they also suggest incidental injuries can be controlled via legislation and regulation practices.

The epidemiological triangle and its linear portrayal of cause-effect relationships between agents, hosts, and the environment is a cornerstone of the public health model. To apply this model to the occupational environment, the Center for Disease Control and Prevention suggests a four-step process that includes defining the injury problem, identifying the risks and protective factors, developing and testing prevention strategies, and assuring widespread adoption. Through this approach, public health problems can be identified and studied through surveillance, human factors and psychological concepts can be considered, and intervention strategies can be planned and evaluated. This concept is depicted in Figure 2.2.

Figure 2.2: The public health approach to injury prevention (as cited in Murphy, 2003)
While effective for explaining illnesses among populations, the application of the public health approach to describing occupational injury is in its infancy stages. For an inclusive injury prevention model that corresponds to the workplace, the industrial safety and health approach is utilized.

The Industrial Safety and Health Approach

From a historical perspective, the agricultural safety and health discipline was derived from the industrial safety and health movement at the turn of the 20th century (Murphy, 1992). Because of the self-governing nature of the agricultural environment, injury prevention strategies have focused on education. In essence, educational strategies utilize basic motivational forces to guide voluntary behavior changes and encourage implementation of best management practices. While this historic approach to injury prevention is an accepted practice in the agricultural community, it is not as effective as those strategies employed in other occupational settings. In the early 1900’s, Julien H. Harvey pioneered an early model of hazard control where he recognized the value of education, but did not put sole emphasis on its effect (Murphy, 1992). Coining the phrase: “Three E’s of Safety,” Harvey described Engineering, Education, and Enforcement as the primary forces driving industrial health and safety programs. His model encouraged management to incorporate engineering safeguards, educate workers on safe use of equipment, and enforce rules and regulations to keep the workplace a safe environment. Harvey’s model was considered a comprehensive approach to injury reduction (Stack & Elkow, 1966), and is commonly referenced in the agricultural safety literature as an effective approach to injury reduction (Murphy, 1992). When constructed
as a pyramid, each side of the pyramid lends structural integrity to the overall infrastructure of the design. If one side of the pyramid is removed, the framework is no longer supported. Figure 2.3 represents this relationship, where the concept of personal safety is the base of the pyramid and is supported by each of the Three E’s. If even one side is eliminated, the holistic model is affected.

![Diagram of ecological pyramid representing the Three E's of Safety](image)

Figure 2.3: An ecological pyramid representing the Three E’s of Safety

Murphy (1992) utilized a consensus hierarchy model to summarize the historical research and explicate the areas of injury prevention and control. Emerging more as priority areas than hard-fast rules, this hierarchical depiction of risk reduction has become a widely adopted practice in the safety and health fields. The consensus hierarchy is simple:
Accepting the premise that risk is omnipresent, it is difficult to argue that a situation can be completely devoid of risk. Therefore, hazard and injury prevention and control must advance over the first level of the hierarchy and descend into other levels of the model, where emphasis is placed in two primary risk reduction efforts, engineering and education.

The second level of the hierarchy depends profoundly on engineering controls with the safeguarding of equipment and consumer products. A multitude of engineering protective factors exist in the industrial safety and health approach to address hazard control. Familiar technology in agricultural equipment includes safety belts, ROPS, and PTO driveline shields. While such agents can be altered or misused by consumer tampering or malfunction by engineer design, generally engineering controls are perceived as positive and useful in safeguarding against hazards (Dixon & Clearwater, 1991).

The remaining three levels of the consensus hierarchy model consist of educational strategies to warn of hazards, train about hazards, and safeguard properly against the hazards. Safety education, then, is “The art of cultivating the knowledge, skills, and attitudes that make for safety” (Albert Whitney, as quoted in Stack & Elkow, 1966, p. 16). Safety (and health) in a broad sense can be referred to as the minimization of risks while maximizing the quality of life (Dixon & Clearwater, 1991).
Education is a significant component of the consensus hierarchy model. Dixon and Clearwater (1991) speculate that people will not take action to reduce risk until they first perceive the risk as a significant health threat. “Education can help individuals expand their awareness of risks and increase their skills for dealing with them” (p. 233). Safety and health education has become a significant factor in injury intervention and control; recognizing that prevention is the only sensible strategy in curbing unintentional fatalities, education provides the framework for increasing knowledge and skills.

Yet for most people the concept of practicing safety has negative connotation, implying a restraint from enjoying a freedom or performing a task as they please. Because of this general disregard, safety education is not a fail-safe mechanism to eradicate injuries in the workplace. For this reason it is necessary to go beyond the human factor component within both the public health and industrial safety approaches of injury reduction. In certain cases and for specific concerns, it is necessary to take a public policy approach.

*The Public Policy Approach*

Public policy is an effective strategy to curb fatality and injury rates. One of the most documented successes of public policy efforts was through the administration of the Occupational Safety and Health Act (OSHA) of 1970; this Act established for the first time in U.S. history a national, federal program to protect the entire work force from occupational deaths, injuries, and illnesses (USDOL, 2005).

Few legal and regulatory protections exist for production agricultural occupations. Possible reasons for this absence includes the complexity of omnipresent risk exposures,
coupled with the ever-changing, multifaceted population of workers and family members. From a safety and health perspective, production agriculture can be characterized as “infinitely variable” since farm workers, farm residents, and farm visitors of multiple generations may be exposed to a vast array of chemical, physical, and biological hazards (Ehlers, Connon, Themann, Myers, & Ballard, 1993; Murphy, 1992; Wilk, 1993). In an effort to reduce the number of fatal injuries among youth, the United States Department of Labor issued two regulations affecting employment of young people in occupational settings, the Fair Labor Standards Act and the Hazardous Occupations Order in Agriculture.

The Fair Labor Standards Act established a minimum age requirement for the employment of minors in agriculture (USDOL, 2004). The law sets forth the following guidelines: (a) the minimum age for employment in any hazardous occupation outside of school hours is 16 years, (b) children age 14 and 15 can be employed in any non-hazardous agricultural occupation outside of school hours, (c) children less than 14 years of age can be employed in agriculture on a farm owned and operated by their parents or with written parental consent, and (d) children less than 12 years of age can be employed in agriculture on a farm owned and operated by their parents or with written parental consent on farms where employees are exempt from federal minimum wage provisions.

The United States Department of Labor issued the Hazardous Occupations Order in Agriculture (HOOA) in 1968; this legislation placed a control for hiring youth in 28 hazardous occupations, of which agricultural operations possessed 11 of those dangerous environments (HOOA, 1990). According to the statute, the following operations were deemed unlawful for persons younger than 16 years of age:
1. Operating a tractor of over 20 PTO horsepower, or connecting or disconnecting an implement of any or its parts to or from such a tractor.

2. Operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) of the following machines:

   (i) Corn picker, cotton picker, grain combine, hay mower, forage harvester, hay baler, potato digger, or mobile pea viner;

   (ii) Feed grinder, crop dryer, forage blower, auger conveyor, or the unloading mechanism of a non-gravity type self-unloading wagon or trailer; or

   (iii) Power post-hole digger, power post driver, or non-walking type rotary tiller.

3. Operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation of) any of the following machines:

   (i) Trencher or earth moving equipment;

   (ii) Fork lift;

   (iii) Power-driven circular, band, or chain saw.

4. Working on a farm in a yard, pen, or stall occupied by a:

   (i) Bull, boar, or stud horse maintained for breeding purposes; or

   (ii) Sow with suckling pigs, or cow with newborn calf (with umbilical cord present).
5. Felling, bucking, skidding, loading, or unloading timber with butt diameter of more than six inches.

6. Working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc.) at a height of over 20 feet.

7. Driving a bus, truck, or automobile when transporting passengers, or riding on a tractor as a passenger or helper.

8. Working inside:
   (i) A fruit, forage, or grain storage designed to retain an oxygen deficient or toxic atmosphere;
   (ii) An upright silo within two weeks after silage has been added or when a top unloading devise is in operating position;
   (iii) A manure pit; or
   (iv) A horizontal silo when operating a tractor for packing purposes.

9. Handling or applying (including cleaning or decontaminating equipment, disposal or return of empty containers, or serving as a flagman for aircraft applying) agricultural chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act (as amended by Federal Environmental Pesticide Control Act of 1972) as Toxicity Category II, identified by the word “Warning” on the label;

10. Handling or using a blasting agent, including but not limited to, dynamite, black powder, sensitized ammonium nitrate, blasting caps, and primer cord; or

11. Transporting, transferring, or applying anhydrous ammonia.
Because of the strict wording and limitations, the Hazardous Occupations Order in Agriculture was met with much opposition from farm employers. Consequently the law was amended six months later to allow for certain exemptions. A total of three exemptions for the employment of youth 14 and 15 years old working in agricultural operations were established:

1. The youth’s parent(s) or guardian(s) own(s) the farming operation. No restrictions are imposed on youth’s age or task on a farm owned by the youth’s parent(s) or guardian(s).

2. The youth, when enrolled in a vocational agriculture program, is permitted to work in tasks outlined by Items 1 through 6 of the Hazardous Occupations Order if he/she is considered a student-learner. A written agreement must be made stating the work is incidental to training, intermittent, and under close supervision of a qualified person. Safety training must also be conducted both at the school and on the job.

3. The youth (14 or 15 years of age) completes a safety course and earns a certificate in safe tractor and/or machinery operation. Upon employment of the youth, a copy of the certificate is to be kept in the youth’s records by the employer and returned to the youth at the termination of his/her employment (HOOA, 1990).

Once in place, the exemptions allowed youth to work in certain agricultural operations. The Department of Labor, a regulatory agency, quickly realized the necessity to assign oversight of these exemptions to another agency, and chose the United States Department of Agriculture (B. Rein, personal communication, October 23, 2002). However, it was not expected that USDA-CSREES administer the certification program, merely manage it. The
responsibility for teaching the certification program to youth was placed with two educational entities, the Federal Extension Cooperative Extension System and the United States Office of Education vocational agricultural programs.

The Code of Federal Regulations (1990) goes on to address two types of certificate programs. Within each program, specific guidelines are outlined. The first program is commonly known as the Tractor Certification course and the second is the Tractor and Machinery Certification course. Requirements for completing either course are dependent upon the entity administering the training, either Extension or vocational agriculture. So in essence, it is possible to have four types of training available to youth.

*Extension Training Program Guidelines*

Within the 4-H or Extension program, instructors may offer either the Tractor Certification course or the Tractor and Machinery Certification course. Specific criteria for each program are prescribed below. It is understood that the Tractor-only course is a 10-hour program, while the Tractor and Machinery course includes both tractor and machinery components, as well as an additional 4-hour orientation course. It is not expected that the machinery operation guidelines be taught as a stand-alone curriculum; when this component is included in the curriculum, it is to fulfill the Tractor and Machinery Certification program requirements.

*4-H Tractor Operation Certification requirements.* The youth must:

1. Be a 4-H member;
2. Be 14 years of age, or older (a 4-H member may be under the age of 14 when qualifying for the certificate, but the certificate cannot be issued until the 4-H member is 14 years or older);
(3) Be familiar with general agricultural work hazards;

(4) Have completed a 10-hour training program which includes the following units on the safe operation of agriculture tractors: 4-H manuals, First year manual: Units 1, 4, 5, 6 and 7; Second year manual: Unit 1; Third year manual: Units 1 and 3;

(5) Pass a written examination on tractor safety;

(6) Demonstrate the skills needed to operate a tractor safely with a two-wheeled trailed implement on the 4-H Tractor Operator’s Contest Course.

4-H Machinery Operation Certification requirements. The youth must:

(1) Satisfy all of the requirements for the Tractor Operation Certificate;

(2) Have completed an additional 10-hour training program (20 hours total) which includes the following units on the safe operation of agriculture tractors: 4-H manuals, First year manual: Units 1, 4, 5, 6 and 7; Second year manual; Third year manual: Units 1 and 3; Fourth year manual: Unit 1;

(3) Pass a written examination on tractor safety;

(4) Demonstrate the skills needed to operate a tractor safely with a two-wheeled trailed implement on the 4-H Tractor Operator’s Contest Course.

4-H Tractor and Machinery Operation Certification requirements. The youth must:

(1) Be 14 years of age, or older;

(2) Completed a 4-hour orientation course on general agricultural work hazards;

(3) Have completed the 20-hour training program (24 hours total) which includes the following units on the safe operation of agriculture machinery: 4-H
Manuals, First year manual: Units 1, 4, 5, 6 and 7; Second year manual: Unit 1; Third year manual: Units 1 and 3; Fourth year manual: Unit 1;

(4) Pass a written examination on tractor safety;

(5) Demonstrate the skills needed to operate a tractor safely with a two-wheeled trailed implement on the 4-H Tractor Operator’s Contest Course.

*Vocational Agriculture Training Program, Office of Education Guidelines*

Teachers within secondary schools may offer either the Tractor Certification course or the Tractor and Machinery Certification course. Similar to the Extension program, criteria are specifically outlined in the Code of Federal Regulations and are included below. In these trainings, the Tractor-only course is a 15-hour program. The Tractor and Machinery course is a 25-hour program, which includes the 15 hours of tractor training and an additional 10 hours in machinery training. Again, it is not expected that the machinery operation guidelines be taught as a stand-alone curriculum; when this component is included in the curriculum, it is to fulfill the Tractor and Machinery Certification program requirements.

*Tractor Operation Certification requirements.* The youth must:

(1) Be 14 years of age, or older;

(2) Be familiar with general agricultural work hazards;

(3) Have completed a 15-hour training program which includes the required sections, as specified in the Vocational Agricultural Training Program in Safe Tractor Operation, Special paper #8, April 1969, Sections: I, V, VI, VII, and VIII;

(4) Pass a written examination on tractor safety;
(5) Demonstrate the skills needed to operate a tractor safely with a two-wheeled trailed implement on a course similar to the one outlined by the Vocational Agriculture Training Program in Safe Tractor Operation.

Machinery Operation Certification requirements. The youth must:

(1) Have completed an additional 10-hour training program (25 hours total) which includes the required sections, as specified in the Vocational Agricultural Training Program in Safe Tractor Operation, Special paper #8, April 1969, Sections: I, V, VI, VII, and VIII;

(2) Pass a written examination on tractor safety;

(3) Demonstrate the skills needed to operate a tractor safely with a two-wheeled trailed implement on a course similar to the one outlined by the Vocational Agriculture Training Program in Safe Tractor Operation.

The certification programs, regardless of instructional agency and program type, share similar requirements. All courses are required to include a prescribed number of training hours, within which instructors can tailor the teaching methods to the students. A suggested course curriculum is identified, as is a pattern for the driving course. Youth are expected to be the required age and to pass both a written and driving test. Despite these thoughtfully constructed guidelines for educational mandates, youth continue to be involved in tractor and machinery incidents, often at rates higher than adult workers.

More recently the 1990 U.S. Congress, under Public Law 101-517, made provisions for a national initiative in agricultural safety and health, to be led by the National Institute for Occupational Safety and Health (U.S. Dept. of Health and Human
Services, 1991). Several key events occurred as a result of this legislation. First, the *Surgeon General’s Conference on Agricultural Safety and Health*, was held in Des Moines, Iowa in April 1991; during this conference a session was devoted to *Intervention: Safe Behaviors Among Adults and Children* (Castillo, Hard, Myers, Pizatella, & Stout, 1998). The following year, a *Childhood Agricultural Injury Prevention Symposium* was held in Marshfield, Wisconsin; its purpose was to seek consensus on relevant research, education, policy, and interventions strategies aimed at childhood injury reduction efforts.

In 1996, the U.S. Congress adopted a plan submitted by a National Committee for Childhood Agricultural Injury Prevention. The national action plan, *Children and Agriculture: Opportunities for Safety and Health*, provided the blueprint for what led to a collection of research studies, injury data collections, and demonstration programs targeted at youth on farms (National Committee for Childhood Agricultural Injury Prevention, 1996). The plan was updated in 2001 through the Summit on Childhood Agricultural Injury Prevention. The outcome of this endeavor identified 3 broad goals, 12 recommendations, and 36 specific strategies for preventing childhood agricultural injuries (Lee, Gallagher, Marlenga, & Hard, 2002). The goals include non-working children, young workers in agriculture, and national leadership and infrastructure. The proposed strategies require a multi-disciplinary effort among farm organizations, youth-serving groups, injury prevention researchers, higher education program specialists, and federal agencies.

Public policy is only one component of an occupational injury prevention model, yet it often drives the safety climate in those occupations. Where there is heavy policy and enforcement, there is often stronger compliance to safety rules. Where there are only
recommendations, there are inadequate application and adoption of safe practices. Such is
the concept in agriculture; it is an industry that has enjoyed many exemptions from
regulations, and as a result suffers a higher fatality rate than other industries.

A common thread in all injury prevention models is education, and the role it plays in changing behavior. Even within the public policy approach, worker training is clearly identified and outlined for instructors. So what makes a good educational program? To understand the fundamental components of a safety education program, it is first important to consider the fundamental philosophy behind the teaching and learning process.

Philosophy of Educational Design

Safety education plays a significant role in injury prevention models. Whether the teachings are formal or informal, instructional activities are conducted in the agricultural work environment. By understanding the philosophy of education, it is possible to reflect on the reasons and logic behind educational design. Philosophy is not discerned with the content of education. More accurately, philosophy concerns itself with the process of education and the symbiotic relations with the various elements in the educational process.

Elias and Merriam (1995) discuss six philosophical foundations of education: liberal, progressive, behaviorist, humanist, analytical, and radical. While each orientation has distinct characteristics, they are often found integrated and synthesized in the educational system. These theories are presented here as a brief orientation for the reader. Through their discussion, Elias and Merriam (1995) determine the Analytical Philosophy resembles a teaching and learning method, not a philosophical foundation for education. As such, it is not included in further detail. Two philosophical foundations, Progressive
and Behaviorist, will receive the majority of attention because of their strong underpinning to the agricultural education discipline and tractor safety certification programs.

*Liberal* education was adopted by colonial America as a traditional knowledge for the arts, classics, and natural philosophy. Perhaps the oldest philosophy of education in the Western culture, liberalism is based on the work of Socrates, Plato, and Aristotle (Broudy & Palmer, 1965). The cornerstones of this philosophy are to produce intelligent and moral citizenry, promote conceptual and theoretical thinking, provide spiritual guidance, and cultivate an aesthetic sense (Elias & Merriam, 1995; Livingstone, 1944). Not discounting its value in the culture, this philosophical orientation rapidly deteriorated in the midst of the industrial society around the time of the American Civil War (1861-1865).

*Progressive* education emerged in the nineteenth century with its pragmatic and utilitarian view affecting societal changes brought about by industrialization, urbanization, and the emergence of science and technology. Likewise, immigration was a concern of the era and the progressive theory of education advocated social responsiveness in a democratic world and the development of a democracy without corruption (Elias & Merriam, 1995).

Perhaps the most influential impact on the educational reform of the twentieth century was the progressivist John Dewey (1916) and his critique of the education system. Isolating education as a separate discipline of study, his epistemology included general principles unique to education such as goals and objectives, curriculum design, methodological principles, the teaching-learning process, and the relationship between
education and society. Credited with the title ‘pioneer of problem-solving teaching’ (Osborne, 1988), Dewey was an indirect forefather to vocational education. Dewey’s methods emphasized the importance of learner centeredness (1956), social activism (1956), and the experimental method (1938).

From Dewey and other progressive philosophers of the era, a behaviorist education theory evolved. Elias and Merriam (1995) describes Progressive education as one that places emphasis on vocational and utilitarian training, learning by experience, scientific inquiry, community involvement, and responsiveness to social problems. From this educational theory came behavioral objectives, accountability issues, and competency-based education.

Behaviorist education emphasizes overt, observable behaviors. Theorists contend that learning takes place when there is an observable change in behavior, brought about by a specific stimulus. Educators can measure student change by writing specific behavioral objectives, also called instructional objectives. An accurately written objective includes the behavior a student is to perform, the relevant conditions by which the behavior is performed, and a description of the criteria by which the behavior will be judged (Elias & Merriam, 1995). Through explicitly stated objectives, student performance can be measured objectively and precisely, thus eliminating any subjective assessment by the educator.

John Watson (1925), a behavioral psychologist, focuses on the observable behavior of an organism and believed that his discipline is the study of behavior, not a study of the mind. If the behavior cannot be observed, then it cannot be measured; therefore lack of observation is not worth an investigation. E. L. Thorndike (1928), a contemporary ally of
Watson, designed the “S-R” theory of learning, where for every stimulus there is a response. His theory proposes that repetition in itself does not establish a bond, but rather, organisms will connect with and remember those responses that lead to satisfying results. Utilizing this type of behaviorist psychology, B. F. Skinner (1974) brought such S-R concepts into the American education. Skinner believed that human beings are somewhat controlled by their environment, and by understanding these external conditions, they can be labeled, isolated, and manipulated to achieve a desired response.

Knowing that behaviorism is not practiced exclusively in the educational setting, neobehaviorists focus on mediation and cognition, the critical processes that occur in the individual between the stimuli and responses (Dubin & Okun, 1973). Robert Gagne (1985), a neobehaviorist cognitive theorist, believed the basis for instructional objectives are for the distinct purpose of communicating. Such communication is between the instructional designer and course planner, course planner and teacher, teacher and student, and teacher and administrator or parent. Gagne believed learning occurs on different levels: verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. Depending on the desired outcomes, educators will utilize different instruction methods for the desired response. In addition, the learning environment plays a significant role if effective learning is to occur.

The early beginnings of the social learning theory evolved from the behaviorist theory where emphasis was placed on observation and its importance to the learning process. Bandura (1971) suggested that a strong reinforcement of the learning process is the ability for one to observe and model behaviors, attitudes, and emotional reactions of others.
The humanistic orientation to educational philosophy grew out of reaction against the behavioral viewpoint. Humanists advocate the need for individuals to take responsibility for their learning, and de-emphasize the external forces of the environment, and the stimulus-response need to react (Elias & Merriam, 1995). Humanism promotes an atmosphere that is learner-centered, filled with interactions that lead learners to their personal growth and development. As the individual strives for such growth, a self-actualization period can be attained, similar to the personal development concepts of Maslow (1954). The humanist philosophical orientation is prominent in continuing education environments (Knowles, 1975; Rogers, 1969). Such philosophy goes well with learners who are internally motivated, can identify their own learning needs, and can make collaborative decisions with the instructor especially with regards to course content, instructional methods, and self-evaluation (Merriam & Brockett, 1997).

Radicalism differs from other philosophical foundations in that its primary purpose is to free the individual learner from educational systems and oppressive political restraints (Elias & Merriam, 1995). Conforming within strict authoritarian structures, individuals are limited to explore and learn in their own capacity. Radicalism seeks a revolutionary change from a capitalistic society to a socialist form of government. This orientation is different from progressivists who believe in personal autonomy, but within an encompassing democratic process. A proponent of radicalism, Paulo Freire (1970) views education as a process of social reform.

Upon the brief review of the six philosophical foundations of education, it is possible to see that much of occupational training programs are grounded within the behaviorist theory. Because of the inherent importance of safety education programs,
specifically those that have the primary purpose to train and instruct, the behaviorist orientation is especially valuable in developing curriculum.

*Foundations of Curriculum Development Utilizing the Behaviorist Theory*

Behaviorism has made an impact in education through curriculum design and program development processes. A significant model that has influenced curriculum planning in the U.S. is that of Ralph Tyler. Tyler viewed the education process as an activity that “changes the behavior patterns of people” (1949, p. 5). Through clearly defined purposes, specific objectives, and a measurable evaluation of performance, Tyler advocated a standardized model for designing instructional units. In the Tyler rationale, four basic questions can be asked during the curriculum development phase: (a) What educational purposes should be sought, (b) What educational experiences can be provided that are likely to attain these purposes, (c) How can these experiences be effectively organized, and (d) How can we determine whether these purposes are being attained? Answering these procedural questions allows the curriculum designer to progress through the curriculum development process in a step-wise fashion, from selection of educational purposes and determination of experiences to the organization of these experiences and finally the evaluation of learning outcomes.

Inspired by Ralph Tyler, Benjamin Bloom, a noted scholar of teaching and learning, together with his colleagues, constructed a classification system for educational objectives (Bloom, 1956). Their focus included three taxonomies in the cognitive, affective and psychomotor domains. The cognitive domain includes objectives that focus on recall or recognition of knowledge and the overall development of intellectual abilities and skills.
The affective domain includes objectives that describe changes in interest, attitudes, and values. The psychomotor domain includes objectives that develop manipulative or motor skill abilities. Derived from the Gestalt philosophy where complex behaviors develop from simpler behaviors, Bloom’s Taxonomy views the educational process as a hierarchical process, where simple cognitive skills precede complex learning skills. The taxonomy is organized into six major classes: (a) knowledge, (b) comprehension, (c) application, (d) analysis, (e) synthesis, and (f) evaluation (Bloom, 1987).

Similar to Bloom, Pratt (1994) identifies learning objectives by their type. He focuses on a classification system that reflects the importance of human life. Associating human functions of knowing, thinking, acting, feeling, growing, experiencing, and being, Pratt uses six objective classifications labeled knowledge, skills, somatic objectives, attitudes, process objectives, and experiences. Pratt contends these objectives serve more as a state of being, rather than specific behaviors to be enacted. He purports the pedagogical purpose of classifying objectives in this manner is to signal the teacher that different instructional techniques may be needed with different objectives (Pratt, 1994).

Pratt (1994) describes four conditions for an effective curriculum; they include clarity of intent, declaration of rationale, use of aims, and clearly written objectives. With no prescribed chain of progression, designers can include these elements as they create curricula. Aims are written to provide a general structure for the instructional unit, and a rationale justifies the needed resources to accomplish the aim. Objectives provide the road map to guide the learning process and provide a premise for evaluation. Finally, clarity is woven throughout the curriculum to clarify educational intentions for the learners.
In Bloom’s (1987) model, students may learn simple behaviors or concepts of type A during one lesson, behaviors AB in the next lesson, and type ABC in another lesson. In order to be successful, students must master type A before progressing to a more complex behavior of AB. Using this explanation, it is understandable that behaviors in type A are not linear to behaviors in type AB rather, they are exponential. The sum of the whole is larger than the independent parts of A and B.

Competency-based education (CBE) programs incorporate behaviorism theory in that learning takes place when there is an observable and measurable change in behavior. CBE programs are specific in identification of goals and objectives, the learning activities required to meet such goals, and the method of evaluation used to measure the predetermined goals (Elias & Merriam, 1995). Utilizing criterion-referenced measures, students are evaluated based on their acquisition of skills or knowledge. Through this method, competition between learners is de-emphasized and cooperation is enhanced. All students, given sufficient time and appropriate reinforcements, have the potential to accomplish the course objectives.

CBE programs have been the primary focus for vocational education programs, continuing education programs, and occupational training programs. The competency-based curriculum was effective between the periods of 1960 – 1990 in setting standards for achievement in the vocational agriculture programs, especially those in engineering disciplines (Ohio Department of Education, 2005). This framework provided accountability in the programs as well as prepared students for the occupational workforce.

Critics of the behaviorist theory contend that learning is a process, and instruction is not simply an end to a mean. Elias and Merriam (1995) insist that behaviorism has “forced
students into the same mold and fragmented curriculum into bits and pieces while overlooking the whole” (p. 96). However, theorists who support the behavioristic viewpoint argue that such educational strategies allow for learners to (a) begin instruction at their level of knowledge and experience with course content, (b) be flexible in the amount of time they spend mastering competency, (c) vary the instructional methods needed to accomplish competency, (d) be evaluated against criterion-referenced standards, and (e) support the mechanism of self-directed learning (Elias & Merriam, 1995).

The behaviorist model provides a theoretical framework for competency-based education. In developing new curriculum to train or instruct students, especially for occupational settings, curriculum developers can be guided by the principles set forth by early behaviorist proponents. The foundation of their theory begins with well-stated goals and objectives followed by specific, measurable competencies that conform to the level of taxonomy created by the instruction.

Within occupational training programs, and more specifically the Tractor and Machinery Certification program, it is essential that the behaviorist perspective is evident, both to the trainer and trainee. Understanding the expected outcomes of a certification course assists the trainer in teaching relevant subject material, as well as explains to the student the criterion for achievement.

Curriculum Development of the Tractor and Machinery Certification Program

In terms of developing curriculum for the Tractor and Machinery Certification program, no national standards exist for what constitutes a sound educational format. Clearly established goals and program objectives are not articulated in the current
standards. Criteria for student achievement are stated in the legislation that the student will pass a written exam and successfully drive a tractor and two-wheeled implement through an obstacle course. If the implicit program objectives are safety education, then certainly the curriculum should reflect articulated goals and objectives for student learners. Educational strategies to achieve a desired level of mastery must be the focus of current and future certification curricula.

To address this gap in instructional materials, several attempts to establish better curriculum criteria have been made, and only a few have been published. Each of the nationally funded tractor certification programs underwent an initial process to identify course competencies prior to the development of their materials. The NIOSH-sponsored program utilized a Nominal Group process with a panel of agricultural representatives to reach consensus on a set of researcher-identified competencies for tractor and machinery certification (Ortega et al., 2003). In their process, the research team reviewed curricula developed by the 4-H Tractor program, HOBAR Publications, and Deere and Company to elicit the first group of potential competencies. A panel of experts reviewed and modified the comprehensive list; confirmation and validation of these items were then sought from high school educators participating in a professional development activity (n=34) and 4-H youth attending an engineering contest (n=79) to confirm the findings of the panel. In their study, a set of 170 competencies was organized into 12 units to effectively guide them in writing the curriculum, *Gearing Up for Safety* (Purdue University, 2004). At the time of this writing, the list of 170 competencies referenced in their curriculum is unpublished.
Similarly the USDA-CSREES sponsored project, “National Safe Tractor and Machinery Operation Program” working under grant initiatives of HOSTA (Hazardous Occupations Safety Training in Agriculture, 2004), convened a panel of higher education agricultural safety specialists from three land-grant universities. Under the direction of the USDA-CSREES Program Supervisor of Processing, Engineering and Technology, the panel identified minimum core content areas for training youth younger than age 16 who wish to receive tractor and/or machinery certification. Rather than an exhaustive list of competencies, the panel identified the essential subject matter to be included in any training program designed to prepare youth for employment in agricultural operations, as described in the Hazardous Occupations Order in Agriculture. Based on the three areas addressed in the statute, three core competency areas where identified: Tractor-Related Operations, Machinery-Related Operations, and General Health and Safety Operation. The panel went on to establish testing parameters for the tractor and machinery certification program, making recommendations that a student be tested in a sequential order from least to highest risk. The committee set a minimum pass rate of 70% and stipulated that students could not progress through the testing process until each level satisfied the 70% achievement rate. The steps of the linear testing process included (a) written exam, (b) pre-operational check, (c) operating skills (drive forward/backward and simple machine hook-up), and (d) driving skills (drive a tractor and 2-wheeled implement through a course) (NSTMOP Program Guidelines, 2004). These guidelines were implemented in a pilot project conducted under the auspices of the USDA-CSREES grant.
Beyond the *Gearing Up for Safety* and *HOSTA* curricula, it is possible that other local instructional materials are available for use with the Tractor and Machinery Certification program. Without knowledge of other potential curricula in published catalogs or research literature, their process of curriculum development is unknown. And because national standards are not clearly identified for the Tractor and Machinery Certification program, it is possible for multiple interpretations to exist at the state and local levels of instruction. For without clearly identified goals and objectives of what the certification program should accomplish, instructors are free to interpret and interject topics they feel are important, without regard to standardized criteria.

While sound educational materials are a major component of the Tractor and Machinery Certification program, other programmatic factors may play a role in the successful delivery of the educational training. Administering a program investigation may determine the other variables and their influence on the safety training. According to Patton (1982), the underlying rationale for conducting a program evaluation is to methodically collect information about the activities, products, personnel, or outcomes of a specific program in order to reduce uncertainties, improve effectiveness, and make decisions. To appreciate all of the inputs, outputs, and benefits of a national program, like the Tractor and Machinery Certification program, it is first necessary to have a fundamental understanding of the process called program development.

**Components of Program Development**

Programming is a comprehensive process used in education that encompasses the planning, implementation, and evaluation of planned efforts (Boone, 1985). As a
dynamic and proactive process, program development is focused on the primary goal of behavior change. This change may be designated as change within the learners or change within a system. The components of program development includes needs assessment of learners, educational psychology in relation to the teaching-learning processes, curriculum development and its association with pedagogy, and finally evaluation and its connection to documenting accountability.

A cohort of popular programming models includes those classical models presented by Lippitt, Watson and Westley (1958); Beal, Blount, Powers and Johnson (1966); Knowles (1970); Tyler (1971); Boone, Dolan, and Shearon (1971); Kidd (1973); and Boyle (1981). More recently, approaches to program development have been identified by Cervero and Wilson (1994); Houle (1996); Sork (2000); Caffarella (2002); and Boone, Safrit, and Jones (2002). While each model has its unique attributes in terms of scope and audience context, each approach possess similar elements in that they (a) define a need or problem, (b) set goals and objectives, (c) involve some form (formal or informal) of learning activity, and (d) apply evaluation strategies, either implicitly or explicitly (Boone, Safrit, and Jones, 2002).

The term program theory is used to describe the underlying components and relationships of the prescribed elements within program development models. Such theory makes up the contents of what Lipsey (1987) appropriately calls the black box evaluation. Program theory is the “proposition regarding what goes on in the black box during the transformation of input and output” (p. 7). Understanding what happens within a program from beginning to end is important to program developers; however, Bickman (1987) contends that it is also important to understand what happens during a
program that makes it work. Examining the causative factors underlying the program process is the basis of program theory. Program developers are encouraged to incorporate deliberate measures to not only determine inputs and outcomes, but to also evaluate the implementation strategies used in the delivery of such programs.

Analyzing the development progression, Boone and his colleagues (2002) contend there are three essential interrelated sub-processes within program development: (a) planning, (b) design and implementation, and (c) evaluation and accountability. Each sub-process entails thoughtful preparation and development from the program planner.

Planning is a crucial first step to the success of any program. Specific and deliberate efforts must be undertaken to understand the needs of the publics utilizing the program. Boone et al. (2002) included the rationale behind these processes to include an analysis of organizational function and structure, identification of target audiences and leaders, and interaction with collaborators to identify and assess educational needs within the publics served by the program.

The focus of the second sub-process in the conceptual programming model is design and implementation. Utilizing three inter-related components, Boone et al. (2002) suggested the following activities occur: (a) an analysis of expressed needs be translated into hierarchies of program needs and objectives, (b) a timeline be prepared for execution of the program elements, and (c) educational strategies for delivery and implementation be enacted for the planned program.

The final component of Boone et al.’s (2002) programming model includes the evaluation dimension, which is represented as a continuous macro feedback loop from input to output and back to input. The accountability of a program is made evident to the
program’s publics, including the learners and their instructors, the educational organization, sponsor agencies, the profession, and any governance body. Such program outcomes are necessary and warranted for revision, refinement, and renewal of the program process.

From an educational context, program evaluation is the process of judging the worth or value of an educational program (Caffarella, 2002). The intent of the process is quite simply to indicate whether a design or particular delivery method was successful in meeting the proposed goals. A program evaluator will employ research methods and concepts from various disciplines like psychology, sociology, education, and policy administration in order to contribute to the improvement of programs (Posavac & Carey, 1997).

According to Wholey, Hatry, and Newcomer (1994), several obstacles exist for program evaluators of public programs. Four general problems include: (a) lack of agreement on the goals, objectives, side effects, and performance criteria to be used in evaluating the problem; (b) program goals and objectives that are unrealistic given the resources that have been committed to the program and program activities that are under way; (c) unavailability of relevant information on program performance; and (d) inability of policymakers or managers to act on the basis of evaluation information (p. 37).

The fact that the Tractor and Machinery Certification program has been in existence for 37 years with no documented program review indicates a gap in the program development process. Inside the black box of the Tractor Certification program, several factors should be considered. Besides evaluation of antiquated curriculum, there may be additional areas in need of modernization with regards to today’s agricultural
workplace, types of equipment youth operate, and youth skills required for entry-level employment in agriculture. Furthermore, the needs of local instructors beg the attention of state leaders and federal decision makers. The availability of a certification course relies solely upon local instructors. Factors that may affect these instructors’ ability to provide a course may include their awareness of the federal certification program requirements, their amount of administrative support, their available time and flexibility to address additional subject matter outside of their state performance standards, their opportunity to secure the agricultural equipment required for the training, and finally, their need for in-service training.

A comprehensive program plan would begin to identify the multitude of needs represented by multiple user groups of the Tractor and Machinery Certification program. The complexity of such a task would require significant resources, contributions from various stakeholders, and research commitment. Such thorough investigation would be possible, however, like so many other efforts in agricultural safety and health, true application of program theory is rarely applied.

*Examination of Agricultural Safety Programs*

In the context of agricultural safety programs as a whole, few comprehensive evaluation efforts exist. In their systematic review of farm safety intervention research, DeRoo and Rautianinen (2000) found only 25 studies of relevance, and 16 of those actually fit the criteria of possessing an evaluation component. While there are many educational programs and safety-related outputs, including fact sheets, brochures, videos, public service announcements (PSAs), and demonstrations (Murphy, 1992), evaluation of
these efforts is rarely undertaken, and often mismatched in documenting effectiveness. Murphy (2003) stated, “Historically, the emphasis in extension safety education has been on the doing of safety education, rather than the evaluation of it” (p. 30).

During the *Childhood Agricultural Injury Prevention Symposium* of 1992 conducted in Wisconsin, recommendations were given for evaluating educational programs (Lee & Gunderson, 1992). The guidelines included: (a) conduct comprehensive, systematic evaluations of the effectiveness of existing farm safety and health education programs in minimizing injury and disease among children; (b) determine the validity of the assumption that labor laws influence safe practices and appropriate work assignments and whether laws might reduce risk of injury to children on farms; (c) emphasize the importance of careful process and impact evaluation of farm safety intervention programs designed for youth; and (d) establish guidelines for evaluation of the quality of educational materials, including program cost-effectiveness and training techniques.

Based on a review of salient studies, Murphy, Kiernan, and Chapman (1996) reported no valid studies were found to document a farm safety or health program that resulted in a long-term gain in knowledge, cognition, or inherent risks; changes in behavior; or reduction of farm hazards. Studies by Hill, May, Coppolo and Jenkins (1993), Lehtola (1993), Murphy (1985), Schwab and Miller (1993) and Wilkinson, Schuler, and Skjolaas (1993) have found a positive effect of safety training programs, including tractor safety knowledge and safe behavior practices (as cited in Murphy et al., 1996). Others studies by Reisenberg and Bear (1980), Silletto (1976), and William (1983) have found no effect of such programs on knowledge and behavior (as cited in Murphy et al., 1996).
Studies of the Tractor and Machinery Certification Program

With regards to the Tractor and Machinery Certification program, no national studies for effectiveness have been documented since legislative inception of the Hazardous Occupations Order in Agriculture in 1968. However, according to Rossi, Freeman, and Lipsey (1999), the benefit of an evaluation assessment is that a systematic process can be utilized to describe the program and determine if it is doing what it purports to accomplish. A pioneer effort to evaluate the Ohio Tractor and Machinery Certification program was conducted by Emory and Ferguson (1980). This study found a statistical difference on demonstrated safety behaviors between students who completed the tractor safety course and those who were not enrolled in the program. However, there were some instances where behavioral change by students was not evident after taking the Tractor Certification and/or Tractor and Machinery Certification course.

A frequently cited evaluation of the Wisconsin certification courses found the youth involved in the safety training were more likely to carry extra riders on tractors as well as operate tractors without Roll-Over Protective Structures (ROPS) (Wilkinson, Schuler, & Skjolaas, 1993). While the research team offered a plausible explanation for the delinquent safety practices, certified youth had more opportunity to work on farm operations with other youth employees and non-ROPS tractors, their findings were corroborated by parent testimony; less than two-thirds of the youths’ parents felt that the program helped improve the safety behaviors of their children. Parents did feel strongly that their children had higher safety knowledge (95.1%), improved equipment operation and maintenance knowledge (89.0%), and operated tractors and equipment in a safer manner (81.9%) as a result of the certification program.
An Indiana study, Carrabba et al. (2000), measured the impact of the Indiana 4-H Tractor Program on such variables as safe tractor operating behavior and safety attitude. Their results showed a perceived and demonstrable positive influence on Indiana 4-H Tractor Program participants, as well as an increased ability to recognize hazards and self-report close call incidents. Both the Wisconsin and Indiana reports cited the need for additional research to understand the complex issues involved with young farm workers and their perceptions of safe behaviors. The Indiana report made a strong recommendation for curriculum updates and additional training and resources for volunteer leaders. The Wisconsin study recommended a standardization of the program as well as increased training opportunities for the instructors.

These findings were congruent with those in the Yarosh (1993) report, where recommendations were made for improvement in both teaching materials and delivery methods. Wilkins (2001) attempted to estimate enrollment potential; the results revealed only 1% of Ohio’s youth who qualified for the Tractor Certification and/or Tractor and Machinery Certification courses were actually enrolled in the program. This low percentage of student participation indicated multiple concerns for safety education specialists. First, there was an obvious gap in program awareness, which negatively affects program enrollment and may ultimately reduced program availability. Concurrently, the study demonstrated the need for revised curriculum objectives to match youths’ educational and employment objectives.

The rationale behind the Hazardous Occupations Order in Agriculture was to insure safety programs were in place and available for youth wishing to work outside of their family farm operation. Limited documented evidence exists that the target audience
for these programs is being served by the educational training, or that the programs are still functioning in the manner appropriated by the legislation (Wilkins, 2001; Yarosh, 1993).

The magnitude of evaluating the structural process of the Tractor and Machinery Certification program lies in the amalgamation between the Cooperative Extension Service and Departments of Education. Each organization has its unique contributions and deficiencies in coordinating tractor and/or machinery certification for youth. And each of these attributes will be different between, as well as within, geographic regions. No two communities are exactly the same in their demographic profile of students, educators (formal and non-formal), administrators, or agricultural commodities. At best, a national program evaluation will be able to report discrepancies in youth enrollment statistics reported to USDA-CSREES, explain variation in certification format and create a forum for future implications of returning to one centrally managed, national program.

Summary of Literature Review

Youth are on farms for a variety or reasons. It is the complexity of the home-work environment that makes injury prevention efforts difficult for public health and safety officials. Due to the nature of farming, it is impractical to eliminate young people from the work site, and likewise from the culture. However, a substantial number of youth experience injuries as a result of their interaction with hazardous environments.

Guidelines have been established to protect youth who work in agricultural operations. Under the Fair Labor Standards Act, the Hazardous Occupations Order in Agriculture set limits for youth employment on farms. Eleven occupational classes were
deemed hazardous for youth below the age of 16 years; several of these included tractor and machinery operation. However, a training exemption, commonly known as the Tractor and Machinery Certification program, was established for 14 and 15 year olds who wished to work for hire.

Since its inception, the Tractor and Machinery Certification program has received little attention, neither in curriculum resources, instructor training, nor financial support. Likewise, many communities have progressed away from production agricultural practices leaving the student clientele of this program in the minority. Large corporate farm structures have also eroded the need for the program, in that many operations do not hire youth to operate the equipment. However, the statistics continue to weigh in against agriculture. Children are routinely killed or seriously injured when they are involved in agricultural operations, and the tractor has been associated with 45% of those fatal injuries. Participating in a training program, youth receive instruction on safety education, which may help them while working in hazardous environments or on dangerous equipment. Yet having a training program in place, like the Tractor and Machinery Certification program, does not ensure behavior change; and even more evident with this program, having the training available does not elicit instructors offering the course or students participating in the offered course.

Studies have documented the need for up-dated training materials. Developing new curricula would require concentrated efforts from safety specialists, educational experts, and public policy officials. Given that the underlying premise of the behaviorist model is to change behavior, safety curriculum should contain observable and measurable objectives, ones that have the potential to shape or change attitude and safety behavior. To document
student achievement, it is expected that students demonstrate knowledge as well as skills learned.

However, at the current time, there are no national standards to evaluate student performance for the national Tractor and Machinery Certification program. Certification training programs exist throughout the nation, but are not managed as a unified program. Course instructors at the community level are empowered to develop their own training and performance standards. Such variability makes the certification program flexible for instructors, but inconsistent for student learners and hiring employers. Before impact of this certification program can be determined, a well-defined needs assessment and agreed-upon program objectives must be in place.

To date, research–based conceptual models in agricultural safety and health have been nebulous. While program development models are available for planners, the application of such models in agricultural safety programming is rarely followed in the strict sense from planning to design, and implementation to evaluation. Applying a conceptual program model to the national Tractor and Machinery Certification program would reveal the assumptions, concepts, and limitations of a national program. Investigating the macro processes of program development would stimulate interest in the target publics, the funding sources, the profession of occupational safety, and the governance body.

Conceptual Framework

To date, no formal investigation of the national Tractor and Machinery Certification program has been undertaken. This study attempts to establish a frame of
reference for understanding course objectives, student enrollment, instructor perceptions and overall general guidelines of the certification program. The study further seeks identification of basic core competencies necessary for youth to be certified after participation in a Tractor and Machinery Certification program, independent of geographic region, teacher pedagogy, or curriculum resources.

The schematic outline of the Tractor and Machinery Certification program’s conceptual framework is presented in Figure 2.4. Structured similar to Maslow’s (1943) Hierarchy of Needs, the reduction of injury to youth tractor operators is grounded on public policy and elevated through educational efforts towards reaching the target student audience. In order for legislation to be effective, it relies upon sound components within the model. Each level provides support to the higher elements, and each component should be stable before progression can be made to the next level. Youth cannot make strides towards safe practices without the impact of an effective educational program; if such a program is based on a faulty structure, one with no available instructors to teach, an out-dated curriculum, or an un-enforced public policy, then the value of this program is seriously comprised and questioned.
GOAL: To reach youth working in hazardous agricultural occupations with safety education training to ultimately reduce injury and increase quality of life

Figure 2.4: Conceptual framework of the Hazardous Occupations Order in Agriculture
CHAPTER 3
METHODS

This chapter provides a brief overview of the qualitative and quantitative research approaches used in this study that led to the overall design. Additional topics addressed in the chapter are research design, sample selection, data collection, and data analysis for five independent phases of the research process. Two research phases utilized qualitative techniques, two phases drew upon quantitative methods, and one phase involved unobtrusive data collection through existing records.

This research project involved multiple techniques to convey the complexity of the national Tractor and Machinery Certification program. Using a multi-method approach, the researcher used a wide-angle lens to report a holistic description of the program. While not always practical to include both quantitative and qualitative approaches in social science research, the benefits usually outweigh the costs in the end. When a research project can demonstrate a particular finding through different methods, the data is said to be “corroborated” (Johnson & Christensen, 2000), a goal of this investigation.
Purpose of the Study

The national Tractor and Machinery Certification program is unique to the geographic region in which it is taught. It was important to document enrollment numbers, training variations, types of instructors, and curriculum available in the nation to teach the certification courses. Understanding the changing nature of agricultural occupations and the educational fundamentals of this widely adaptive program was a crucial step in the evaluation process. Policy makers and agricultural safety specialists must have clear insight into the program structure, knowledge of instructor demographics, and awareness of student participation rate in order for future decision-making or resource allocation to occur. To provide this baseline information, the researcher employed a multifaceted data collection approach and was guided by a list of research objectives.

Objectives of the Study

The objectives of the study were to:

1. Determine the program’s youth enrollment status over a five-year period, as reflected in the USDA-CSREES reporting system;
2. Identify attributes of the Tractor and Machinery Certification program offered in various geographic regions and stakeholders’ perspective on the need for program improvement;
3. Describe perceived objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be
certified after participation in such a program, as identified by agricultural safety professionals;

4. Quantify the number of instructors offering the program in each state according to their certifying agency: USDA-CSREES Extension Service and the United States Department of Education vocational agricultural programs;

5. Describe the type of certification, Tractor or Tractor and Machinery, offered by the certifying agency including the number of educational hours: 10-, 15-, 20-, 24-, or 25-hours;

6. Identify teaching methods and curriculum resources used in the certification program by community-based instructors;

7. Examine community instructors’ perceptions and management styles of the Tractor and Machinery Certification program; and

8. Determine program objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by community-based instructors.

Research Design

This study employed a combination of descriptive research techniques, including focus groups, a modified-Delphi technique, survey research, and secondary data sources to achieve a comprehensive assessment of the national Tractor and Machinery Certification program. Using mixed-mode methods, the researcher strengthened the
confidence in the results in the effort to answer the fundamental question, “What is the current status of the Tractor and Machinery Certification program in the United States?”

The primary objectives driving the study were inquiring into the nature, incidence, and distribution of variables involving the Tractor and Machinery Certification program. The findings are meant to guide future policy makers, curriculum developers, and prevention educators towards critical or unmet needs of the program.

The researcher addressed eight research objectives through a series of independent investigations. Unobtrusive data collection techniques were used to answer Objective 1 to determine the program’s youth enrollment status over a five-year period, as reflected in the USDA-CSREES reporting system. Two forms of qualitative research methods were used at initial stages of the investigation to address Objectives 2 and 3. Quantitative research was used in the final investigative stages to answer the remaining objectives. To answer Objectives 4 and 5, state program leaders of the Cooperative Extension Service and Departments of Education were surveyed to determine the number of instructors offering courses in each state of the nation, as well as the type of certification offered. To answer Objectives 6, 7, and 8, community Extension educators and secondary school vocational agricultural teachers were surveyed to identify methods and curriculum resources used in their local programs, as well as additional curricular needed to teach effective programs.

Unobtrusive Data Collection

Unobtrusive data collection methods were used to answer Objective 1 to describe the Tractor and Machinery Certification program’s youth enrollment status over a five-
year period. This method involves the acquisition and analysis of existing documents, databases, or artifacts without the actual participants’ knowledge. Examples of these types of data sources include public archival records, private records, physical trace evidence, and contrived observation through audio or video tapes (Johnson & Christensen, 2004; Worthen & Sanders, 1987). Within educational research, other unobtrusive data collection methods can include attendance records, disciplinary actions, grade reports, and drop-out rates (Metfessel & Michael, 1967); data collection of this nature is generally objective in that it describes a situation without human reporting bias. Johnson and Christensen (2004) also include archived research data as a possible data source; these data sets are collected by other researchers or sources, often for purposes other than the current research objectives. However, unobtrusive data collection has the tendency to be unreliable in that records could be inaccurately reported to the collection agency or erroneously entered into the databases. Worthen and Sanders (1987) warn researchers utilizing this technique to “never base a conclusion on just one (unobtrusive) measurement” (p. 312).

Qualitative Research Methods

This research project utilized two qualitative methods to address the research objectives. Focus group interviews were used in Objective 2: Identify attributes of the Tractor and Machinery Certification program offered in various geographic regions and stakeholder’s perspective on the need for program improvement. A modified-Delphi technique was used in Objective 3: Describe perceived objectives of the Tractor and
Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program.

Qualitative methods are particularly valuable for examining programs. As programs are decentralized from their administrative core, they begin to take on important differences based on geographic location, conditions of support, instructor characteristics, and clientele participation. While the nature of these variations cannot be fully predicted, they can be described using a naturalistic, qualitative approach. Such process allows for open, unanticipated findings, and elicits data sets void of predetermined variables (Patton, 1987).

Qualitative research methods are particularly oriented towards exploration, discovery, and inductive logic. Inductive reasoning begins with specific observations and migrates towards general patterns. Dimensions for analysis emerge from open-ended data the evaluator collects and synthesizes along the way to discovery. This approach differs from the hypothetical-deductive approach found in experimental designs in that specific hypotheses and measurable variables are not defined prior to the data collection process. Qualitative analysis is guided by a series of questions, issues, or a search for patterns, and not research hypotheses (Patton, 1987).

The qualitative research approach usually takes place over a period of time. Data can be collected concurrently with several groups of people or through cycles where the researcher learns from one group and then continues to collect additional data. Johnson and Christensen (2004) view qualitative research as a general term, and categorized five basic areas as being the most popular: phenomenology, ethnography, case study, grounded theory, and historical research; these same authors discuss the six primary types
of data collection methods used by educational researchers as (a) tests, (b) questionnaires, (c) interviews, (d) focus groups, (e) observation, and (f) secondary data. Typical with mixed-method research designs, a study will include two or more methods of data acquisition. The two methods used to collect qualitative data in this investigation include focus group interviews and the Delphi technique.

*Focus Group Interview*

To address Objective 2, the researcher utilized focus group interviews. Commonly used in market research where clients’ opinions are important to the sustainability of a product, focus group interviews are a research method for gathering experiences and perceptions on a target population. Focus groups can be used in a multitude of evaluation applications, and have gained much popularity since their inception in the 1950’s (Patton, 1987).

Focus groups are not designed to develop a consensus about the topic, service, or product under investigation, nor are they appropriate to arrive at an agreeable plan or decide which course of action to take (Krueger, 1994). Focus groups pay attention to the feelings and perceptions of the users or stakeholders of the products or services and allow insight to their needs. According to Morgan and Krueger (1993), focus group research is the most efficient and effective tool for understanding the success or failure of a particular program in a specific setting.

Morgan and Krueger (1993) outlined five situations where focus groups methods were advantageous to both the researcher and the interaction among participants:

1. When there is a power differential between participants and decision makers.
2. When there is a gap between professionals and their target audience.
3. When investigating complex behavior and motivations.

4. To learn more about the degree of consensus on a topic.

5. When a friendly research method is needed to show respect and not be condescending to the target audience.

Witkin and Altschuld (1995) contend that focus groups are an essential component of assessing the needs of an organization. The needs assessment phase of the research is “conducted to derive information and perceptions of values as a guide to making policy and program decisions that will benefit a specific group of people” (p. 5). The majority of time spent during a needs assessment is used to identify and measure the level of unmet needs within an organization, community, or educational program.

As the name implies, a needs assessment is a systematic approach that progresses through a defined series of phases (Witkin & Altschuld, 1995). Needs assessments have the functional purpose of setting priorities and determining criteria for solutions so that administrators can make justifiable decisions; they also set criteria for determining resource allocation, which includes money, people, facilities, and other resources. Needs assessments will also lead to action; this action is what the public sees as improvement. Improvements in a program can include better services, products, organizational structure, policy, or operational guidelines.

Delphi Technique

To address Objective 3, the researcher used a modified-Delphi technique. The Delphi technique is a method for eliciting and applying systematic opinion on a given research topic. Through a set of carefully designed, sequential questions, experts are able
to provide opinions and modify such opinions in future rounds of questioning. The process continues until the panel reaches consensus. Since the Delphi does not require face-to-face contact, experts have the opportunity to be frank and truthful with their remarks and opinions.

The Delphi technique originated at the Rand Corporation in the late 1940’s. The original studies forecasted likely scenarios related to national defense issues; panels of experts provided opinions about possible courses of action by other nations related to the U.S. defense system (Dalkey, 1969; Dalkey, Rourke, Lewis, & Snyder, 1972; Helmer, 1967). While the pioneers of this methodology include Dalkey, Helmer, Gordon, and Kaplan, applications have expanded into a variety of research fields used for forecasting, planning, predicting, and problem solving (Dalkey, 1972; Delbecq, Van de Ven, & Gustafson, 1975; Turoff, 1971; Weaver, 1972). Delbecq et al. (1975) applied this technique to a multitude of administrative and program planning issues; still others found the technique useful for curriculum development, goal setting, policy determination, program development, and issue clarification (Bell, 1997; Cyphert & Gant, 1971; Judd, 1972; Linstone & Turoff, 1975; Skutsch, 1972; Ulschak, 1983; Weaver, 1972; Ziglio, 1996).

The Delphi technique can be best described as a problem-solving or idea-generating strategy in research methodology. It is designed to allow anonymity, controlled feedback, and a statistical representation of pooled responses (Dalkey et al., 1972). In a world where administrators and professional planners require input or judgment from outside sources, the Delphi can bring multiple user groups and expert opinion together under one mission. This technique has gained popularity in recent years
and when used in planned settings, can achieve a number of objectives (Delbecq, Van de Ven, & Gustafson, 1975):

1. To determine or develop a range of possible program alternatives;
2. To explore or expose underlying assumptions or information leading to different judgments;
3. To seek out information which may generate a consensus on the part of the respondent group;
4. To correlate informed judgments on a topic spanning a wide range of disciplines;
5. To educate the respondent group as to the diverse and interrelated aspects of the topic.

**Quantitative Research Methods**

This research project utilized quantitative research methods to address the remaining research objectives, Objectives 4 through 8. Quantitative collection processes take large sources of data and condense it into a manageable package to make sense, describe a condition, make inferences, or show relationships and trends. Many of these events are classified into predetermined, standardized categories, all of which are summarized with numerical values (Smith & Lincoln, 1984). Within education, the most common quantitative method is the survey (Fraenkel & Wallen, 1996). Survey research allows the researcher to summarize substantial information or characteristics of people and/or conditions.
Survey Research

Survey research, also commonly referred to as status studies or normative studies, has the primary objective of exploring or describing an entity or problem (Fraenkel & Wallen, 1996). Through this method, the researcher gathers data from a fairly large population using a mail (in this case an electronic mail) questionnaire. Survey research does not investigate relationships between variables or makes predictions about those relationships, but rather describes conditions as they exist at that point of time.

Research Methods

This study employed multiple descriptive research techniques to portray the status of the Tractor and Machinery Certification program in the United States at the turn of the twenty-first century. Within each investigative phase, data collection strategies were employed suitable to the research method. A description of each process is presented for each of the eight research objectives.

Objective 1:

*Describe the program’s youth enrollment status over a five-year period, as reflected in the USDA-CSREES reporting system*

4-H, the youth program division of USDA-CSREES, produces the National 4-H Enrollment Summary report each year to describe demographic information on their nearly 7 million participants. This widely distributed report is available in print or electronic format. It is distributed to both internal and external Extension partners. As prescribed in the Government Performance Review Act (GPRA) Goal 5, *Enhanced*
Economic Opportunity and Quality of Life Among Americans, all 4-H program areas are reported. The number of youth participants is registered according to their participation in Extension-sponsored educational efforts; this registration includes all students, not just those who have the label 4-H.

All state and local projects are counted in the comprehensive report according to curriculum categories. The Tractor and Machinery Certification program is included in the 4-H Safety curriculum category, and is classified EEF. Other areas that fall under the Safety curriculum category include ATV Safety, Automotive Safety (which includes seat belts), Bicycle Safety, Communities for Child Safety, and Emergency Preparedness.

Tractor certification data is also collected by USDA-CSREES through the Agricultural and Natural Resources (AGNR) Program area of the Cooperative Extension Service. Under the leadership of Bradley K. Rein, the CSREES National Program Supervisor for Processing, Engineering, and Technology, a Farm Safety Database is maintained to record the number of youth participating in the Tractor and Machinery Certification program each year. Such enrollment numbers have been collected since 1998. Unlike the 4-H Program data that includes multiple input sources, the Farm Safety Database only contains student participation rates known by the AGNR Program Leaders in each state, usually with consultation of the State Safety Leaders.

Data Collection

Data reports were obtained from the 4-H Program Area using the EEF category of the published National 4-H Enrollment Summary report for the past five years, 1999 – 2003. Youth enrollment numbers were prepared in a table format for the five-year period.
Data were obtained from the AGNR Program Area of USDA-CSREES through unpublished reports from the Farm Safety Database. A request was made to the CSREES Program Coordinator, and approval was received by the CSREES Program Supervisor to have access to the collected certification records for the past five years, 1999-2003.

Participation rate within both data sources were classified by state and USDA region. These numbers were useful throughout the research project as reference points when communicating with state program leaders and instructors.

Objective 2:
Identify attributes of the Tractor and Machinery Certification program offered in various geographic regions and stakeholders’ perspective on the need for program improvement

Selection of Focus Group Participants

A series of eight regional focus groups were conducted in the United States. Regional variations of agricultural operations were considered as states were selected for their particular area. Figure 3.5 depicts the geographic zones established by the researcher. Within the established zones, every state had an equal opportunity to provide representation to the focus group meetings.
Regional focus groups had the potential to have up to 10 participants. Using a lottery system, states were randomly selected to provide a certain type of participant; the participant types were farmers and employers of youth working in agriculture operations, parents of youth engaged in agricultural work, machinery dealers, high school agricultural educators, county extension agents, extension safety specialists, and Farm Bureau safety directors. Although it was possible that one state could provide all participants for that particular region, this did not occur.

Within participant types, population frames were constructed using organizational directories and personal contacts of those within the directories. A telephone and/or e-
mail message was delivered to each frame in the eight zones to identify possible participants, as well as to assist the researcher in selecting a homogenous sample of persons familiar with the Tractor and Machinery Certification program (Appendix A). During the telephone pre-screening, candidates were invited to participate in their respective regional focus group. After the pre-screening invitation, a written letter was sent to all focus group participants (Appendix B). The letter confirmed the invitation, gave the time and date of the focus group, and provided a map to the hotel facility. The individual communication allowed for personalization of the study and was congruent with the focus group interactions that were to follow.

The focus group interviews were conducted in all eight zones between March 6 and April 17, 2002. Locations were selected based on central airports and hotel facilities. Because many participants did not know each other, an evening meal was provided for the opportunity to become acquainted before the interviews began.

**Instrumentation**

For the sake of the focus group discussion, 14 questions were identified (Appendix C). The questions were designed to ask the participants about their experience with the tractor and machinery certification program in a non-threatening manner. Standardized open-ended questions were selected to allow for more discussion among the participants.

At the conclusion of each focus group session, participants received a questionnaire to collect certain demographic information about their occupation and roles of participation within the tractor and machinery certification program (Appendix D). There was a space available for participants to provide written comments about the focus
group process or to make additional comments that may not have been stated during the interview process.

Validity and Reliability

Content validity of the focus group discussion guide was established by a panel of experts. The panel reviewed the questions for (a) content and clarity, (b) wording, and (c) length of instrument for a two-hour focus group setting. The panel consisted of three federal Extension employees serving at land-grant universities: Dr. Thomas Bean of The Ohio State University, Dr. Dennis Murphy from Penn State University, and Dr. Richard Clark of University of Illinois. Two individuals were familiar with health and safety programmatic and management issues, while the third specialized in youth program development and served as a state Extension director.

The first focus group served as the instruments’ field test. After conducting the initial session, consideration was given to room arrangements, instrument clarity, and moderating procedures. Additional information about the tasks considered hazardous according to the Hazardous Occupations Order was asked of the first group, and amended into the first question in every group thereafter. Data acquired from the field test group was used in the final analysis of all focus group sessions.

Eight focus groups were scheduled, in order to address reliability. Repetitions of focus groups in various agricultural regions allowed for discrepancies to surface and at the same time establish reliability in the test instrument.

Data Collection

Within the confines of this study the researcher made every attempt to facilitate interaction among focus group participants, while at the same time maintaining
objectivity. Several techniques were used to ensure research perceptions were accurate and reflective of reality:

1. The researcher was responsible for facilitating the eight focus groups. The primary role of the moderator was to concentrate on asking the questions in a similar fashion as the other groups, following up on main ideas and making a smooth transition from one question to another. A secondary responsibility was to monitor group interaction and dynamics of conversation. An assistant moderator was available at each location but was not always the same person. The assistant moderator’s main role was to assist the moderator with note taking and audio taping responsibilities. This person also served as a technical resource if questions were asked about the Certification program during the interview process.

2. One informant’s description was checked against another informant’s description. The focus group interviews by nature encourage dialogue and sharing of experiences, something that is not available in other types of data collection techniques.

3. There was an understanding of the vocabulary and characteristics of the sampled group. In this case, both the moderator and assistant moderators had intimate knowledge of the program characteristics and the types of persons involved with the teaching participating in the certification process.

4. Audio tapes helped the researcher track communication of participants and make sense of any comments that were unusual or incorrect when the data were
Data Analysis

All focus group interview data were audio recorded and transcribed by an outside contractor. The researcher compiled transcripts from all eight groups and utilized NUD*IST N6 Software, a statistical package for qualitative data (QSR N6, 2002).

Common in inductive data analysis, the transcriptions underwent two simultaneous processes to uncover embedded information, coding and categorizing (Lincoln & Guba, 1985). Coding is the process of labeling key words for the software package to isolate during analysis. Coded units could include words or phrases that re-occurred during the focus group interviews. Categorization is the process of uncovering emerging themes from the text-rich data sets. Scanning the transcripts for code words, the N6 software categorizes the data into manageable segments that contain similar ideas. During this processes the researcher interpreted the filed data sets, making the responses explicit.

Objective 3:
Describe perceived objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as determined by a panel of experts

Selection of Delphi Participants

The Delphi is a survey technique for making decisions between isolated, anonymous participants. The panel of experts must feel personally involved in the topic, have the time to commit to the lengthy project, have pertinent information to share, and
feel they can gain from the experience with information that would have not be available to them otherwise (Delbecq et al., 1975).

Determining the number of experts needed to serve in a qualitative, purposeful sample such as the Delphi panel should be based on the purpose and rationale of the study (Patton, 1990). Large Delphi panels are used when the study involves increasing group understanding or gaining group support; smaller populations are used in exploratory research or where decision-making is a priority. With a homogenous group of people, 10 to 15 panelists are recommended (Delbecq et al., 1975). These same researchers indicate that few new ideas emerge within homogeneous groups larger than 30 participants.

Although they are called experts, the panel merely represents a group of informed participants. The validity of the panel is represented by the knowledge and experience they bring to the process, not by the number of people reporting the information.

In this research project, the experts were selected based on their knowledge of the national Tractor and Machinery Certification program, including the history of the legislation, the condition of existing curriculum, the operational components of the certification process, the type and competency of instructors and program volunteers, as well as the traditional demographic type of student participants. The pool of panelists were selected from the directory of the National Institute for Farm Safety (NIFS), a professional organization dedicated to providing leadership in preventing agricultural injuries. The researcher identified 15 individuals around the U.S. who met the knowledge-based criteria of the program.
Determining an adequate sample size in qualitative research is subject to researcher specifications. Time and financial resources are two primary considerations for panel selections. In this case, time was the critical component for determining the number of panelist responses the researcher could adequately manage in the timeline presented. Since the inquiry format was structured as open-ended questions, there was potential for a high number of qualitative responses. After consultation, the researcher condensed the panel size to 10 participants (Appendix E).

In March 2003, the identified experts were contacted by telephone requesting their participation in the study. One participant declined the offer, based solely on time limitations, not interest in the research topic. Another participant declined based on a conflict of interest with a sponsor relation. Replacement participants were identified for the two vacancies. During the telephone interview, the researcher informed the panelists of the qualitative research objectives, read the two questions that would be used in the discussion, explained the timeline and expected length of time the process would take, and described the electronic process expected to be used in collecting data. Several participants were unfamiliar with the Delphi technique, so additional time was spent explaining this type of research method. Contact information printed in the current 2003 NIFS directory was verified with each participant. Panel members also shared dates they would not be available to allow flexibility in determining the best time to commence the project. Following the telephone interview, participants were sent a letter of invitation to participate in the research project (Appendix F).

One week prior to the project’s start, a confirmation e-mail was sent to each participant, reiterating the process and project timeline, as well as to test the accuracy of
the e-mail address the researcher would use in the study (Appendix G). Since e-mail communication would be used to disseminate questions and collect qualitative data, it was crucial that the researcher had an accurate Internet address, and that the participant could reply back to the researcher’s listserv. In this introductory e-mail, the names and affiliations of all panelists were shared with the group. Because the majority of panelists were well acquainted based on their participation in the national organization, no other introductory comments or biographies were shared. Participants were told their comments would not be associated with their names, but rather as collective answers to the posed question. Given the low sensitivity of the topic, and the enthusiasm for creating a new foundation for the national Tractor and Machinery Certification program, the researcher did not feel the panelists would be worried about their comments being linked back to a particular individual. Hence there was no need for code names to be used in the data collection process.

*Instrumentation*

Since the national Tractor and Machinery Certification program is a one-size-fits-all program used in outreach education and vocational agricultural classrooms around the country, it was necessary to answer fundamental questions about the nature and intent of the program. The primary objective of the Delphi process was to flesh out perceived overarching objectives of the DOL program as well as to identify core competencies and skills youth could demonstrate after participation in such a course. Based on these two objectives, three open-ended questions were formulated: (a) what is (are) the primary objective(s) of the Tractor and Machinery Certification program; (b) should the Tractor and Machinery Certification program be based on hours of program participation,
performance of competency, or a combination of both; and (c) what are the basic competencies that every student should possess after completion of the Tractor and Machinery Certification program?

Validity and Reliability

Content and face validity of the three questions was obtained through a two-person review panel of Dr. Thomas Bean and Dr. Dennis Murphy. The panel was informed of the research objectives; they were asked to review the questions for clarity and content to achieve the stated objectives. The Delphi technique is unique in that it does not lend itself to typical validity measures, like its quantitative counterpart surveys. Within this Delphi process, neither construct validity, criterion related validity, population validity, nor ecological validity were considered in instrument development.

Similarly, reliability coefficients are difficult to establish when expert panels are used in the Delphi process (Sackman, 1975). Reliability is conventionally associated with test-re-test stability, as well as measurement over time with different user groups. The process of repeating the test instrument with the same group of experts after an elapsed period of time would be seriously limited by the amount of time such experts could afford from their professional schedules. Likewise, using the same instrument with different panelists could produce inconsistent results.

The methodological shortcoming of establishing a reliability coefficient was considered by the researcher during the design process. Hence, consideration of the modified-Delphi approach was warranted. The modification included the use of another population (i.e., the local instructors) to help confirm reliability for this method.
Data Collection

The researcher structured the Delphi rounds to occur once a week. Using electronic mail, the participants were sent Question 1 on Wednesday of the first week. The panelists had time to contemplate and respond to the question by Tuesday of the following week, giving time for thoughtful consideration. Responses were collectively organized and re-distributed by the researcher the following day. Panelists continued to receive weekly Wednesday e-mails reporting the group’s efforts. It was originally anticipated that each question could conceivably take three rounds; however, questions reached consensus earlier than planned. Data collection began on Wednesday, March 12, 2003; subsequent rounds followed each Wednesday for the next 5 weeks, finishing the process on April 18, 2003.

By design, the computer-incorporated response mechanism allowed for more efficient distribution of the questionnaire. In today’s society, electronic mail is an accepted, and often preferred, method of communication. As responses from each round were received, they were copied into a Microsoft® Word 10.0 document for easy formatting. If jury members identified similar concepts, the ideas were tabulated and reported as a repeat. It was not uncommon for multiple panelists to identify similar concepts.

In the initial round, the instrument contained two questions (Appendix H). Question 1 asked panelists to identify the primary objectives of the Tractor and Machinery Certification program. They were able to list more than one objective, but no more than five. The second question asked panelists if they believed the certification
program should be based on hours of participation, performance of competency, or a combination of both.

In the second and third rounds, panelists’ opinions were listed in unedited format and reviewed for agreement. Ten objectives were initially identified for Question 1; but after additional deliberation, one objective became the overarching goal of the program, and eight objectives became supporting objectives to this goal. Such deliberations were reviewed in rounds three and four until a consensus was reached. Likewise, results and comments from Question 2 were shared with the panel during two rounds of discussion.

In Round 4, panelists had the opportunity to see the progression of earlier rounds; they were also asked their final question (Appendix I). The last task of the panel was to identify basic competencies that every student should possess after completion of the Tractor and Machinery Certification program. Similar to the earlier questions, the task to identify competencies was conducted over two rounds. Consensus was not an objective of this question; rather, it was important for the researcher that youth competencies be identified. Plans for consensus were to be addressed in a survey to community instructors.

Data Analysis

The nature of the Delphi technique was to produce comprehensive thoughts and opinions on a designated topic. Data sets were collected every week for six weeks; common themes were summarized. Each week the panel received an organized summary of pooled answers from the previous week. All responses were treated confidentially in that they were aggregated into one Microsoft® Word 10.0 document. The panelists had
the opportunity to revise statements from earlier rounds and make suggestions on the pooled data sets. The rounds continued for six weeks.

The researcher refers to this phase of investigation as a modified-Delphi technique in that panelists’ did not have to reach a consensus for Questions 2 or 3. Although it was possible to have continuing rounds of deliberation, Martino (1972) suggested additional rounds would not yield sufficient new data to justify the time or energy of panelists. Rather, the intent of this Delphi process was to elicit the foundation for what would be later validated or refuted by instructors of the Tractor and Machinery Certification program.

Objective 4:
Quantify the number of instructors offering the program in each state according to their certifying agency: USDA-CSREES Extension Service and the United States Office of Education vocational agricultural programs

The qualitative steps taken prior to survey development assisted the researcher in understanding some of the complex issues surrounding the national program. The focus group data from Objective 2 provided the framework for establishing the subsequent instrumentation. In this objective, inquiry of state program leaders, the researcher began using survey research methods to gain a more specific understanding of the Tractor and Machinery Certification program within each state of the nation.

Population and Subject Selection

The Code of Federal Regulations specifies two agencies as sources for Tractor and Machinery Certification, Extension and vocational agricultural education programs. Within each agency, there are two types of populations, those who provide programmatic
administration at the state level, and those who teach the program at the community level. The unique character of the two populations’ roles in the course necessitated independent surveys. It was likely that state program leaders would have a more global opinion about the Certification course, and would know little of the implementation obstacles at the community level. Likewise, the local instructors would be the best source for identifying curriculum gaps and/or outdated guidelines in program delivery methods.

 Appropriately, state program leaders providing administrative support to the educators in the community would be candidates for inquiry to address Objective 4. The survey population could include 105 state program leaders, one representative from Extension and one representative from vocational agricultural for each of the 50 states; an additional 5 leaders could include those state Extension leaders in the five U.S. territories.

 All land-grant universities in the United States have an appointed Agricultural Safety Specialist, although this person may not hold a full-time appointment; it is understood that this person has knowledge of the safety programs in his/her state, including the Tractor and Machinery Certification program and its guidelines (B. Rein, personal communication, October 23, 2002). While the certification program may not be actively managed by these specialists, they are generally aware of the program’s fundamental structure. USDA-CSREES maintains a directory of appointed agricultural safety specialists in a listing entitled Farm Safety State Contacts. This directory was accessed in April 2004 to provide a sampling frame of 50 Farm Safety Specialists, one per state. In addition, there were contacts for the five U.S. territories of American Samoa, Micronesia, Northern Marianas, Puerto Rico, and the Virgin Islands. These additional five specialists were added to the Extension population. All farm safety
contacts in the states and territories were asked to complete the survey instrument; however the researcher learned the Hazardous Occupations Order in Agriculture was a legislative entity unknown to the Farm Safety Contacts in the U.S. territories. All island contacts reported no tractor certification programs in their respective regions. After consultation with the USDA-CSREES Program Supervisor, the data collected from these United States territories were not used for further inquiry. Therefore, the farm safety Extension population was back to 50 people, one per state.

Likewise all U.S. states have a State Department of Education, with a staff member assigned to coordinate the vocational agricultural program. A national directory, the *Agricultural Education State Leader List*, was accessed in May 2004 to provide the sample frame of 50 State Leader Key Contacts.

*Instrumentation*

The researcher used two different instruments in this component of the study. One instrument was used with Extension specialists and the other with state vocational agricultural education administrators. The survey questions were syntactically identical, but varied in agency descriptive contexts of the program. Because each agency, Extension and Department of Education, uses different titles for educators in their programs, it was appropriate to reference their organizational job titles accurately. Therefore questions varied in word references to organizational educators. The Extension specialist survey is included in Appendix J.

The 8-item instrument gathered agency information about the types of tractor and machinery certification programs available in their state. The first question asked program leaders to identify the possible types of instruction offered by their educators.
The option types included: (a) educators TEACH the Department of Labor (DOL) Tractor and Machinery Certification Program and ISSUE the DOL certificates of training; (b) educators TEACH the Department of Labor (DOL) Tractor and Machinery Certification Program but DO NOT ISSUE the DOL certificates of training; (c) educators SUPPORT the Department of Labor (DOL) Tractor and Machinery Certification Program by either providing educational materials or assist with the teaching in the classroom or on the driving course; and (d) educators TEACH general tractor and machinery safety programs, but these trainings ARE NOT Department of Labor (DOL) certification program. It was possible for all of these offerings to be available in each state; therefore, program leaders indicated YES, NO, or DON’T KNOW after each course type.

State program leaders were asked their opinion of how the instructional leadership of the Tractor and Machinery Certification program was conducted. Three questions were asked related to the certification agencies. Leaders indicated either YES or NO, as to whether the current agencies, Extension and vocational agricultural programs, should be the sole agencies responsible for certifying youth. A second question asked leaders to indicate either YES or NO as to whether other agencies, organizations or businesses were qualified to teach the tractor and machinery certification program. If leaders answered YES, the follow-up question asked them to identify these other individuals. State program leaders were also asked their opinions as to whether the DOL Tractor and Machinery Certification program could be available as a self-study program.

An open-ended question allowed state leaders to identify instructors in their respective state who taught tractor and machinery certification courses. Responses from this question created a population of local course instructors in Extension and vocational training.
agricultural programs. This directory was used in later quantitative phases of data
collection.

Validity and Reliability

A two-person panel of Dr. Thomas Bean, from The Ohio State University, and
Dr. Sam Steel, from the National Safety Council reviewed the survey instrument for
content validity. The panelists suggested that not all state program leaders would be able
to provide the information sought; but the consensus was to proceed, recognizing there
may be missing data fields.

Selecting a random sample of state level administrators for instrument validity
measures was not possible. Since all U.S. state safety specialists and all vocational
agricultural education administrators were included in the population, it was not feasible
to use them in a field test. Consequently, no preliminary testing was performed.
Likewise, no pilot test for reliability was conducted.

Data Collection

Actual survey administration was performed through an on-line survey program
called Zoomerang®. This process facilitated an effective approach to survey deployment,
data collection, and coding of results. The benefit of this electronic survey tool was it
provided the researcher with real-time monitoring of survey completions, and allowed for
easy management of non-responders.

Consideration was given to administrators’ time and busy schedules. The survey
instrument was not lengthy, but required a thoughtful response. Using the streamlined
effectiveness of the electronic age, the researcher used e-mail as the delivery mechanism
for survey communications. In today’s era, the majority of educational administrators use
electronic technology, both for efficiency and flexibility; some research suggests organizations have better information systems and higher success communicating organizational goals when administrators utilize e-mail systems (Kraut & Attewell, 1997).

Following Dillman’s (2000) electronic design approach, an e-mail letter was sent to all state program leaders requesting them to complete the on-line survey (Appendix K). Once the leaders accessed the electronic survey, they were again presented with a web greeting (Appendix L). After seven business days, non-responders received an automatic reminder message launched from the Zoomerang® program. A third contact was made directly by the researcher (Appendix M), using the organizational address and not a Zoomerang® return address; this personal attempt was made in case the receivers did not recognize the website address of Zoomerang® and considered the message junk or spam mail. The fourth contact was by telephone. Program leaders who had not responded by e-mail were verbally contacted to finalize data collection. The importance of receiving all state contact information was for both the documentation of the agency’s certification status, as well as creating a population frame for the later phase of survey research.

Data Analysis

Data were coded and entered into a Microsoft® Excel 10.0 worksheet and then converted to an SPSS 11.0© data file for analysis. Contingency tables of the descriptive statistics were created by agency, Extension and vocational agriculture, as well as collectively by geographic region of the United States.

Responses from open-ended questions were not treated as quantitative data. A Microsoft® Word 10.0 document was created to list the other agencies suggested to assist
with the teaching of the DOL course, and a Microsoft® Excel 10.0 spreadsheet allowed for easy management of directory data.

Collection of Objectives 5, 6, 7, and 8

The four remaining objectives were designed for use with the local instructors. This final phase of data collection was guided by the following research objectives:

Objective 5: Describe the type of certification, Tractor or Tractor and Machinery, offered by the certifying agency including the number of educational hours: 10-, 15-, 20-, 24-, or 25-hours;

Objective 6: Identify teaching methods and curriculum resources used in the certification program by community-based instructors;

Objective 7: Examine community instructors’ perceptions and management styles of the Tractor and Machinery Certification program; and

Objective 8: Determine program objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by community-based instructors.

Population and Subject Selection

Because there is no national registry of Tractor and Machinery Certification instructors, or a mechanism to track them through an agency’s reporting system, the researcher relied upon state-level informants to provide the target population for this investigative phase. The researcher took careful measures to construct this population directory, reviewing names provided by state program leaders from the earlier phase.

As described in the previous method section for state program leaders, two state agencies per state were asked to provide a list of potential instructors of the Tractor and Machinery Certification program. From that data, 185 instructors were identified.
Several states filed reports indicating no available instructors, neither in Extension nor vocational agricultural education. In several states, the instructor population was unknown by the state administrator. In these states, program leaders sent an e-mail message to their educators on their states’ respective listserv seeking educators of tractor safety programs. By taking this approach, the researcher felt confident additional instructors would be identified. This additional step, in states with uncertain state leaders, increased the population frame to 467 instructors.

Working with the state program leaders in Extension and vocational agriculture education, the target population of potential teachers was considered as complete as possible. Although it would have been possible to sample within this group of instructors, a decision was made to include all possible participants. The nature of the inquiry was to describe the national certification program. Therefore, the researcher did not want to limit the responses to a certain number of participants. Such limitation may have excluded information on policy or geographic regional influences on the program. With regards to potential curriculum development and competency identification, data collection from a census not only incorporates all opinions, it also assists in consensus building when a new product is delivered.

To encourage survey participation, an incentive was provided (Dillman, 2000). When field test participants were asked an appropriate incentive, $5 cash was a popular choice. However, after reviewing the reviewers’ comments and adjusting the survey instrument to include all Delphi and focus group data, the researcher believed $10 was more appropriate for the amount of data being collected from busy educators.
Instrumentation

The survey was comprised of 43 questions, and was segmented into three broad categories (Appendix N). While the respondent was unaware of the implicit segments, the three categories are Description of Local Instructor’s Certification Course, Instructor’s Opinions of the Programmatic Structure of the Certification Course, and Expected Student Competencies after Participation in a Certification Course.

Description of local instructor’s certification course. The first section of the survey contained 22 questions to gather descriptive data about the type of tractor and machinery certification courses offered by the instructors. Demographic variables and course characteristics included: (a) type of certification program taught, (b) identification of agency through which the certification was administered, (c) course fee structure, (d) number of instructional and driving hours associated with course, (e) number of students enrolled, (f) ages of students enrolled, (g) type of final exam including minimum percent to passing, (h) primary course book, (i) number of years instructor has taught certification courses, (j) instructor’s occupational relationship to agriculture, (k) instructor’s age, (l) instructor’s experience with tractor and machinery trainings, (m) instructor’s childhood experience in agriculture, and (n) instructor’s awareness of national curriculum recently released.

Instructor’s opinions of the programmatic structure of the certification course. The second section of the instrument was designed to collect instructors’ opinions about the program’s effectiveness as well as instructors’ ability to offer the Tractor and Machinery Certification program. Instructors were also asked what they believed to be
the goal and objectives of the DOL Tractor and Machinery Certification program. This section was comprised of ten questions.

A 3-item Likert-style scale was used to determine the magnitude of external influences on the instructor’s ability to offer a certification program. Instructors were asked to rate their ability to offer a Tractor and Machinery Certification program according to the variables: (a) number of youth interested in taking the course, (b) support from administration, agricultural employers and the community to offer a course, (c) funding, (d) teaching resources and availability of agricultural equipment, (e) instructor time, and (f) legislative enforcement of the current law. Participants could answer for each variable: definitely affects my ability to offer a program, somewhat affects my ability to offer a program, and never affects my ability to offer a program.

A ranking question allowed the instructors to select the top three issues that would increase the effectiveness of the certification program; twelve options were available, of which the instructors could choose three. The twelve items included: (a) increase the number of hours for course requirements, (b) decrease the number of hours for course requirements, (c) increase instructors’ access to teaching resources, (d) provide additional learning activities for students, (e) standardize the teaching materials, (f) standardize the testing requirements, (g) allow students the ability to take a self-study course, (h) coordinate in-service training for instructors, (i) increase the number of instructors available to offer the course, (j) increase community awareness of the program, (k) create employer support for the program, and (l) enforce the legislation.

The survey instrument included questions about appropriate teaching aids for the certification course. From a list of 11 teaching aids, instructors were asked to identify any
and all that were considered effective in enhancing student learning. The teaching aids included textbooks, student workbooks, slide presentations, overhead transparencies, flip charts, hands-on activities, guest lectures, video tapes, DVD’s, computer assisted instruction, and on-line computer instructional activities.

Discussions from the focus group sessions identified areas of strengths and weakness of Tractor and Machinery Certification programs. Since focus group results are not generalized back to any larger population than the group that participated in the sessions, the researcher took the opportunity to incorporate the qualitative results into the survey instrument for corroboration by the local instructors. This one survey item was divided into 19 sub-questions about the instructors’ ability to offer a certification course. The series of opinion-related questions included: (a) the course is beneficial for students, (b) students take the course seriously, (c) students should be assessed a fee for receiving safety training, (d) students should be assessed a fee for receiving certification credentials, (e) up-to-date teaching materials are available to instruct this course, (f) additional teaching aids should be developed for this course, (g) homework is appropriate for this course, (h) this course could be offered in its entirety as a self-study program, (i) portions of this course could be offered as a self-study program, (j) the course is only beneficial to students when led by an instructor, (k) the written test should meet nationally identified standards, (l) the skill/driving test should meet nationally identified standards, (m) the required course hours identified by law, for both Extension and vocational agricultural programs, are sufficient to adequately teach a safety training program, (n) instructor’s experience of tractor and machinery operation should be enough to teach the certification course, (o) instructors should be expected to complete a formal
train-the-trainer program in order to teach the certification course to youth, (p) the program should no longer be offered, (q) the program has potential to attract many more students than what it currently reaches, and (r) the program could attract new youth audiences, like those in landscaping and horticultural services. Using a Likert-type scale, the instructors could rate each item as: (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly Agree.

Similar to using the focus group data in instrument development, the researcher also utilized the Delphi results. The responses elicited from the expert panel in Objective 3 were now presented to the local instructors of the certification program. These Delphi questions related to training requirements and identification of the certification program’s goals and objectives.

So, according to the Delphi data, training requirements were an area of interest for the researcher to explore. Currently the legislation prescribes a required number of training hours for each of the certification types. Instructors were asked to select the basis of a Tractor and Machinery Certification program based on three options: (a) hours of participation (the current law), (b) performance of competency, and (c) a combination between hours of participation and competency.

Another Delphi-based question involved course objectives. The Tractor and Machinery Certification program has been in the legislation since 1968, however, the implicit curriculum was developed and used years prior to legislation. Curriculum goals and objectives, while they seem intuitive, are not explicitly stated and disseminated. Through their rounds of deliberation, the panel of agricultural safety experts generated a list of eight possible program objectives. The survey instrument presented these
objectives to the instructors to inquire whether they are in agreement that these are objectives of the national program. For each of the eight objectives, instructors simply chose Yes or No next to each intended objective.

*Expected student competencies after participation in a certification course.*

During the Delphi process, the panel of safety experts created and deliberated over 117 youth skills and competencies. This colossal list of competencies was grouped by the researcher into three categories of General Safety and Health (contained 18 competencies), Tractor-Related (contained 77 competencies), and Machinery-Related (contained 22 competencies). Instructors reviewed all Delphi-generated competencies and assigned a value to each skill coded as: (1) not important, (2) slightly important, (3) moderately important, (4) highly important, and (5) critically important. Appendix N contains the complete list of youth competencies. A sample of competency questions included the youth should be able to (a) recognize common hazards of older equipment and their deficiencies of safety equipment, (b) safely connect/disconnect a PTO driveline, and (c) identify harmful workplace hazards and suggest specific corrective actions during a walk-around inspection.

The results of the modified-Delphi technique were incorporated into the survey instrument for the primary reason to validate the panel of experts’ opinions with course instructors’ opinions. Sackmann (1975) discounted the sole reliance of an expert panel to validate scientific findings; and therefore the opinions of the instructors (basically the target group of program resources), was a valuable step in the validation process. Course instructors, because of their interaction with youth, local agricultural employers, and the
curriculum, were in the best position to corroborate course objectives and expected youth competencies.

*Validity and Reliability*

This final phase of the investigation allowed the researcher to develop a survey instrument, one that would produce reliable information that was valid and relevant to the questions being asked.

*Validity.*

An instrument is considered valid when it measures what is intended to be measured (Fraenkel & Wallen, 1996). The significant concern for internal validity in designing the questionnaire was the presence and degree of measurement error. Poorly worded questions had the potential to create non-random error; therefore it was important to state questions clearly so that individual respondents could make accurate interpretation of the questions being asked and eliminate any ambiguity or double meaning of the questions. To appropriately minimize this source of error, to the extent possible, the researcher was guided by qualitative findings from both the focus groups and Delphi technique.

Another research strategy to control measurement error was to submit the instrument for field-testing. For this process, the researcher selected 15 instructors from Ohio; this pool was comprised of both Extension and vocational agricultural educators. These educators evaluated the questionnaire for face validity and suitability for community instructors. Their suggestions and clarifications were incorporated into the instrument.
Reliability.

A survey instrument is considered reliable when repeated measurements, using the same procedures, yield dependable, consistent, and stable data sets (Nunnally, 1967). A pilot test was conducted on the survey instrument to ensure the responses were consistent and reliable. Using the test-re-test method 16 educators, half vocational agricultural teachers and the other half Extension educators, completed the survey two different times. The test-re-test method is widely used in the development of new surveys (Garson, 2006). The Spearman Brown statistic is used to establish reliability when estimations are made based on correlations between pairs of scores from the same people on two different administrations of the same test (Cohen & Swerdlik, 2002). Comparing data from Time 1 to Time 2 allowed the researcher to calculate a reliability coefficient for nine topic areas of interest within the DOL program. The reliability coefficients ranged from .962 to .660 for 8 out of the 9 topic areas. The ninth area, factors that influence instructors’ ability to offer a DOL course (6 items), had a reliability coefficient of .414. This area should be viewed cautiously. However, the researcher included the findings since the lower reliability coefficient may be a result of the narrow 3-item Likert-style scale.

Data Collection Procedures

Similar to the state program leader survey, the instructor survey was administered through Zoomerang®, a web-based survey program. The benefit of using an electronic format for this national survey was the time- and cost-saving benefits for the researcher. Archer (2003) described such benefits as elimination of paper, postage, and data entry
costs; ease of following up with non-responders; and transformation of raw data into a data analysis program.

Following Dillman’s (2000) approach to electronic surveys, an e-mail letter was sent to instructors requesting them to access the web-based survey (Appendix O). A hot link to the web site was included in each e-mail invitation, where instructors could simply click the link to enter survey. Once at the site, an introduction page greeted the instructors before they entered into the questions (Appendix P). Non-responders were sent electronic reminder messages 7 and 14 days following the initial invitation. If a third contact was needed, the researcher used her organizational e-mail account rather than the Zoomerang® automated messages to send a reminder message (Appendix Q). Through this approach, it was possible to detect e-mail messages that may have been blocked by firewalls. Phone calls to a sample of non-responders found several incorrect or outdated e-mail addresses; clarifications were made and new survey links were resent to those contacted by phone and qualified as a survey participant.

Data Analysis

After data were collected by the web-based survey program, they were converted into a Microsoft® Excel 10.0 spreadsheet. Data sets were then transferred to SPSS 11.0© for analysis. Descriptive statistics, means and frequencies, were computed. Contingency tables were created for each of the four objectives, which allowed straightforward comparisons between administering agencies’ educators as well as those who teach a DOL program, and those who teach a general safety program.
Institutional Review Board

Over the years of data collection involving human subjects, several institutional reviews were undertaken. The Institutional Review Boards at Penn State University and The Ohio State University reviewed the research methodologies at various times of the research process. These committees reviewed the proposal, survey instruments, and procedures. It was their opinion that components of this research project met the standards established by the universities. Protocol numbers PSU-18744, OSU-2004F0269, and OSU-2005E0095 were assigned to this comprehensive project.
CHAPTER 4
RESULTS

Purpose of the Study

It is important to document the national Tractor and Machinery Certification program as it exists at the turn of the twenty-first century. In the 37 years since legislation, the program has undergone limited, local review; no national investigation has been undertaken. This study documents several characteristics of the program, including student enrollment numbers for the past five years, stakeholder perspectives of the program, state leaders’ administrative understanding of the program, and local instructors’ perspectives of pedagogy, teaching resources, youth competencies, and programmatic structure. Establishing baseline data will provide policy makers with curricular evaluation as well as a better understanding of local needs for future improvement and resource allocation of the Tractor and Machinery Certification programs.

Unobtrusive Data Results

Objective 1:
Describe the program’s youth enrollment status over a five-year period
Two independent sources were queried to quantify student enrollment in the national Tractor and Machinery Certification program. While both databases are managed by USDA-CSREES, their sources are different. One collects data from the states’ 4-H Program Leaders and the other from the states’ Agricultural and Natural Resource (AGNR) Program Leaders. These data sets were collected annually from 1999 to 2003 to familiarize the researcher with the scope of the national program, and to help identify pockets of the nation with strong or weak program participation rates.

The National 4-H Enrollment Summary is an annual report provided each year by USDA-CSREES to describe demographic and program enrollment information on their nearly 7 million participants. Data reports for the classification code EEF are provided in Table 4.1 for the years 1999-2003. Participation is presented by state and U.S. region for each year. Over the past five years, an average of 16,180 youth have enrolled in the 4-H Safety curriculum category. Besides the Tractor and Machinery Certification program, other areas reported in the 4-H database under the same classification code include ATV Safety, Automotive Safety, Bicycle Safety, Communities for Child Safety and Emergency Preparedness.

The USDA Central Region reported the highest youth enrollment in the EEF category (40,443 participants) with the Southern Region second highest (35,649). The Eastern and Western Regions reported considerably lower enrollment numbers than the other regions, with 3,783 youth in the East and 1,027 youth participants in the West.

The states with the top five EEF enrollment rates in the Central Region were Iowa, Nebraska, Wisconsin, Illinois, and Ohio. Within the Southern Region, Tennessee, North Carolina, Alabama, Oklahoma, and Louisiana report the highest enrollment. States
in the Eastern Region with the highest EEF enrollment were New York, Maine, Vermont, and New Jersey. The two Western Region states with the highest enrollment included Oregon and Utah.

Table 4.1: EEF Curriculum Participation by States According to the USDA-CREES 4-H Program Leaders for the Years 1999 – 2003.
Table 4.1 (continued).

<table>
<thead>
<tr>
<th>States by USDA Region</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>Total</th>
</tr>
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<td>9,892</td>
<td>8,837</td>
<td>4,752</td>
<td>35,649</td>
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<td>346</td>
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<td>8</td>
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<td>1</td>
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<table>
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<th>190</th>
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<td>20</td>
</tr>
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<td>0</td>
</tr>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
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</tr>
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<td>0</td>
</tr>
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<td>5</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
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<td>0</td>
</tr>
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<td>25</td>
<td>224</td>
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<td>72</td>
<td>478</td>
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<td>106</td>
<td>106</td>
<td>71</td>
<td>469</td>
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<td>0</td>
<td>0</td>
<td>6</td>
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<td>Wyoming</td>
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<td>0</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

| United States         | 11,349| 18,322| 19,540| 19,173| 12,518| 80,902 |
Tractor and Machinery Certification program data are also collected by the USDA-CSREES Agricultural Program Areas in each state and reported annually to the Farm Safety Database. Youth certification numbers are reported by the AGNR Program Director, often with assistance from the State Safety Leader when such a position is available. Participation reports are internally prepared and utilized by the USDA-CSREES National Program Supervisor to monitor the DOL program. Data reports for the past five years are presented in Table 4.2.

The USDA Central Region reported the highest youth enrollment (13,611 participants) with the Southern Region second highest (5,422). The USDA Eastern and Western Regions reported considerably lower enrollment numbers than the other regions, with 2,864 youth in the East and only 819 youth participants in the West.

In the Central Region, states with the top five enrollment numbers were Wisconsin, Kansas, Nebraska, Wisconsin, Ohio, and Minnesota. Within the Southern Region, the only states reporting enrollment are Texas, Oklahoma, Virginia and Tennessee. States in the Eastern Region reporting enrollment were New York, Vermont, Pennsylvania, Maryland, Delaware and Maine. The five Western Region states with enrollment include Utah, Oregon, Washington, Arizona, and Idaho.
<table>
<thead>
<tr>
<th>State by USDA Region</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>612</td>
<td>681</td>
<td>470</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>District of Columbia</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>-</td>
<td>-</td>
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<td>0</td>
<td>60</td>
</tr>
<tr>
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</tr>
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<td>0</td>
<td>0</td>
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</tr>
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<td>0</td>
<td>0</td>
</tr>
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<td>350</td>
<td>277</td>
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</tr>
<tr>
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<td>-</td>
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<td>150</td>
<td>88</td>
<td>388</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>75</td>
<td>80</td>
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<tr>
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</tr>
<tr>
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<td>2,412</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>161</td>
<td>119</td>
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<td>531</td>
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<td>920</td>
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<td>900</td>
<td>800</td>
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*Note. A (-) indicates no data submitted. A (0) indicates a submitted value.*

(Table 4.2 continues)

Table 4.2: Tractor Certification Annual Enrollment According to the USDA-CSREES Farm Safety Database for the Years 1999 – 2003.
Table 4.2 (continued).

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<th>State by USDA Region</th>
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<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>Total</th>
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<td>0</td>
</tr>
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<td>0</td>
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</tr>
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<td>194</td>
<td>592</td>
</tr>
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</tr>
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<th>157</th>
<th>96</th>
<th>298</th>
<th>119</th>
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<td>0</td>
</tr>
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</tr>
</tbody>
</table>

United States        4,139 | 3,851 | 4,022 | 7,896 | 2,808 | 22,716 |

Note. A (-) indicates no data submitted. A (0) indicates a submitted value.
Comparisons can be observed in the two systems. Similar to participation status in the 4-H database, the USDA Central and Southern regions had higher youth enrollment in safety curricula than the Eastern and Western regions.

A noted variation is in enrollment status. This is explained by the broad classification within the EEF code. The 4-H report groups all safety curricular into one data field, and does not isolate DOL program participation from the other safety programs. Figure 4.6 visually highlights the magnitude of other safety-related programs represented in the EEF data, as compared to the AGNR report, which is only an account of the Tractor and Machinery Certification program.

![Figure 4.6. USDA-CSREES database comparisons between 4-H and AGNR](image-url)
Qualitative Data Results

Two independent research methods were designed to collect additional information about the Tractor and Machinery Certification program. Through these methods, opinions from stakeholders could be systematically collected and documented.

**Objective 2:**

*Identify attributes of the Tractor and Machinery Certification program offered in various geographic regions and stakeholders’ perspective on the need for program improvement*

Focus groups were one data collection method used to obtain qualitative information from various stakeholders of the Tractor and Machinery Certification program. Findings were systematically analyzed for each question of the moderator guide to provide insight into the participants’ attitudes and experiences with the Tractor and Machinery Certification program for the region they reside.

*Response Rate*

Geographic zones were established in an effort to provide a more homogeneous sample of participants according the agricultural practices of that area. Figure 4.7 summarizes the states and U.S. territories included in each zone.
Qualitative data were collected from 49 individuals within eight focus groups. Participants ranged in age from 26 – 71 years old, with the mean age of 56.35 years. Extension represented the largest type of participants (34.7%), while vocational agricultural teachers represented the next largest category (18.4%). Table 4.3 provides a breakdown of all participant types by zone.
Table 4.3: Categories of Participants by Zones.

<table>
<thead>
<tr>
<th>Zone</th>
<th>VoAg Instructor</th>
<th>Extension Educators</th>
<th>Machinery Dealer</th>
<th>Farm Bureau</th>
<th>Employer</th>
<th>Parent</th>
</tr>
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<tr>
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<td>1</td>
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<td>1</td>
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<td>Population</td>
<td>9</td>
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<td>5</td>
<td>7</td>
<td>6</td>
<td>5</td>
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<td>(n = 49)</td>
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<td></td>
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</tbody>
</table>

Table 4.4 presents information on participants’ occupation. Participants held a multitude of positions related to agriculture. Nearly half of the 49 participants were directly involved in owning or operating a farm (46.8%). As a child, 76.6% of the participants grew up on a farm, and 44.7% reported they still live on a farm.
<table>
<thead>
<tr>
<th>Occupation</th>
<th>N</th>
<th>Mean (years)</th>
<th>Range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS Teacher</td>
<td>16</td>
<td>13.00</td>
<td>2 – 35</td>
</tr>
<tr>
<td>Extension</td>
<td>20</td>
<td>16.28</td>
<td>2 – 30</td>
</tr>
<tr>
<td>Ag Business</td>
<td>16</td>
<td>17.38</td>
<td>3 – 37</td>
</tr>
<tr>
<td>Farm Bureau</td>
<td>7</td>
<td>15.81</td>
<td>1 – 30</td>
</tr>
<tr>
<td>Farm Owner/Operator</td>
<td>22</td>
<td>18.32</td>
<td>1 – 45</td>
</tr>
<tr>
<td>Parent</td>
<td>13</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* Participants could select any occupational relationship that applied; therefore participants could select more than one category.

Table 4.4: Occupation of Focus Group Participants.

**Results**

Three topic areas were examined during the qualitative analysis and were appropriately labeled: educational structure, student evaluation, and program marketing. These areas encapsulated the participant discussion and are presented independently, although the discussion was entwined throughout the data sets.

**Educational structure.** Each focus group began in the same manner, the moderator read from the Code of Federal Regulations the types of equipment and kinds of tasks deemed hazardous for youth 14 or 15 years old to perform, unless training was provided. Upon review of the legislation, focus group participants were asked to identify any agricultural equipment or tasks performed by 14 or 15 year olds in today’s farm environment that were not included in the original law written in 1968. Participant responses to this question were vigorous and lively at all interview sessions. Discussing the type of work performed by youth sometimes took 35 – 45 minutes. Similarities were
evident across focus groups for entry-level work performed on U.S. farms. Participants’ comments were aggregated by subject matter, and such topics were recorded as they were mentioned. No weight was given to any specific topic or the level of discussion it generated. Figure 4.8 combines topic areas generated by the participants from all eight zones.

This list represents a possible gap in the legislation. The types of tasks youth performed when the Hazardous Occupations Order in Agriculture was implemented in 1968 are different in today’s agricultural workplace. The focus group participants were familiar with the types of entry-level jobs young persons are asked to do. Machinery identified in the 1968 legislation included older-styled equipment no longer used by youth in the majority of agricultural operations, such as corn pickers and mobile pea viners. However, youth are currently operating smaller horse-powered tractors, combines, All-Terrain Vehicles (ATV’s), skid steer loaders, and larger lawn equipment; such equipment is not listed in the law.

Besides technology changes to equipment, young people also need training in basic farmstead hazards. With fewer opportunities to grow up on a farm, many youth are not as familiar with rudimentary agricultural practices. Learning about environmental hazards, livestock behaviors, and general safety concepts in a certification course may be their only opportunity to be instructed on the best management practices while working in agriculture. Likewise, if youth have never observed or worked closely beside an adult using various pieces of agricultural equipment, they have no frame of reference for proper respect of that equipment. Therefore, incorporating basic safety principles into the certification program was a common theme that emerged from all focus group regions.
Agricultural Equipment Operations and Tasks Performed by 14- and 15-Year Olds Not Originally Included in the Hazardous Occupations Order in Agriculture of 1968

- Tractors
  - even those under 20 horsepower
  - maintenance
  - brake systems
  - electronic systems
  - road travel
- Combines
- Skid steer loaders
- All Terrain Vehicles (ATV’s) and multi-purpose utility vehicles
- Irrigation equipment
- Bale stackers
- Mechanical harvesters
- Safe operation while working around canals and waterways
- Livestock
  - Medicinals
  - Equine
- Green Industry
  - Garden tractors
  - Dethatchers, string trimmers, and other equipment w/moving parts
  - Herbicides and pesticides
- Miscellaneous Topics
  - Ladder safety
  - Eye protection
  - Falls
  - Chainsaws
  - Working on icy surfaces
  - Heat stress
  - Hazardous environments, i.e., silos, grain bins, manure storage, animal confinement
  - Agricultural dusts and respirators

Figure 4.8: List generated by focus group participants identifying tasks, agricultural equipment, and safety topics that are not currently listed in the Hazardous Occupations Order in Agriculture
Participants were aware of the two current certifying organizations for the Tractor and Machinery Certification program, Extension and vocational agricultural programs. There were confirmations that these two organizations should continue to offer the program, however additional entities were identified as possible certifying agencies for the program. These include Farm Bureau organizations, machinery dealers, state labor industries, private consultants, junior colleges with agricultural programs, community and state agricultural groups, and volunteers or alumni of the program.

It was a general consensus that instructors possess some level of experience with agricultural equipment and program objectives. It was suggested at every regional meeting the instructor training could be accomplished through a train-the-trainer styled course. Comments from the focus group included:

“I think there needs to be guidelines for instructors… there are still individuals that have done it there own way, and there haven’t been really good guidelines for the 10- and 20-hour program… there is a lot of difference from one community to another… a train the trainer would help them know what is expected and the kinds of things they should be covering.”

“You can have a train-the-trainer certification like the WPS (Worker Protection Standard) had at one time.”

“I think whoever signs off on the certificate should have some sort of training.”

“But for me as a teacher, if I am going to have to do the certification for the children, I want to know what I am expected to do and I want to be trained.”

“I don’t think experience should be grandfathered in because of all the mistakes people keep making… there are certified baby seat installers… and you see that car seats are a lot less complex than a $150K tractor.”

In terms of how youth are taught in the certification course, several delivery modes were identified. The most popular choices included student workbook, slide sets,
videos, and CD-ROMs. Guest speakers and farm injury victims were also identified as effective resources for the program. Focus group participants provided details during the discussion including:

“If the book is done, it should have more pictures.”

“I think there does need to be a printed manual, and it probably has to be at an eighth grade reading level, or less.”

“It would be nice if the videos you knew where to send for them and so forth.”

“I have a lot of guest speakers come in. For example, a youth had lost an arm in a grain car. He’s twenty. He talks about what happened and the ramifications…”

Novel approaches to educational delivery included DVD movies and simulators. Several focus groups identified web-based or on-line instruction as positive delivery modes that could be accomplished with today’s technology. They shared comments like:

“Well I think too that either CD or web-based could work because that could individualize a lot of that 24-hour requirement.”

“Kids are very motivated by working on a computer and I think there are some possibilities there.”

“Well, if money were no object you could have tractor simulators. Jet pilots don’t get out in a $60 million dollar jet and fly around to learn. There are lots of options if… We always think about with all of our constraints of budgets and all these things, but if you look at a national program, maybe some of these things are more of a reality than you might think.”

Still there were others who did not agree with computer-based instruction. Opponents of computerized instruction shared their opinions with statements like:

“You can put anything in a computer that you can put in that book. It’s just pages, written stuff, and pictures. So if you want to do it on a computer, what’s the difference?”
“There are not many tractor drivers out there that have a computer at home. You need to be realistic on that.”

“The CD is a start, but they still need to be out there getting the hands-on experience.”

“I’m just biased against the idea of just using computer programs to replace workbooks and videotapes. It has to be done right… I don’t think you can just write this on a computer and have the kids go sit at a computer screen and look at this stuff. The best teaching stunt by a teacher is in front of the class and knows what is going on and can bring a lot of different experience to the table. So you have to have tractors there. You have to have movies of accidents. You have to have speaking, and unfortunately, you need some workbook that has information that they have to have.”

The majority of participants felt the course needed to be “instructor led.” Self-study instruction was discussed as a possible option, but that the students would still receive some level of personal instruction or guidance. Comments to support these feelings include:

“If we say tractor driving is something kids can do after our program, then they have to be able to get on a tractor.”

“A complete on-line program with no hands-on is not going to meet the objectives.”

“I think you are still having to, in the certification process, you still need to have the human element of the certified instructor out there that will get the feeling so to speak of the competency of the student on various things and I think that is important.”

“…part of this hours thing is that you are watching them and you are working with them in a teacher/student relationship”

“I think that hands-on training is absolutely imperative in knowing all the controls, the operation, and this kind of thing.”

“Maybe 20 years from now it (absentee instructors) is a possibility, but maybe you will be conducting this again in 20 years and we will be talking about virtual reality and training in a whole different fashion, but for right now I don’t see that.”
Proponents of a self-study course believed students could study educational materials on their own, and then attend an evaluation session to demonstrate their written and driving competencies for necessary certification. For example,

“A kid turns, I don’t know the age for him to get a driver’s license, but there is nothing that says I have to go and attend 20 hours worth of training before I get my license. I just have to know the material, take a test, and pass the test that is recommended by the state…then if I can pass the test studying in one hour, it is the same as another kid studying 20 hours…”

“Having an independent study would really be helpful… I know in more than a few counties now where it is difficult to either find the instructors that are willing and have the time… or you only got a few kids…”

“That is what I run into. I have got one person here and one person there…. And at different times of the year.”

There was no clear consensus to address course fees. Within individual focus groups, participants were often split in their opinions regarding course fees. Many programs charged a small fee to cover the costs of workbooks and refreshments, yet others utilized sponsorships to pay for coursework. Several participants alluded to “testing fees” rather than “program fees” as a possible way to generate revenue for the national program. The range of comments expressed during these discussions included:

“I feel there should be some monetary buy-in from the participant…whether its literature costs, test costs, or what…it doesn’t have to be a lot.”

“I don’t know how you could really make the fee high enough to make it meaningful…I think we’re going to have to be careful when we charge these kids…”

“They’ll pay for a hunting license; they’ll pay for a snowmobile license…”

“I subscribe to the fact that there is a need for a fee, but it can’t be set at a national level…it probably needs to be made at the local level.”
Summarizing the key themes in the topic area of educational structure, several patterns were revealed. The first was the general agreement the law does not currently include the types of equipment young workers are utilizing in agricultural operations. Technology in the agricultural industry has advanced at a pace faster than what is reflected in the law.

The second theme was the support for basic farmstead training. Young workers should have fundamental instruction on agricultural hazards, and the certification course is the appropriate venue for such instruction to occur. Background or no background in agricultural sciences, youth require occupational safety training. And as more young people enter the classroom without an up bringing in agriculture, their need for basic farmstead training increases.

Instructors’ agricultural knowledge and experience was a third theme identified in the educational structure topic area. There was a general consensus for Extension and vocational agricultural programs to continue offering the certification program, with a few additional agencies identified as potential sources for training. The most frequently cited supplementary sources had knowledge of agricultural operations and included Farm Bureau organizations, machinery dealers, junior colleges with agricultural programs, farm-related volunteers, and alumni of the certification program. Focus group participants felt it was always important for the instructors to possess some level of experience with agricultural equipment. It was also important for the instructors to understand the certification program’s objectives and processes for training youth.

It was important for the certification program to be led by an instructor, as opposed to a complete self-study course. This fourth theme emerged in all regions.
Participants consistently supported the fact that qualified instructors were important for student learning, especially during the hands-on portion.

A diversified collection of curriculum resources was identified to assist instructors through the training course. With the unanimous agreement that the course handbook was out of date, participants identified a variety of delivery modes for use within the training program. Such ideas were important for the researcher to uncover through the focus group interviews, and were later incorporated into the survey administered to community course instructors. The same holds true for the topic area of program fees; no theme emerged, yet the discussion was important for researcher understanding.

*Student evaluation.* Besides educational structure, another topic discussed in the focus groups was student evaluation. In accordance with the current legislation, participants felt favorably about the certification testing. When asked, “How should youth be evaluated for certification,” three methods of evaluation were acknowledged: a written test, a skill test, and a driving test.

The written exam was the most common response. Opinions to support this testing method included:

“ I think the kids should go through the instruction, and then take a written test.”

“…if a young person wants a drivers license he goes and takes a test… if he doesn’t pass he goes home and comes back 7 days later… they have to study it and know it… you either pass or you don’t…”

“You get a book, study the book, and then go take the test.”

“There should an on-line course (test) to get the scores someplace else so I don’t have to be involved whether the kids pass or fail… some national database…”

“I think you need to be able to have random questions where the computer generates the test.”
Having youth perform a skill test was another evaluation component for demonstrating knowledge. Participant comments to support this type of testing included:

“There is a safety part so they need to identify so many safety features of the tractor. So they may have a piece of tape on them or depending on how I did it, I may go around and point to different things.”

“We do a walk-around inspection to check oils, motor oil, hydraulics, fuel, air pressure in the tires, and do a complete inspection.”

“I think it is good for kids to know how to hook up a PTO and how to release it. How the hydraulic hoses attach and release.”

“On the commercial driver’s license if you fail the pre-trip, you don’t drive. You go home and you come back again, and it (the Tractor and Machinery Certification program) could be the same way… if you thought they didn’t know enough on the pre-trip you sure don’t want them cranking up and driving.”

A third evaluation component included basic tractor operation. Focus group participants were highly supportive of youth demonstrating their driving ability; they shared their comments in statements like:

“I believe that there needs to be a driving skills evaluation.”

“I would be reluctant to do any type of on-line certification just because of the practical nature of the trainee having to demonstrate to the instructor their functional knowledge of not only how to operate the tractor but incorporating what they have learned, the do’s and the don’ts.”

“I think if they drive the little obstacle course with the cones and things, that is about the only way you can judge it. They can take off so many points for so many cones that they hit and then the backing. They can make sure that they can pull up and back, so many points just like, again, on the CDLs. If you miss a few things when you’re driving, they take off so many points.”
To support the premise that youth should be tested of their knowledge and tractor-related skills, it is understood that testing sites are necessary. When asked, “What is a reasonable distance to ask youth to travel for certification or test locations,” participants felt the program should be local, either within the county or within a natural border of the community. The most commonly identified test locations included county Extension offices, schools, community colleges, machinery dealerships, and libraries (as in the case for on-line learning centers).

Focus group interviews revealed several key themes in the topic area of student evaluation. The most significant was consensus for the written test to continue to be included in the certification process. Performance evaluations were also important for the students to demonstrate some level of mastery.

*Program marketing.* Knowing there are youth operating tractors in both traditional and non-traditional production agricultural settings, it was important to ask focus group participants about marketing strategies. Safety education programs of this nature are not only important for students entering the workforce, but also those involved on the family operation. So knowing how to generate interest for farm families to voluntarily participate in the certification process was a question asked during the interview. Responses were slightly slanted towards the urban agricultural population; focus group participants were more concerned about marketing the program to the students with limited agricultural backgrounds who still had contact with machine operation. Their opinions are represented in the following comments:

“I think that in trying to look at tractor safety relative to a kid getting ready to get his license to drive a normal vehicle, I find it rather hard to believe we could ever create a system that will have enough kids to participate to justify it to where, of
course, you have the Driver’s Ed in high school. You have to do behind the wheel and then you have to sit for a test. I question whether there are enough kids to justify a program of that magnitude for tractor safety.”

“The largest number of sales of units in tractors are 20 hp, are the baby tractors, the compact utilities. Our compact utility business has exploded and gone through the roof…You need to get to the kids of those people because those are non-farm, and those people are just as dangerous, in some cases more so than the traditional farmers.”

“If we are going to have a broader message than just tractor safety, then we need a broader base to get that message out to people…you have to go to other areas of the high school to get the message out that safety is important…you have to give up on some of the strict FFA stuff…”

“We call it Urban Ag, and that is kind of getting there for people who don’t consider themselves in farming. Yet they are out there driving a tractor or doing something around machinery, or putting on Round-Up…I think you need to change the name (of the Tractor and Machinery Certification Program) and move if off to the side a little bit…consider environmentalists or something…”

There was a general consensus that responsibility for a young person ultimately comes down to the employer hiring the minor. Therefore targeting employer groups, commodity groups, and insurance companies was a possible marketing avenue. Several regions mentioned the responsibility of the equipment dealers, and used the analogy of the ATV dealers to train the new owners on safe equipment operation. Supporting comments include:

“The next step has to be part of that work situation… and providing more information to people employing these kids…that you have the responsibility as an employer.”

“…that is where your insurance comes in. If I, as an employer, hire somebody and don’t train them to operate whatever he has got to operate and he gets hurt, then my insurance company is going to have to pay for it.”

“Well a good way to attract that audience is every state has some associations, landscape associations or horticultural associations and those owners, operators
and producers need to know about it. All the farm organizations need to know about it too.”

“I think the employer himself has to be the motivator; not the kid, not his parents.”

“When we had vegetables, we hired a lot of kids for picking. There were some that would come and say, ‘How come that kid is able to drive a tractor back and forth through the field and I am not allowed on the tractor?’ I said, ‘You were hired to pick. You weren’t hired to drive a tractor.’ ”

“…the dealerships, the tractor dealerships. That would be a good way to start. They are selling the equipment. They should make sure their customers are trained to operate it.”

The general farm community should also be made aware of this legislation. Publicity in local newspapers, commodity magazines, public service announcements, and TV advertisements were possible media outlets for targeting potential youth participants into the program. Parents, grandparents, and other family members were also identified as media targets for the certification program, focusing on the caregivers’ need to protect their children from danger. From the focus group comments, the general consensus was the lack of knowledge about the legislation; this message was evident in their comments:

“We have done the newspaper and the 4-H newsletter, but it is still difficult I think in some areas of the state to get the information out. My frustration is the fact that so many still don’t understand the law.”

“I make a poster or two about farm tractor safety and post them in every high school… I think it goes in the guidance counselor’s office…”

“We send out stuffers that basically say, ‘We can provide you this service…’ Very seldom do we get anybody to respond to it. Also, it’s got to be something localized in my opinion, and promoted locally.”

“How about a federal website that had the general or federal requirement…or some sort of national brochure that states might use and then modify it to their own conditions.”
Media campaigns were also discussed as a benefit for justifying instructors’ time and effort of the program, especially in small communities where funds may not be abundant for agricultural-oriented programs. Their opinions strongly suggested the need to market to the course instructors and are expressed in the following statements:

“I think another piece of marketing is to the perspective teachers. I know a lot of my colleagues in Extension aren’t giving the course because they don’t think there is a need. But statistically, I think we have to show them there is a need. That a lot of individuals are killed and maimed every year on farms and it can happen right in your backyard or in your county. So I think we need to encourage Extension educators and Vo-Ag teachers to do it, make it available.”

“You can come up with the best darn program that ever existed and if you don’t have something to entice the Extension educator or the Vo-Ag instructor to put it on, it becomes another unfounded mandate that is going to be difficult to sell.”

Additional comments about marketing included production of bilingual materials and having extra money put towards the national program.

“We talked about Spanish manuals, but I think we need some multilingual or multicultural type of marketing too.”

“The other thing that is kind of going to be a key is whether or not there are any dollars available for making the rubber hit the road.”

A reoccurring idea within the focus groups included a course re-structuring to look similar to the pesticide certification program. The program would have a core content area that primarily involved tractor operation. Additional courses could be added to the core, reflective of the regional agricultural environment. For example, there could be individual courses on irrigation equipment, confined spaces, livestock safety, ATVs, and harvesting equipment. A certification card would be issued upon completion of the core tractor operation program, and as youth completed additional segments of the
program, they would receive additional punches or checks on the card. The suggestion for this type of course often occurred during discussion of educational content or marketing. Interestingly, focus group participants agreed it would be a marketing strategy for youth to continue participation in the course. Having additional training in content areas would make the youth more marketable to the employer, or allow for additional internship opportunities if the youth wished to work in another agricultural region. Students may also compete with others in their class to become certified in all program areas. Such ideas are represented in the following comments:

“So, I think you are going to have to do something similar and parallel, and I won’t say with what our state has in terms of certified pesticide operators, but at least in concept present it parallel to that where there is a standard EPA set of training that was developed, and in this case by you folks, and there is ‘train the trainer’ exercises and everybody is reading off the same page when we go out and start doing training.”

“You could just have modules… train them in a landscape module, pesticide module, livestock module.”

“And as far as the pesticides (re-certification program), there are how many different tests (you could take for specific certification areas)…”

To summarize, the focus groups identified key themes in the topic area of marketing. Certainly marketing was needed to attract the youth participants to the program. Beyond the traditional farm youth who are dwindling in numbers, there is an untouched audience of “urban agricultural” youth who have exposure to tractors. These youth may not be working for hire in production agricultural settings, yet they are exposed to the same dangerous equipment in their horticultural activities or urban sprawl housing developments. These urbanized youth do not see the connection that they are exposed to the same dangers as the typical farm youth employed to drive big tractors and
bale hay. Yet, modern-day utility tractors pose the same risks as their larger agricultural counterparts.

Besides the youth, focus group participants also thought it important to inform parents, agricultural employers, and the general community about the certification program. While it was the ultimate responsibility for the employer to ensure proper training of their youthful employees, other adults should be made aware of this available training program. Parents, equipment dealers, and farm organizations were likely targets of media campaigns.

Of equal importance to the program’s availability is the enticement for instructors to offer the course. Focus group participants felt targeted marketing campaigns should also be delivered to the instructor level in order for the program to be perceived as valuable use of time.

Another theme identified by focus group participants called for the restructuring the course to be similar to the pesticide applicators training program. This marketing strategy would allow youth the opportunity to be trained in specific areas important for their agricultural employment. While students would all benefit from a core tractor safety curriculum, there would be additional courses available for specialized instruction in agricultural tasks like irrigation, confined spaces, livestock, and grain operations.

*Focus Group Summary*

Utilizing focus groups, opinions were sought from various stakeholders around the United States. With this method, multiple user groups were able to provide the researcher with an understanding of the current state of the Tractor and Machinery Certification program. Although not fundamentally possible to generalize beyond the
population participating in the focus group discussion, it was vitally important to have an initial understanding of the perceptions of those familiar with the program. Interestingly, there were similar opinions expressed by the stakeholders between regions.

The focus groups examined three areas of inquiry: educational structure, student evaluation, and program marketing. Discussion of the first topic, educational structure, included lively dialog around the tasks and equipment young workers are hired to perform. There was general consensus that occupational training is important for all employees, especially those in their teens. The current legislation identifies specific tasks and pieces of equipment that young hires under 16 years should not be asked to perform without participation in a certification program. Focus group participants reviewed those tasks and discussed other pieces of agricultural equipment that should be included in the training program. The most popular suggested additions to the training programs include ATVs, skid steer loaders, and combines. Because of the increase in urban sprawl, agricultural markets are targeting smaller rural operations with smaller sized equipment. More youth have the opportunity to work with smaller sized utility tractors, and so it was recommended that all tractors, even those under 20 hp, be included in the training program. Another recognized area for inclusion in the current legislation was the green industry; safety training was suggested for dethatchers, string trimmers, mowers chain saws, and wood chippers.

Focus group participants were in agreement with several beliefs about the educational structure of the certification program. While other entities, like equipment dealers, junior colleges, trade schools and farm organizations, were identified as possible trainers for the training, the two currently identified agencies of Extension and vocational
agricultural programs were still the readily agreed upon agencies that should be responsible for conducting the youth training programs. Focus group participants were also in agreement with the types of training needed, as well as the types of student curriculum materials that could be developed, including workbooks, slide sets, videos, CD-ROMS, and DVD’s.

Where the participants deviated with their opinions was in the area of self-study. For every argument in agreement with a self-study program, there seemed to be an equal refute for this type of training. Reasons to support self-study included: (a) time savings for instructors where they could assign outside homework and have students work on their own through various sections; (b) enhanced self-directed learning for students, especially when there is such a divergence of equipment experience between students and several students may be able to advance more rapidly through the curriculum; and (c) in geographic areas where no training programs are offered, a self-study program would enable students to learn the material and receive their certification. Arguments opposed to the self-study program included: (a) students cannot learn about safety from their own experiences, but benefit from the experience and knowledge of an instructor; (b) occupational training is best taught by an impartial instructor, not a parent or employer who may not be the best role model; and (c) students need the opportunity to have hands-on experiences with various pieces of equipment, not just learning through books or through computer instruction.

There was concurrence among focus group regions about instructor training. As the teaching population becomes further removed from agricultural experiences, a suggestion was to conduct training programs for instructors to learn how to teach
equipment safety. Modernized equipment has intricate electronic systems, diverse control panels, and different braking systems from previous eras. Training updates would help instructors feel more comfortable with their teaching roles. Even while there may be instructors with vast knowledge of equipment operation and safety, focus group participants felt that regular training updates would benefit all individuals. Instructor training programs would keep course leaders informed of their certification roles and provide administrative updates, a component missing from the current programmatic structure.

Besides exchanging ideas about the educational structure of the certification program, a second topic, student evaluation, was discussed during the focus groups. Participants supported the current legislation that includes three modes of evaluation, including a written exam, skill exam, and driving exam. While this structure is currently in place, it is typical for the skill and driving components to be evaluated at the same time. Focus group participants discussed the possibility of the skill evaluation to be conducted independently of the driving evaluation, for the reason they involve different types of student performance.

Additional dialogue surrounding student evaluation included identification of various test locations and incorporation of testing fees. Focus group participants discussed the opportunity of equipment dealerships, county Extension offices, schools, community colleges, and libraries (as in the case for on-line learning centers) as possible testing locations for the certification. Course fees are generally assessed at the local level to compensate for student workbooks, program resources, and refreshments. The concept
of charging students a testing fee was discussed by participants as a way to compensate for equipment and certification expenses.

The third topic area, program marketing, encapsulated ideas about marketing beyond the currently targeted student population. Students working for family operations or working with agricultural equipment smaller than that identified in the Code of Federal Regulations are not required to receive safety certification. Likewise, students operating mowers and mechanized equipment in the green industry are not targeted with training materials. However, these individuals would benefit from safety education training and should be targeted for inclusion in certification programs. Designing a youth Tractor and Machinery Certification program similar to the USDA pesticide re-certification training was discussed as a possible marketing strategy to involve more youth in targeted training programs. The concept involved a core content training for tractor operation, and additional courses for regional or specialized agricultural tasks like irrigation, confined space, livestock, grain handling, and specialty crops training.

Marketing the Tractor and Machinery Certification program should be targeted towards multiple audiences. Focus group participants believed there to be lack of knowledge amongst the farm community about this legislation. Therefore multiple audiences needed certification information. The obvious audiences included the young workers and their parents; however additional audiences included the employers hiring young persons, the equipment dealers selling tractors to families with children, insurance agents providing insurance coverage over agricultural operations, and commodity groups or farm organizations that promote agricultural businesses. Publicity in local newspapers,
trade magazines, public service announcements, and TV advertisements were identified as possible media outlets for these audiences.

A significantly under-marketed audience included the instructors of the local certification program. If instructors are not aware of the program or knowledgeable of the certification requirements, they are not likely to offer the course. This audience was identified as the direct link to program enrollment. This population is in need of information addressing program requirements, available curriculum, and certification logistics. Marketing to this audience could increase program participation and at the least create a better transfer of information to the service providers of the certification program.

The focus groups served as the first step in assessing the current condition of the Tractor and Machinery Certification program. The qualitative information offered a foundation for subsequent data collection techniques that would be employed in the survey research phases. The responses elicited from focus group participants were presented for verification to a larger population of course instructors in the last stage of data collection. Before this phase could be implemented, additional information was gathered from agricultural safety experts to determine their opinions of what makes a comprehensive Tractor and Machinery Certification course. Therefore, the next phase of data collection utilized the Delphi technique with a panel of agricultural safety experts. This phase of data collection was designed to frame an educational structure for the program, including overall programmatic goals, objectives, and curriculum competencies.
Objective 3:

Describe perceived objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as determined by a panel of experts.

The Delphi technique was used to collect qualitative information from agricultural safety professionals about the curriculum used for the Tractor and Machinery Certification program. Three questions were discussed by the panel over a six-week time period. Answers to each question were methodically reviewed and compiled by the researcher into one data set; these discussions were then systematically shared with the panel in the weekly rounds of deliberation.

Response Rate

The Delphi panel included 10 safety specialists who were members of the professional organization National Institute for Farm Safety. Participants ranged in agricultural safety experience from 13 – 35 years, with the average years of experience being 20.6 years. Seven panelists were Extension agricultural safety leaders, two were agricultural engineers, and one was a safety director with the Farm Bureau. The panel had national representation, with participants from all four USDA regions.

Results

Delphi Question 1. In the first round of questioning, Delphi panelists were provided a short synopsis of the legislation behind the Hazardous Occupations Order in Agriculture. If they required specific information or a review of the regulation, they were provided the web link to the Department of Labor Code of Federal Regulations 29CFR570.71. Question 1 was presented: “Based on what you know of the legislation,
and your past experience with the Tractor and Machinery Certification program, what do you feel is (are) the primary objective(s) of a certification program. You may list more than one objective, but no more than five.”

The researcher took careful efforts to craft the compilation of qualitative data sets into cohesive statements, using the panelists’ language. The statements were organized into two groups, those with broad program goals and those with specific objectives. In the second week of deliberation, the panel reviewed the collective statements and had the opportunity to comment or edit the statements. During the third round, the panelists selected program goals and objectives that they agreed with, and these were tabulated by the researcher and represented in round four. The results of this process identified a primary goal of the certification program as:

The overall goal of the Tractor and Machinery Certification program is to provide an educationally-based certification process for youth ages 14 and 15 years old who seek agricultural employment, whereby instructors, evaluation, and certification are consistent with the Hazardous Occupations Order in Agriculture.

Utilizing phrases from earlier discussion rounds deliberating the overall program goal, the researcher formed the introduction statement, “Upon successful completion of a Tractor and Machinery Certification program, the participants will understand the magnitude, nature, and lasting impacts of potential hazards and injuries associated with agricultural tractor and machinery operation.” This introduction served as the basis for identifying course objectives. It was in the fourth round that eight supporting objectives were identified:

Upon successful completion of a Tractor and Machinery Certification program, the participants will understand the
magnitude, nature, and lasting impacts of potential hazards and injuries associated with agricultural tractor and machinery operation. Specifically, students will be able to:

1. Make informed and safe decisions about the operation of agricultural tractors and machinery;

2. Demonstrate mastery of a tractor and an attached implement through a series of common obstacles;

3. Identify hazardous work environments and tasks in agricultural production;

4. Apply accepted and standard operational techniques used with agricultural tractors and machinery, focusing on those that relate to the presence and maintenance of safety-related systems and components;

5. Understand farm safety principles in general;

6. Integrate equipment safety information in any personal decision;

7. Identify protective equipment related to tasks assigned to specific age groups;

8. Understand basic equipment maintenance.

The first four objectives ranked highest with the Delphi participants. Objective 1 had consensus from all panelists as the primary objective. Objective 2 received nine out of ten votes, while there was a tie for Objectives 3 and 4 with both receiving eight out of ten votes. The last four objectives were identified by the panel process, but did not receive the majority of votes to rank higher in the list. However, the purpose of this modified-Delphi process was to generate a list of objectives to present to local instructors in a later phase of data collection.
Delphi Question 2. A second question was posed to Delphi panelists during the first round of deliberation. The question required little discussion, and was presented as a multiple-choice question. The question was asked: “In your opinion, should the Tractor and Machinery Certification program be based on: (a) hours of participation, B) competency of student performance, or (c) a combination of the two. Panelists were asked to indicate their response. Table 4.5 shows the initial tally.

<table>
<thead>
<tr>
<th>Initial Panel Response to Question 2</th>
<th>Panelists’ Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based solely on hours of participation</td>
<td>0</td>
</tr>
<tr>
<td>Based solely on competency and student performance outcomes</td>
<td>5</td>
</tr>
<tr>
<td>Based on a combination of student hours of participation and performance objectives and competencies</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4.5: Initial Results to Delphi Question 2.

None of the ten panelists was in favor of a Tractor and Machinery Certification program based solely on hours of participation. There was equal support for the other two options. Examples of supporting arguments from the panelists supporting the student competency and performance outcomes included:

“In an ideal world, the program should be based on true competency, both written knowledge and hands-on performance… This would require some minimal level of skill or competency in operating the equipment (not only doing it safely, but being able to perform certain tasks or maneuvers).”

“By basing on competency rather than a set amount of time, it makes it more convenient if self-paced. This may encourage more tractor operators to take the
training, even if they don’t need it for certification, e.g. adult tractor operators and youth who work on their own farm.”

“Use performance of competency only; lose the time criteria. I view time as an unconnected (statistically non-significant) variable in the equation used to judge a participant’s ability. Certification programs will require time to complete, but the actual time in class should not be used as part of the regulation.”

“Personally I am less concerned about how individuals obtain information to pass the certification as long as the certification process is grounded in identified required skills and knowledge…I am less concerned about the hours and more concerned about the competency of those being certified.”

Five of the ten panelists were in support of a combination between hours of participation and competency. Supporting arguments from this perspective included:

“Most volunteer instructors need a structured curriculum in order to determine course content. This would naturally include an hour requirement. At the same time, they also perform best when some flexibility is designed into the curriculum so that they can custom tailor their course for their local needs. If the delivery of the program remains in the current two agency format, then the program should be based on both criteria.”

“The program should be based on both. Clearly the program should be competency based. But the competency should be based on very specific skills that are readily measured and easy enough to evaluate…At the same time, you do have inter-instructor variability. Volunteer instructors are sometimes not very self-aware of how well they do or how well students are learning; an instructor who thinks they are really good might think they can get a group trained in an hour. So I think there needs to be a floor on the number of contact hours required.”

“A combination of both. While some [students] may be able to perform adequately on examinations, there is additional learning in participation.”

During the second round, participants reviewed other panelists’ opinions, and were given the option to re-consider their vote. While discussion threads were robust, Table 4.6 presents the question’s final results. Two panelists who were originally in
favor of a competency-based program changed their response and were in support of a
program that combined student hours of participation and performance competencies.

<table>
<thead>
<tr>
<th>Final Panel Response to Question 2</th>
<th>Panelists’ Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based solely on hours of participation</td>
<td>0</td>
</tr>
<tr>
<td>Based solely on competency and student performance outcomes</td>
<td>3</td>
</tr>
<tr>
<td>Based on a combination of student hours of participation and performance objectives and competencies</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 4.6: Final Results to Delphi Question 2.

**Delphi Question 3.** The third and final question was presented in Round 4, and
continued through two rounds of deliberation. The final request was for panelists to
identify basic competencies that every student should possess after completion of the
Tractor and Machinery Certification program. Delphi panelists could review any
available curriculum to assist them in their responses. The HOBAR manual was
provided to any participant who requested it.

Upon the first round of deliberation, 156 competencies were identified by the 10
panelists. The researcher took careful consideration of all competencies generated through
the process. After similar competencies were grouped together, 122 remained. Two rounds
of deliberation allowed panelists to refine and regroup the competencies into a more
manageable list. During the final round of discussion, competencies were placed into three
broad categories, Tractor-Related, Machinery-Related, and General Safety and Health
Topics. Within each major classification, sub-headings were used to organize the
competencies into three areas of General Safety, Maintenance Safety, and Operation Safety. The sub-headings allowed the panelists to think about the competencies in terms of how the materials would be presented during instruction. By combining like items within the sub-headings, it was possible to pare the list down to 117 competencies. Table 4.7 provides a list of the 77 student competencies related to tractor operation, Table 4.8 identifies the 22 youth competencies related to machine operation, and Table 4.9 lists those 18 competencies related to general safety and health topics.
TABLE 4.7: Student Competencies for Tractor Operation as Identified by the Modified-Delphi Technique.
Table 4.7 (continued).

<table>
<thead>
<tr>
<th>TRACTOR SAFETY: General Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To identify and understand approved universal symbols, instruments, and gauges used to monitor tractor operation and performance</td>
</tr>
<tr>
<td>To be able to make operating decisions based upon the information, gauges, and tractor operation symbols and how to react to malfunctions when they occur</td>
</tr>
<tr>
<td>To conduct pre-operational checks on a daily basis</td>
</tr>
<tr>
<td>To check if equipment has been properly serviced and adjusted</td>
</tr>
<tr>
<td>To be able to listen for unusual sounds and shut off engine if abnormalities are heard</td>
</tr>
<tr>
<td>To locate all grease fittings, clean and lubricate them</td>
</tr>
<tr>
<td>To explain the differences between gasoline and diesel engines</td>
</tr>
<tr>
<td>To understand how to check fuel levels of common engines</td>
</tr>
<tr>
<td>To safely refuel a tractor, making sure the engine is cool and refrain from smoking</td>
</tr>
<tr>
<td>To safely check coolant levels of liquid cooled engines</td>
</tr>
<tr>
<td>To safely check oil levels of any engine</td>
</tr>
<tr>
<td>To be able to check the battery’s electrolyte level and add battery water as needed</td>
</tr>
<tr>
<td>To be able to check, clean, coat, and tighten battery connections</td>
</tr>
<tr>
<td>To safely use a battery charger to charge a weak battery</td>
</tr>
<tr>
<td>To safely use booster cables to jump start a weak battery</td>
</tr>
<tr>
<td>To become familiar with hazards of lead acid batteries, including identification of battery parts and their functions</td>
</tr>
<tr>
<td>To understand the hazards of bypass starting; never start the tractor from the ground</td>
</tr>
<tr>
<td>To safely start and stop the engine of a gasoline and diesel tractor</td>
</tr>
<tr>
<td>To warm the engine before applying a heavy load</td>
</tr>
<tr>
<td>To know not to operate the tractor in a closed building without adequate ventilation</td>
</tr>
<tr>
<td>To understand the operational safety concern of hitching properly</td>
</tr>
<tr>
<td>To be able to operate a tractor without stalling or jerking through proper use of the clutch pedal</td>
</tr>
<tr>
<td>To negotiate the tractor between destinations; basic techniques of driving</td>
</tr>
<tr>
<td>To understand the safety concern of excessive speed</td>
</tr>
<tr>
<td>To be able to safely drive in reverse gear to a specific location</td>
</tr>
<tr>
<td>To be able to park the tractor properly</td>
</tr>
<tr>
<td>When stuck, to know how to back out or have the tractor towed</td>
</tr>
<tr>
<td>To recognize and use the proper types of tow ropes or chains</td>
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</tbody>
</table>

(Table 4.7 continues)
Table 4.7 (continued).

<table>
<thead>
<tr>
<th>TRACTOR SAFETY: Wheels and Tires</th>
</tr>
</thead>
<tbody>
<tr>
<td>To identify faulty tire and wheel situations and take corrective action</td>
</tr>
<tr>
<td>To recognize low tire pressure</td>
</tr>
<tr>
<td>To correctly check air pressure in both regular use and calcium-filled tires</td>
</tr>
<tr>
<td>To be able to adjust wheel width</td>
</tr>
<tr>
<td>To be able to check brakes</td>
</tr>
<tr>
<td>To be able to add or remove weights</td>
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<table>
<thead>
<tr>
<th>TRACTOR SAFETY: Lighting, Marking, and Road Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>To check the lighting system to ensure all lights work</td>
</tr>
<tr>
<td>To check the slow moving vehicle emblem for proper placement and that it is clean and not faded</td>
</tr>
<tr>
<td>To explain the Slow Moving Vehicle (SMV) emblem and its usage</td>
</tr>
<tr>
<td>To select a safe speed for roadway travel based on size and weight of towed equipment</td>
</tr>
<tr>
<td>To know why and how to lock brakes for roadway travel</td>
</tr>
<tr>
<td>To identify the requirements for road operation</td>
</tr>
<tr>
<td>To safely make left and right turns</td>
</tr>
<tr>
<td>To safely cross an intersection</td>
</tr>
<tr>
<td>To know how to safely select a place to pull over to let traffic pass</td>
</tr>
<tr>
<td>To use safe and courteous traffic driving practices to prevent collisions with motor vehicles</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>TRACTOR SAFETY: Auxiliary Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>To recognize safety shields and guards on tractors</td>
</tr>
<tr>
<td>To ensure the Power Take Off (PTO) master shield is in place</td>
</tr>
<tr>
<td>To clean and oil PTO stub shaft and splines</td>
</tr>
<tr>
<td>To engage the PTO slowly, check for operation, and disengage properly</td>
</tr>
<tr>
<td>To operate hydraulic features, check hydraulic controls for proper operation</td>
</tr>
<tr>
<td>To understand the safety concern of adding weights and towing heavy loads</td>
</tr>
<tr>
<td>To understand the safety concerns of adding auxiliary equipment to tractor like loader buckets,</td>
</tr>
<tr>
<td>saddle tanks, dual tires, or ballasting</td>
</tr>
</tbody>
</table>
To identify the hazards of improper hitch pins
To recognize safety concerns associated with stationary equipment like augers, grinder-mixers, and farmstead equipment like motor driven pumps, etc.
To know how to turn off and let a machine spin down to a stop before approaching
To safely connect/disconnect an implement to the tractor’s drawbar
To safely connect/disconnect an implement to the 3-point hitch
To safely connect/disconnect hydraulic components
To safely connect/disconnect electrical components
To safely connect/disconnect a PTO driveline
To identify components of a PTO system
To identify the hazards involved with PTO use
To develop PTO safe use habits
To operate equipment at proper PTO speed
To clean and oil a PTO shaft
To know it is not safe to unclog, adjust, or service equipment while it is running
To know how to watch and listen to equipment; shut power off at first sign of malfunction
To know how to spot the tractor drawbar to the hitch of the machine
To understand safe pulling/towing techniques; gently start a heavy load
To select the right gear for the load and terrain
To maneuver a towed implement through a gate or other opening
To know how to enter a roadway safely with a towed implement
To know how to drive down the road while keeping the implement in the lane of travel
To safely use drawbar implements during transport, field use, turns, and backing operations

Table 4.8: Student Competencies for Machinery Operation as Identified by the Modified-Delphi Technique.
To dress safely for work
To recognize housekeeping needs of the farm to prevent hazards
To identify factors and situations that contribute to agricultural hazards
To identify farm workplace hazards and suggest specific corrective actions during a walk-around inspection
To become aware of regulations that affect agricultural workers
To provide examples of why hazard control and mitigation are more effective approaches to prevent injuries than common statements like “be careful” and “use common sense”
To identify typical growth traits by age groups and how these traits affect the jobs young workers should be assigned
To understand the variability of agriculture and how it relates to farm safety and health
To understand caution, warning, and danger signs
To learn when to use specific types of personal protective equipment
To recognize the symbols that indicate specific types of personal protective equipment
To recognize when sound levels can become a threat to hearing
To use correct hearing protection
To recognize the respiratory hazards associated with agriculture
To use the correct respiratory protection
To recognize the hazards associated when working with animals
To work with animals safely
To protect one’s personal health while working in changing weather conditions

Table 4.9: Student Competencies for General Safety and Health Topics as Identified by the Modified-Delphi Technique.
Summary of Delphi Technique

The advantage of the Delphi process is that it works as an informal, subjective model when decisions are based on opinion (Cline and Development, 2003). In its strict usage, the methods of this research technique would have Delphi participants prioritize each of the 117 competencies on a set of predetermined criterion, using mean scores or rankings. A modified approach to the Delphi process allowed the researcher to utilize panelists’ expertise to generate a comprehensive list of curriculum competencies. In this process, it was not necessary to debate preference of safety competencies, but rather to identify the types of competencies youth must be able to master within a curriculum. It would be difficult, as well as unnecessary, to spend time debating priorities within the safety curriculum. The goal of this process was to generate a comprehensive list of curriculum topics. These topics will be presented to community instructors in a later research phase, for validation they are needed in such a course.

The modified-Delphi technique used in this research objective generated scholarly discussion between a panel of experts in the agricultural safety field. A list of 117 competencies was identified in a relatively short time period. These competencies were grouped into three categories as they relate to tractor operation, machinery operation, and general safety or health topics.

In addition to the competencies, the panelists developed a written goal and eight supporting objectives for the certification program. The panel also recommended the program be based on a combination of hours of participation and performance of competency. These concepts were presented to community instructors to address Objective 7. Through this approach, data were corroborated between multiple stakeholder groups.
Quantitative Data Results

Two independent surveys were designed to collect further information on the Tractor and Machinery Certification program. Through these methods, additional stakeholders were able to provide descriptive data of the program. These methods were also helpful to provide validation of the qualitative results collected in earlier phases.

Two populations surveyed were state program leaders and community instructors. Each population had specific roles in the research process. State program leaders from Extension and vocational agricultural programs were targeted to provide community instructors to answer specific questions regarding the certification process in their state. Their results are presented under Objective 4. The community instructors from county Extension offices and vocational agricultural programs deliver the program and work closely with the youth enrolled in the program. Their opinions and perspectives are presented in the discussion of Objectives 5, 6, 7, 8.

Objective 4:

*Quantify the number of instructors offering the program in each state according to their certifying agency: USDA-CSREES Extension Service and the United States Department of Education vocational agricultural programs*

Survey research methods were used to collect information from state program leaders in Extension and Departments of Education. Utilizing Zoomerang®, an electronic survey program, data collection was a simple and efficient process. Data were transferred into SPSS 11.0© software for analysis. Basic descriptive statistics along with contingency tables with chi-square tests were performed.
Response Rate

One program leader from each of the 50 states reported information about their agency’s Tractor and Machinery Certification program. This represents a 100% response rate, Federal Extension \( (n=50) \) and Department of Education \( (n=50) \); a census of state program leaders for both agencies surveyed.

Results

Before Objective 4 could be answered and the number of instructors could be tabulated, it was first necessary to establish the states that offered the Tractor and Machinery Certification program. State program leaders from Extension and Department of Education were asked the type of participation their educators had with the Tractor and Machinery Certification program. Four classifications of participation were reported: (a) educators teach the Department of Labor (DOL) Tractor and Machinery Certification program and issue the DOL certificates of training, (b) educators teach the DOL program but do not issue the DOL certificates of training, (c) educators support the teaching of the DOL program by teaching portions of the curriculum or driving courses, and (d) educators teach general agricultural safety programs but these trainings are not DOL certification programs. Raw data reports are included in Appendix R.

According to the program leaders, only 22% of the U.S states teach the DOL program and provide training certificates to their youth. Of these states, the majority (41.67%) were from the Central Region. The other regions in descending order were Eastern (29.17%), Western (15.38%), and Southern (3.85%). Table 4.10 documents the responses by the state program leaders who offer the training program and issue the DOL certificates.
Program leaders in 17% of the U.S. states reported they have instructors teaching the DOL certificate program, but not issuing the certificates of training to the enrolled youth. Of these states, the majority (29.17%) were from the Central Region. The other regions in descending order were Eastern (20.83%), Southern (11.54%), and Western (7.69%). Table 4.11 documents the responses by the state program leaders who offer the training program without issuing the DOL certificates.
Table 4.11: U.S. Regions Offering Tractor Certification Programs Without Issuing DOL Certificates of Training as Reported by State Program Leaders.

Many program leaders, 48% from Extension and 36% from vocational agriculture, have instructors supporting the DOL certificate program. This support is either through educational materials or assistance in teaching in the classroom or on the driving course. Of these states, the majority (75.00%) were from the Central Region. The other regions in descending order were Eastern (54.17%), Southern (26.92%), and Western (15.38%). Table 4.12 reports the responses by the state program leaders who support the DOL training program.
Table 4.12: U.S. Regions Supporting DOL Training Programs as Reported by State Program Leaders.

The majority of program leaders (56%) reported having instructors teaching general tractor safety programs to youth, but these were not DOL certification programs. The Southern states lead the other regions with 69.23%. The Central and Eastern regions were tied at 54.17%, and the Western region reported 46.15%. Table 4.13 presents the responses by the state program leaders who teach general safety tractor and machinery programs to youth.
Table 4.13: U.S. Regions Teaching General Tractor and Machinery Safety Programs as Reported by State Program Leaders.

Overall, Extension educators report a higher involvement (32%) in teaching the DOL certification programs and offering the training certificates, as compared to vocational agricultural educators (12%). Extension educators also support the training programs in more states (48%) than the vocational agricultural instructors (36%). The vocational agricultural instructors teach general tractor safety programs more often than any other type of program (68%).

The Tractor and Machinery Certification program is a national program.

However, according to the state program leaders from both Extension and Department of Education, half of the states in the U.S. do not have the DOL program available. Eleven
of those states do not offer the DOL training at all, and another 14 states were unsure of its availability. The 11 states not offering the DOL program include Arizona, California, Idaho, Mississippi, Missouri, Nevada, New Mexico, North Carolina, Rhode Island, South Carolina, and Wyoming. The 14 states with differing responses from the state program leaders, where leaders from one agency reported no DOL program available while the leader from the other state agency reported they were unsure if the program was available, include Alabama, Alaska, Arkansas, Colorado, Florida, Georgia, Hawaii, Kentucky, Louisiana, Massachusetts, Montana, New Hampshire, New Jersey, and Texas.

The remaining 25 states reported some form of DOL program available, through either of the two certifying agencies. Eighteen of those states had at least one agency offering the DOL program; these include Connecticut, Illinois, Indiana, Iowa, Maine, Maryland, Michigan, Minnesota, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Utah, Vermont, Washington, West Virginia and Wisconsin. Seven states had both agencies offering the DOL program; these states include Delaware, Kansas, Nebraska, New York, Oregon, Pennsylvania, and Virginia.

Overall, Extension offered the DOL program in 38% of the states ($n=19$), including Delaware, Illinois, Indiana, Iowa, Kansas, Maine, Maryland, Minnesota, Nebraska, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Utah, Virginia, and Wisconsin. The Departments of Education reported having educators in their vocational agricultural programs offer the DOL program in 26% of the states ($n=13$), including Connecticut, Delaware, Kansas, Michigan, Nebraska, New York, Oregon, Pennsylvania, Tennessee, Vermont, Virginia, Washington, and West Virginia.
Looking at each region, it was possible to make observations about the programs availability. Within the Central region, 11 out of the 12 states reported at least one agency offered the DOL program. The Eastern region reported 8 out of the 12 states had the DOL program available. The Western region had 3 out of 13 states who offered the DOL program, while only 2 out of the 13 states in the Southern region offered the program.

Surveying state program leaders about the type of Tractor and Machinery Certification program available in their state was not as accurate as initially expected. For the most part, state leaders were not always confident in the type of training program offered by their agency educators. However, the task of quantifying the number of instructors in the U.S. teaching the DOL certification program proved to be just as difficult.

At the national level, there is no database documenting the names and states of tractor and machinery certification teachers. Similarly, such records do not always exist at the state level. Program leaders in the majority of states found it difficult to provide the researcher with names of potential instructors in their state offering the training program. To accommodate this limitation, states where the administrators were not familiar with persons teaching the course used an electronic announcement through their organizational listserv to have course instructors identify themselves.

Through the identification process 467 instructors were named. However, the researcher is cautious to report this number as an accurate total of those teaching the Tractor and Machinery Certification course. It is highly possible for some instructors to remain unnamed, in that the state leader did not know these instructors offered the program, or that the instructors themselves did not respond to the electronic
announcement. It should be noted that not all states utilized the electronic announcement process.

The results from this process provided the researcher with a frame of tractor and machinery certification instructors, as provided by state certifying agencies in the United States. This was the best approach for identifying possible course instructors. This directory was the population for further inquiry (as reported in Objectives 5 through 8).

Summary of Survey Data from State Program Leaders

The purpose of Research Objective 4 was to determine the number of instructors offering the program in each state according to the state program leaders within Extension and the vocational agricultural program. Before instructors could be quantified, state program leaders from each agency classified the type of tractor and machinery safety programs available in their states. This step allowed program leaders to sort between general safety programs and DOL certification programs.

Only 32% of state leaders in Extension (n=16), and 12% in State Departments of Education (n=6) reported having instructors that teach the DOL program and issue the training certificates. Another 16% of state leaders in Extension (n=8) and 18% in Departments of Education (n=9) reported having instructors teach DOL programs but do not issue certificates to the youth. Overall, Extension offered the DOL program in 38% of the states (n=19), while Departments of Education offered the DOL program in 26% of the states (n=13). The Central region had more educators involved in the DOL program, while the Southern region reported the least number of instructors. However, the Southern region reported more instructors teaching general tractor and machinery safety programs as opposed to the official DOL programs.
By using state program leaders’ information, a directory of 467 community instructors was identified as Tractor and Machinery Certification course instructors, 180 from Extension and 150 from vocational agriculture programs. This population became the frame for the final investigation to answer Objectives 5 through 8.

Data Collection for Objectives 5, 6, 7, and 8

This section reports the results for Objectives 5-8:

Objective 5: Describe the type of certification, Tractor or Tractor and Machinery, offered by the certifying agency including the number of educational hours: 10-, 15-, 20-, 24-, or 25-hours;

Objective 6: Identify teaching methods and curriculum resources used in the certification program by community-based instructors.

Objective 7: Examine community instructors’ perceptions and management styles of the Tractor and Machinery Certification program.

Objective 8: Determine program objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by community-based instructors.

The steps taken prior to survey development for this phase of investigation assisted the researcher in understanding the complex issues surrounding the national program. The qualitative data collected through Objectives 2 and 3 provided the framework for establishing the instrumentation to address Objectives 5, 6, 7, and 8.
Survey research methods were used to collect information from course instructors at the local level in Extension and vocational agricultural programs. Utilizing Zoomerang®, an electronic survey program, data collection was a simple and efficient process. Data was transferred into SPSS 11.0© software for analysis. Frequency and descriptive statistics are reported.

**Response Rate**

Lacking a national database or registry of tractor and machinery certification instructors, or a mechanism to track them through an agency’s reporting system, the researcher relied upon state program leaders to provide the target population for the four remaining research objectives. The researcher took careful measures to construct this population directory of 467 instructors, reviewing names provided by state program leaders and constructing a listserv of participants from advertisement e-mails.

After data collection, 330 usable surveys were included in the analysis, representing a 70.7% response rate. This population had national representation. The majority of responses were from the Central region (63.3%) while the western region had the least (7.3%). Table 4.14 provides the response rate by region.
Thirty-three states contributed to the data collection process (Table 4.15). In cases where state program leaders reported no tractor and machinery program was taught, there would be no instructors in such state to survey.

<table>
<thead>
<tr>
<th>USDA Region</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>209</td>
<td>63.3</td>
</tr>
<tr>
<td>Eastern</td>
<td>62</td>
<td>18.8</td>
</tr>
<tr>
<td>Southern</td>
<td>35</td>
<td>10.6</td>
</tr>
<tr>
<td>Western</td>
<td>24</td>
<td>7.3</td>
</tr>
<tr>
<td>Total</td>
<td>330</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.14: Overall Response Rate of Course Instructors by Geographic Region.
<table>
<thead>
<tr>
<th>State</th>
<th>Instructors Identified by Leaders</th>
<th>Response</th>
<th>% Response for State</th>
<th>Cumulative % of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>0.3</td>
</tr>
<tr>
<td>Connecticut</td>
<td>5</td>
<td>5</td>
<td>100</td>
<td>1.8</td>
</tr>
<tr>
<td>Delaware</td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>2.1</td>
</tr>
<tr>
<td>Georgia</td>
<td>6</td>
<td>5</td>
<td>83</td>
<td>3.6</td>
</tr>
<tr>
<td>Idaho</td>
<td>3</td>
<td>1</td>
<td>33</td>
<td>3.9</td>
</tr>
<tr>
<td>Illinois</td>
<td>30</td>
<td>14</td>
<td>47</td>
<td>8.2</td>
</tr>
<tr>
<td>Indiana</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>8.8</td>
</tr>
<tr>
<td>Iowa</td>
<td>30</td>
<td>23</td>
<td>77</td>
<td>15.8</td>
</tr>
<tr>
<td>Kansas</td>
<td>31</td>
<td>21</td>
<td>68</td>
<td>22.1</td>
</tr>
<tr>
<td>Kentucky</td>
<td>10</td>
<td>10</td>
<td>100</td>
<td>25.2</td>
</tr>
<tr>
<td>Maine</td>
<td>7</td>
<td>4</td>
<td>57</td>
<td>26.4</td>
</tr>
<tr>
<td>Maryland</td>
<td>4</td>
<td>4</td>
<td>100</td>
<td>27.3</td>
</tr>
<tr>
<td>Michigan</td>
<td>15</td>
<td>4</td>
<td>53</td>
<td>29.7</td>
</tr>
<tr>
<td>Minnesota</td>
<td>18</td>
<td>16</td>
<td>89</td>
<td>34.5</td>
</tr>
<tr>
<td>Missouri</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>35.2</td>
</tr>
<tr>
<td>Montana</td>
<td>3</td>
<td>3</td>
<td>100</td>
<td>36.1</td>
</tr>
<tr>
<td>Nebraska</td>
<td>19</td>
<td>10</td>
<td>53</td>
<td>39.1</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>12</td>
<td>7</td>
<td>58</td>
<td>40.9</td>
</tr>
<tr>
<td>New Jersey</td>
<td>4</td>
<td>4</td>
<td>100</td>
<td>42.4</td>
</tr>
<tr>
<td>New York</td>
<td>28</td>
<td>17</td>
<td>61</td>
<td>47.9</td>
</tr>
<tr>
<td>North Dakota</td>
<td>9</td>
<td>9</td>
<td>100</td>
<td>50.6</td>
</tr>
<tr>
<td>Ohio</td>
<td>40</td>
<td>32</td>
<td>80</td>
<td>61.5</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>20</td>
<td>15</td>
<td>75</td>
<td>66.1</td>
</tr>
<tr>
<td>Oregon</td>
<td>23</td>
<td>13</td>
<td>57</td>
<td>70.0</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>18</td>
<td>11</td>
<td>61</td>
<td>73.9</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>74.5</td>
</tr>
<tr>
<td>South Dakota</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>75.2</td>
</tr>
<tr>
<td>Utah</td>
<td>4</td>
<td>4</td>
<td>100</td>
<td>76.4</td>
</tr>
<tr>
<td>Vermont</td>
<td>4</td>
<td>2</td>
<td>50</td>
<td>77.0</td>
</tr>
<tr>
<td>Virginia</td>
<td>8</td>
<td>5</td>
<td>63</td>
<td>78.5</td>
</tr>
<tr>
<td>West Virginia</td>
<td>3</td>
<td>3</td>
<td>100</td>
<td>79.4</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>101</td>
<td>66</td>
<td>65</td>
<td>99.4</td>
</tr>
<tr>
<td>Wyoming</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.15: Overall Response Rate of Course Instructors by State.
The occupational experience and tenure within an agricultural profession was evident among survey participants and is presented in Table 4.16. Participants had the opportunity to report any careers related to agriculture, therefore it was possible to obtain a response greater than the number of survey participants. Of the 330 questioned, 197 had worked as an agricultural teacher at some point of their career. The average number of years as a teacher was 12.14. The second most reported occupation was an Extension educator \((n=188)\), with an average of 12.97 years in the profession. Experience as a farm worker or owner was reported with 176 respondents, and the average number of years in this profession was 20.76. Other occupations included agri-business \((n=78)\), equipment dealers \((n=19)\), sales \((n=8)\), and non-agricultural business \((n=7)\).

<table>
<thead>
<tr>
<th>Occupation</th>
<th>N</th>
<th>Minimum Years</th>
<th>Maximum Years</th>
<th>Mean Number of Years</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural teacher</td>
<td>197</td>
<td>0</td>
<td>36</td>
<td>12.14</td>
<td>9.889</td>
</tr>
<tr>
<td>Extension educator</td>
<td>188</td>
<td>0</td>
<td>40</td>
<td>12.97</td>
<td>10.626</td>
</tr>
<tr>
<td>Agri-business</td>
<td>78</td>
<td>0</td>
<td>45</td>
<td>8.19</td>
<td>10.547</td>
</tr>
<tr>
<td>Farm worker/owner</td>
<td>176</td>
<td>0</td>
<td>59</td>
<td>20.76</td>
<td>12.924</td>
</tr>
<tr>
<td>Other</td>
<td>34</td>
<td>0</td>
<td>32</td>
<td>8.26</td>
<td>9.330</td>
</tr>
</tbody>
</table>

Table 4.16: Course Instructors’ Experience and Tenure in Agricultural Occupations.
Survey participants reported their experience teaching tractor and machinery safety programs (Figure 4.9). Of the 330 instructors, 37.9% had less than 7 years experience teaching the subject. Twenty-five instructors (7.6%) reported never teaching the subject at all.

Figure 4.9: Number of accumulative years instructors reported teaching tractor and machinery safety programs

Instructors reported receiving their teaching expertise for the tractor and machinery safety program by a variety of methods. The most common method reported was general experience (36.5%) and self-study (27.6%). Fifty-eight instructors (7.7%) completed formalized training, while 127 instructors (16.8%) participated in workshops.
and in-service training programs. Fifty-two had participated in a HOSTA training seminar, while four had received instruction through the *Gearing Up for Safety* workshops.

The distribution of instructor ages ranged from 24-64 years. The average age was 43.4 years with a standard deviation of 10.7. Instructors reported their involvement with agricultural equipment when they were young persons. Most all instructors reported they had experience with tractors (84.2%) and farm machinery (83.3%) before the age of 18. However, many instructors (73.6%) did not participate in the DOL tractor and machinery certification program.

*Results*

Instructors reported information about their local Tractor and Machinery Certification program, opinions of tractor safety programs, and basic competencies for youth to possess after completion of a certification program. Results for Objectives 5, 6, 7, and 8 are presented sequentially.

*Objective 5:*

*Describe the type of certification, Tractor or Tractor and Machinery, offered by the certifying agency including the number of educational hours:*

*10-, 15-, 20-, 24-, or 25-hours*

Of the 330 respondents, 44.8% did not teach a DOL Certification program. Of those who offered a DOL training, the certification was administered through an extension or 4-H program (68.7%) as opposed to the agricultural education program (24.7%). Of the 12 who indicated they offer a DOL program other than through an
Extension or vocational agricultural course, they specified the training was administered through a combination of Extension and agricultural education programs ($n=11$) or a through a Farm Bureau program ($n=1$). Table 4.17 reports these data.

<table>
<thead>
<tr>
<th>Administering Agency</th>
<th>$N$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension or 4-H Program</td>
<td>125</td>
<td>68.7</td>
</tr>
<tr>
<td>Agricultural Education Program</td>
<td>45</td>
<td>24.7</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>6.6</td>
</tr>
<tr>
<td>Total</td>
<td>182</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note.* Non-DOL programs, $n=148$.

Table 4.17: Administering Agency of the Tractor and Machinery Certification Program.

The type of DOL program most often taught was the full Tractor and Machinery Certification program (Table 4.18). The two “Other” programs reported by instructors were Tractor certification programs, however one program added mechanical blueberry harvesters to the curriculum, while the other added commercial lawn equipment. Three of the four USDA regions provided this type of training; the exception was the eastern region, which offers the Tractor Certification most frequently (Table 4.19).
Table 4.18: Type of DOL Certification Course Offered Most Often by Community Instructors.

<table>
<thead>
<tr>
<th>Type of DOL Certification Program</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor and Machinery Certification</td>
<td>109</td>
<td>59.9</td>
</tr>
<tr>
<td>Tractor Certification</td>
<td>71</td>
<td>39.0</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>182</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note.* Non-DOL programs, *n*=148.

Table 4.19: Type of DOL Certification Course Offered by Geographic Region.

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>Tractor and Machinery Certification</th>
<th>Tractor Certification</th>
<th>Other</th>
<th>Non-DOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>209</td>
<td>81</td>
<td>43</td>
<td>1</td>
<td>84</td>
</tr>
<tr>
<td>Eastern</td>
<td>62</td>
<td>13</td>
<td>19</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>Southern</td>
<td>35</td>
<td>9</td>
<td>4</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Western</td>
<td>24</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>330</td>
<td>109</td>
<td>71</td>
<td>2</td>
<td>148</td>
</tr>
</tbody>
</table>

The Code of Federal Regulations sets criteria for the number of hours the comprehensive training courses, with no distinction between classroom, driving, or out-of-classroom study. The law makes a distinction between the Extension and vocational agricultural program in terms of hours of instruction. Within Extension, the Tractor-only course is a 10-hour program while the Tractor and Machinery course is a 24-hour program.
In the secondary school training programs, the Tractor-only course is a 15-hour program and the Tractor and Machinery course is a 25-hour program. In either of the two formats, it is not expected that the machinery operation guidelines be taught as a stand-alone curriculum.

If the instructors offered a DOL training course, they reported the number of hours students spent in the course (Table 4.20). Instructors reported a range of classroom instruction to be 0 – 36 hours, with the average amount of time of 15.15 hours. They spent 1 – 45 hours driving or performing hands-on activities, with an average amount of time with the equipment as 6.96 hours. Instructors assigned homework outside of the classroom that consumed 0 – 24 hours, with an average amount of time spent on self-study as 6.94 hours.

Because it is possible for instructors to vary their hours of course instruction between classroom, driving, and homework hours, a weighted mean was calculated. This approach allowed the researcher to derive a class-hour average to be 30.05 instructional hours, more than the prescribed 24-hour program indicated in the legislation.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Min. Hours</th>
<th>Max. Hours</th>
<th>Mean Hours</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours for classroom instruction</td>
<td>169</td>
<td>0</td>
<td>36</td>
<td>15.15</td>
<td>6.708</td>
</tr>
<tr>
<td>Hours driving/doing hands-on activities</td>
<td>153</td>
<td>1</td>
<td>45</td>
<td>6.96</td>
<td>6.092</td>
</tr>
<tr>
<td>Hours assigned to homework or self-study</td>
<td>130</td>
<td>0</td>
<td>24</td>
<td>6.94</td>
<td>5.437</td>
</tr>
</tbody>
</table>
Table 4.20: Amount of Instructional Hours Teaching DOL Certification Programs.

Objective 6:

Identify teaching methods and curriculum resources used in the certification program by community-based instructors

All instructors participating in the survey were asked about their teaching resources and methods. Table 4.21 reports the primary course book used by tractor and machinery instructors. The primary course book was the manual published by HOBAR, *Safe Operation of Agricultural Equipment*, used by 66.0% of instructors. Forty-six instructors (14.6%) reported they use state- or locally-developed curriculum as their primary teaching resource.

<table>
<thead>
<tr>
<th>Resource</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Safe Operation of Agricultural Equipment</em>, by HOBAR Publications</td>
<td>208</td>
<td>66.0</td>
</tr>
<tr>
<td>State or locally developed materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-H curriculum</td>
<td>26</td>
<td>8.3</td>
</tr>
<tr>
<td>Not Applicable</td>
<td>25</td>
<td>7.9</td>
</tr>
<tr>
<td>Dealer publications</td>
<td>10</td>
<td>3.2</td>
</tr>
<tr>
<td>Total</td>
<td>315</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note. Missing, n=15.

Table 4.21: Primary Course Book Used to Teach Tractor and Machinery Safety to Youth.

Instructors indicated they used other books to compliment their training program,
and these are presented in Table 4.22. The most reported resources include dealer publications (28.6%) and state- or locally-developed curriculum (28.4%).

<table>
<thead>
<tr>
<th>Supplemental Resource</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dealer publications</td>
<td>115</td>
<td>28.6</td>
</tr>
<tr>
<td>State or locally developed materials</td>
<td>114</td>
<td>28.4</td>
</tr>
<tr>
<td>Not applicable</td>
<td>72</td>
<td>17.9</td>
</tr>
<tr>
<td><em>Safe Operation of Agricultural Equipment</em>, by HOBAR Publications</td>
<td>55</td>
<td>13.7</td>
</tr>
<tr>
<td>4-H curriculum</td>
<td>46</td>
<td>11.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>402</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.22: Supplemental Resources Used to Teach Tractor and Machinery Safety to Youth.

Instructors identified the types of teaching aids they believed to be most effective for student learning (Table 4.23). From a list of 11 possible choices, instructors selected their top five aids to be hands-on activities (21.4%), video tapes (18.5%), student workbooks (14.7%), guest lecturers (13.5%), and DVDs (10.4%). The least selected aids were flip charts (.6%), textbooks (2.6%), on-line computer instruction (3.2%), and overhead transparencies (3.4%). Other aids written into the survey include demonstrations, toy equipment, games, worksheets, newspaper clippings of actual accidents, working with an adult mentor, group discussion, driving actual equipment, and students teaching safety to elementary audiences. Preferences for teaching aids were similar regardless of instructors who teach or do not teach a DOL course, as depicted in Figure 4.10.
<table>
<thead>
<tr>
<th>Teaching Aids</th>
<th>N</th>
<th>%</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands-on activities</td>
<td>296</td>
<td>21.4</td>
<td>1</td>
</tr>
<tr>
<td>Video tapes</td>
<td>255</td>
<td>18.5</td>
<td>2</td>
</tr>
<tr>
<td>Student workbooks</td>
<td>203</td>
<td>14.7</td>
<td>3</td>
</tr>
<tr>
<td>Guest lecturers</td>
<td>186</td>
<td>13.5</td>
<td>4</td>
</tr>
<tr>
<td>DVDs</td>
<td>143</td>
<td>10.4</td>
<td>5</td>
</tr>
<tr>
<td>Computer assisted instruction or activities</td>
<td>89</td>
<td>6.4</td>
<td>6</td>
</tr>
<tr>
<td>Slide presentations</td>
<td>70</td>
<td>5.1</td>
<td>7</td>
</tr>
<tr>
<td>Overhead transparencies</td>
<td>47</td>
<td>3.4</td>
<td>8</td>
</tr>
<tr>
<td>On-line computer instruction or activities</td>
<td>44</td>
<td>3.2</td>
<td>9</td>
</tr>
<tr>
<td>Textbooks</td>
<td>36</td>
<td>2.6</td>
<td>10</td>
</tr>
<tr>
<td>Flip charts</td>
<td>8</td>
<td>.6</td>
<td>11</td>
</tr>
<tr>
<td>Not applicable</td>
<td>4</td>
<td>.3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1381</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.23: Teaching Aids Identified as Most Effective for Student Learning.
Figure 4.10: Teaching aids identified as most effective for student learning, comparison of DOL and non-DOL instructors
Objective 7:

Determine community instructors’ perceptions and management styles of the Tractor and Machinery Certification program

Perceptions from Community Instructors about DOL Program

In order to gain a perspective of how the DOL program is perceived on the local level, course instructors were asked their opinions on 19 topics related to the federal certification program. These topics were based on qualitative information attained through focus group discussions from Objective 2. Since focus group results are not generalized back to any larger population than the group that participated in the sessions, the researcher took the opportunity to incorporate the qualitative results into the survey instrument for corroboration by the local instructors. Using a Likert-type scale, the instructors rated each of the 19 items as: (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly Agree. Instructors who did not have experience with a DOL program to make a valid judgment were able to select “No experience with DOL program.” No value was assigned to this option; the choice was available as a mechanism to control for non-responses.

Instructor perceptions for their level of agreement to the 19 items are reported in Table 4.24. For purposes of analysis, the researcher combined values 4 and 5 to indicate levels of agreement.

Community instructors believed the course was beneficial to students (86.3%) and that the students took the course seriously (77.3%). Course instructors also agreed additional teaching aids were needed for the DOL program (73.7%), that the DOL course had potential to attract new audiences in landscaping and horticultural services (80.0%),
and the DOL program had potential to attract many more students than what it currently reaches (69.6%). Instructors also believed written tests (72.3%) and skills/driving tests (69.9%) for the DOL program should meet nationally identified standards.

Two hundred sixty-six of the instructors (85.8%) disagreed with the statement, “This program should no longer be offered.” Instructors ($n=201$) were also in disagreement that the course could be offered in its entirety as a self-study program (65.5%).

Three topic areas that received considerable discussion time during the regional focus groups were: (a) course fee structure, (b) instructor training programs, and (c) student self-study options. These topics, now posed to a national sample of course instructors for perceived need, showed no strong support for or opposition to these issues.
<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>% No Opinion</th>
<th>% Agree and Strongly Agree</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>The course is beneficial for students.</td>
<td>313</td>
<td>10.9</td>
<td>86.3</td>
<td>1</td>
</tr>
<tr>
<td>This program could attract new youth audiences, like those in landscaping and horticultural services.</td>
<td>310</td>
<td>7.1</td>
<td>80.0</td>
<td>2</td>
</tr>
<tr>
<td>Students take the course seriously.</td>
<td>312</td>
<td>11.5</td>
<td>77.3</td>
<td>3</td>
</tr>
<tr>
<td>Additional teaching aids should be developed for this course.</td>
<td>312</td>
<td>10.9</td>
<td>73.7</td>
<td>4</td>
</tr>
<tr>
<td>The written test should meet nationally identified standards.</td>
<td>310</td>
<td>7.7</td>
<td>72.3</td>
<td>5</td>
</tr>
<tr>
<td>The skill/driving test should meet nationally identified standards.</td>
<td>312</td>
<td>7.7</td>
<td>69.9</td>
<td>6</td>
</tr>
<tr>
<td>This program has potential to attract many more students than what it currently reaches.</td>
<td>309</td>
<td>8.1</td>
<td>69.6</td>
<td>7</td>
</tr>
<tr>
<td>The required course hours identified by law for 4-H/Extension programs (10 hours for tractor, and 24 hours for tractor &amp; machinery) are sufficient to adequately teach a safety program.</td>
<td>313</td>
<td>9.3</td>
<td>67.4</td>
<td>8</td>
</tr>
<tr>
<td>The required course hours identified by law for school-based programs (15 hours for tractor, and 25 hours for tractor &amp; machinery) are sufficient to adequately teach a safety program.</td>
<td>308</td>
<td>12.0</td>
<td>66.9</td>
<td>9</td>
</tr>
<tr>
<td>Homework is appropriate for this course.</td>
<td>311</td>
<td>10.3</td>
<td>63.3</td>
<td>10</td>
</tr>
<tr>
<td>The course is only beneficial to students when led by an instructor.</td>
<td>310</td>
<td>7.7</td>
<td>55.2</td>
<td>11</td>
</tr>
<tr>
<td>Instructors should be expected to complete a formal train-the-trainer program in order to teach the certification course to youth.</td>
<td>311</td>
<td>7.4</td>
<td>51.1</td>
<td>12</td>
</tr>
<tr>
<td>Portions of this course could be offered as a self-study program.</td>
<td>311</td>
<td>7.7</td>
<td>50.5</td>
<td>13</td>
</tr>
<tr>
<td>Students should be assessed a fee for receiving safety training.</td>
<td>313</td>
<td>8.0</td>
<td>44.1</td>
<td>14</td>
</tr>
<tr>
<td>Students should be assessed a fee for receiving certification credentials.</td>
<td>312</td>
<td>7.7</td>
<td>38.8</td>
<td>15</td>
</tr>
<tr>
<td>Instructor’s experience of tractor and machinery operation should be enough to teach the certification course to youth.</td>
<td>310</td>
<td>7.7</td>
<td>38.7</td>
<td>16</td>
</tr>
<tr>
<td>Up-to-date teaching aids are available to instruct this course.</td>
<td>310</td>
<td>11.0</td>
<td>37.1</td>
<td>17</td>
</tr>
<tr>
<td>This course could be offered in its entirety as a self-study program.</td>
<td>307</td>
<td>8.5</td>
<td>11.4</td>
<td>18</td>
</tr>
<tr>
<td>This program should no longer be offered.</td>
<td>310</td>
<td>7.7</td>
<td>2.3</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 4.24: Community Instructor Perceptions of the DOL Certification Program.
Instructors were asked to rate their ability to offer a Tractor and Machinery Certification program based on 11 external factors (Table 4.25). A 3-item Likert-type scale allowed instructors to indicate the degree these external factors affected them in offering a DOL course. Participants could answer for each variable: (a) never affects my ability to offer a program, (b) somewhat affects my ability to offer a program, and (c) definitely affects my ability to offer a program. Instructors who did not have experience with a DOL program were able to select “No Opinion.” No value was assigned to this option; the choice was available as a mechanism to control for non-responses.

The majority of instructors (59.9%) indicated they did not lack support from their administration in order to offer a training program. The highest reported factors that definitely affect their ability to offer a DOL program was lack of time to teach the course in the prescribed number of hours required by legislation (24.3%), lack of support or awareness from employers or labor groups to encourage students to receive certification (23.6%), and lack of enforcement on employers to comply with the certification requirement (22.5%). Interestingly, the items commonly thought to influence community leaders’ abilities to offer the program were accounted for as “somewhat of an influence.” These external factors included lack of teaching resources (42.4%), not enough students interested in the course (40.85), and lack of enforcement on employers to comply with the certification requirement (40.1%).
### Table 4.25: External Factors that Affect Local Course Instructors’ Abilities to Offer a DOL Program.

<table>
<thead>
<tr>
<th>External Factors</th>
<th>N</th>
<th>% No Opinion</th>
<th>% Never</th>
<th>% Somewhat</th>
<th>% Definitely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of support from administration to offer a course.</td>
<td>309</td>
<td>8.4</td>
<td>59.9</td>
<td>20.4</td>
<td>11.3</td>
</tr>
<tr>
<td>Lack of community support or awareness of course benefits</td>
<td>311</td>
<td>7.1</td>
<td>49.5</td>
<td>32.5</td>
<td>10.9</td>
</tr>
<tr>
<td>Lack of people to assist with teaching the course.</td>
<td>311</td>
<td>5.8</td>
<td>46.9</td>
<td>33.8</td>
<td>13.5</td>
</tr>
<tr>
<td>Lack of equipment to conduct the skills or driving portion of the course.</td>
<td>309</td>
<td>6.8</td>
<td>40.1</td>
<td>32.7</td>
<td>20.4</td>
</tr>
<tr>
<td>Lack of funding to offer the course.</td>
<td>311</td>
<td>7.1</td>
<td>39.9</td>
<td>34.7</td>
<td>18.3</td>
</tr>
<tr>
<td>Lack of teaching resources.</td>
<td>309</td>
<td>5.5</td>
<td>38.5</td>
<td>42.4</td>
<td>13.6</td>
</tr>
<tr>
<td>Not enough students to justify my time offering a course.</td>
<td>311</td>
<td>9.0</td>
<td>37.0</td>
<td>36.7</td>
<td>17.3</td>
</tr>
<tr>
<td>Lack of time to teach the course in the prescribed number of hours required by Dept. of Labor.</td>
<td>305</td>
<td>8.5</td>
<td>33.8</td>
<td>33.4</td>
<td>24.3</td>
</tr>
<tr>
<td>Not enough students interested in the course.</td>
<td>311</td>
<td>10.0</td>
<td>30.5</td>
<td>40.8</td>
<td>18.7</td>
</tr>
<tr>
<td>Lack of support/awareness from employers or labor groups to encourage students to receive certification.</td>
<td>305</td>
<td>8.9</td>
<td>29.8</td>
<td>37.7</td>
<td>23.6</td>
</tr>
<tr>
<td>Lack of enforcement on employers to comply with this certification requirement.</td>
<td>307</td>
<td>12.0</td>
<td>25.4</td>
<td>40.1</td>
<td>22.5</td>
</tr>
</tbody>
</table>
Instructors were asked to select the top three issues that would increase the
effectiveness of the DOL certification program (Table 4.26). Of the 12 available options,
three issues rose to the top of importance; these included community awareness of the
program (14.7%), employer support for the program (14.6%), and access to teaching
resources (14.6%). Instructors identified in-service trainings (10.0%) and additional
student learning activities (9.7%) as considerable issues to increase program
effectiveness, while standardizing the testing requirements (4.2%) and decreasing the
required number of course hours (3.7%) were not thought to be issues that would enhance
the DOL program’s effectiveness.

<table>
<thead>
<tr>
<th>Items to Increase Effectiveness of DOL Program</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community awareness of the program</td>
<td>147</td>
<td>14.7</td>
</tr>
<tr>
<td>Employer support for the program</td>
<td>146</td>
<td>14.6</td>
</tr>
<tr>
<td>Access to teaching resources</td>
<td>146</td>
<td>14.6</td>
</tr>
<tr>
<td>Enforcement of the legislation</td>
<td>112</td>
<td>11.2</td>
</tr>
<tr>
<td>In-service training for instructors</td>
<td>100</td>
<td>10.0</td>
</tr>
<tr>
<td>Additional learning activities for students</td>
<td>97</td>
<td>9.7</td>
</tr>
<tr>
<td>Standardized teaching materials</td>
<td>82</td>
<td>8.2</td>
</tr>
<tr>
<td>Ability for students to take the course as a self-study program</td>
<td>44</td>
<td>4.4</td>
</tr>
<tr>
<td>Standardized testing requirements</td>
<td>42</td>
<td>4.2</td>
</tr>
<tr>
<td>Availability of more instructors</td>
<td>41</td>
<td>4.1</td>
</tr>
<tr>
<td>Decrease the number of hours for course requirements</td>
<td>37</td>
<td>3.7</td>
</tr>
<tr>
<td>Increase the number of hours for course requirements</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>999</td>
<td>99.9</td>
</tr>
</tbody>
</table>

*Note.* Due to rounding the total % does not equal 100.

Table 4.26: Instructors’ Opinions of Issues Affecting the Effectiveness of the DOL
Program.
According to the Code of Federal Regulations, the two state agencies responsible for certifying youth in the Department of Labor program are federal Extension and vocational agricultural programs. Data from focus group participants and state program leaders indicated an acceptance of the two current certifying organizations; however, additional entities were identified as possible certifying agencies for the program. These organizations included Farm Bureau, machinery dealers, state labor industries, private consultants, junior colleges with agricultural programs, community and state agricultural groups, and volunteers or alumni of the program.

Data collected from community course instructors substantiated the question, “In your opinion, should Extension and Agricultural Education programs remain the sole agencies responsible for certifying youth in the DOL Tractor and Machinery Certification program?” The majority of course instructors (65.4%) were in agreement. Only 17.1% (n=54) did not agree, and another 17.5% (n=55) were not sure.

Course instructors were not certain there were other agencies, organizations, or businesses qualified to teach the DOL Tractor and Machinery Certification program. Only 26.7% of course instructors believed there to be other agencies qualified to teach the program, with 24.1% answering “No” there were not others qualified. Of this same population, 49.2% indicated “Don’t Know.”

If survey participants answered “Yes” there were other agencies, organizations, and businesses qualified to teach the DOL tractor and machinery certification program, they were asked to identify them. Their responses were similar to those heard earlier in focus groups, including Farm Bureau, equipment dealers, tractor industry representatives, technical colleges, universities, insurance companies, farm safety coalitions, rural
volunteers, and farmers. Course instructors elaborated their list to include OSHA representatives, State Highway Patrols, Emergency Medical Technicians, 4-H and FFA alumni, volunteer organizations (i.e., Ruritans), retirees from implement dealerships, local agricultural foundations, national safety organizations like the National Institute for Farm Safety, state testing schools, and other governmental agencies like state departments of agriculture, Soil and Water Conservation offices, and Farm Service Agency.

Utilizing data generated by the panel of agricultural safety experts in the modified-Delphi process of Research Objective 3, community course instructors were asked their opinions of the required number of training hours for DOL certification (Table 4.27). The majority of community instructors (73.9%) were in agreement with the panel of experts (70.0%), supporting the combination of hours of participation and student competency.

<table>
<thead>
<tr>
<th>DOL Program Requirements</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>On a combination of hours of participation and competency.</td>
<td>229</td>
<td>73.9</td>
</tr>
<tr>
<td>On performance of competency (includes written and skill).</td>
<td>75</td>
<td>24.2</td>
</tr>
<tr>
<td>On hours of program participation.</td>
<td>6</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note:* Missing, \( n = 20 \).

Table 4.27: Instructor’s Opinion of How the DOL Program Should Be Based.
Management of Local DOL Programs

Local instructors who offer the DOL Tractor and Machinery Certification programs were asked a series of questions related to their management of the course. These questions included criteria to pass the course, assessment of testing fees, and age of student participants. The results of these questions are presented below.

DOL course instructors reported their average passing grade for the written exam as 72.74%. Minimum passing grades for the written exam ranged between 40 - 100% (SD = 6.747). The skill and driving exam had a wider range of 0 - 100%, with the average, passing grade of 77.24% (SD = 13.966).

Table 4.28 reports the type of fees assessed for DOL training programs. The majority of programs assessed student participation fees (59.0%). Slightly over 11% of the DOL programs are sponsored all or in part by a club, organization, or business. The 13 responses that selected “Other,” include responses like students only pay a partial workbook fee (n=6), course is offered as part of classroom budget (n=3), course is paid or supplemented through a grant (n=3), and demonstration equipment is donated by an implement dealer (n=1).
<table>
<thead>
<tr>
<th>Fee Type</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students pay a participation fee</td>
<td>131</td>
<td>59.0</td>
</tr>
<tr>
<td>Course is sponsored all or in part by a club, organization or business</td>
<td>26</td>
<td>11.7</td>
</tr>
<tr>
<td>Course is provided as part of my organization’s operating budget</td>
<td>39</td>
<td>17.6</td>
</tr>
<tr>
<td>There are no costs associated with my program.</td>
<td>13</td>
<td>5.9</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>5.9</td>
</tr>
<tr>
<td>Total</td>
<td>222</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.28: DOL Instructors’ Report for Assessing Course Fees.

When fees were assessed (Table 4.29), they were primarily used for student workbooks (34.1%), supplemental teaching materials (18.0%), and student refreshments and activities (14.8%). Other uses for program fees, as written in by survey responders, included costs associated with insurance coverage, fuel, or transportation expenses.
<table>
<thead>
<tr>
<th>Description</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student workbooks</td>
<td>131</td>
<td>34.1</td>
</tr>
<tr>
<td>Supplemental teaching materials</td>
<td>69</td>
<td>18.0</td>
</tr>
<tr>
<td>Student activities/refreshments</td>
<td>57</td>
<td>14.8</td>
</tr>
<tr>
<td>Guest speakers</td>
<td>19</td>
<td>4.9</td>
</tr>
<tr>
<td>Equipment rental</td>
<td>21</td>
<td>5.5</td>
</tr>
<tr>
<td>Facility rental</td>
<td>15</td>
<td>3.9</td>
</tr>
<tr>
<td>Instructor compensation</td>
<td>20</td>
<td>5.2</td>
</tr>
<tr>
<td>Administrative costs/Cost recovery</td>
<td>30</td>
<td>7.8</td>
</tr>
<tr>
<td>Don’t know</td>
<td>6</td>
<td>1.6</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>4.2</td>
</tr>
<tr>
<td>Total</td>
<td>384</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.29: Description of How DOL Course Fees Were Used.

Course instructors participating in the survey reported an average class size of 19.7 students, where boys were more likely represented two to one. The primary age of students enrolled in the program were 14- and 15-year-olds. The variable age followed a normal distribution curve ranging from less than 10 years to greater than 18 years (Figure 4.11).
Figure 4.11: Age distribution of students enrolled in tractor and machinery safety programs, as reported by community course instructors
Objective 8:

Determine program objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by community-based instructors

Program Objectives

The Tractor and Machinery Certification program has been in the legislation since 1968, without explicitly stated curriculum goals and objectives. Results from Objective 3, the modified-Delphi process, identified eight objectives of the DOL program. These objectives were presented to the community course instructors to determine agreement that these are, or should be, overall objectives of the national program. Table 4.30 summarizes the program objectives according to the opinions of the community instructors. With such a high level of agreement to all of the objective statements, it was more evident to document disagreement. With this approach, it was clear to see the statement that received the least amount of support from community instructors. The program objective with the lowest support was “Demonstrate mastery of driving a tractor and attached implement through a series of common obstacles.”
Program Objectives of Tractor and Machinery Certification Program

<table>
<thead>
<tr>
<th>Program Objectives</th>
<th>N</th>
<th>% Yes</th>
<th>% No</th>
<th>% No Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilize accepted practices or equipment operation, focusing on the presence and maintenance of safety components.</td>
<td>310</td>
<td>96.8</td>
<td>0.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Understand farm safety principles in general.</td>
<td>308</td>
<td>96.7</td>
<td>1.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Identify hazardous work environments and tasks in production agriculture.</td>
<td>311</td>
<td>96.1</td>
<td>1.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Make Informed decisions about the operation of agricultural tractors and machinery.</td>
<td>310</td>
<td>96.1</td>
<td>0.3</td>
<td>3.6</td>
</tr>
<tr>
<td>Apply equipment safety knowledge in matters of personal decisions.</td>
<td>309</td>
<td>95.5</td>
<td>1.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Identify protective equipment related to tasks assigned to specific age groups.</td>
<td>308</td>
<td>92.2</td>
<td>2.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Understand basic equipment maintenance.</td>
<td>308</td>
<td>90.6</td>
<td>5.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Demonstrate mastery of driving a tractor and attached implement through a series of common obstacles.</td>
<td>310</td>
<td>87.1</td>
<td>10.3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Table 4.30: Course Instructors Agreement of Program Objectives Identified by Panel of Experts.

Program Competencies

Through the modified-Delphi process, 117 performance competencies were identified for the tractor and machinery certification program. Of those, 77 related to tractor operation, 22 related to machine operation, and 18 related to general safety and health topics. The intended outcome was for community instructors to rate the competencies identified by the Delphi panel of experts. Because the competencies related to safety, all topics could be perceived as important; therefore it was decided to have the course instructors distinguish between the levels of importance. Course instructors reviewed all
Delphi-generated competencies and assigned a value to each skill coded as: (1) not important, (2) slightly important, (3) moderately important, (4) highly important, and (5) critically important.

Results for each competency received high ratings. In order to find distinction between the long list of competencies, the researcher grouped the data according to the two highest classifications, Highly or Critically Important. These percentages are presented in the following tables; competencies for Tractor Safety are presented in Tables 4.31 – 4.35, competencies for Machinery in Table 4.36, and competencies for General Health and Safety in Table 4.37. The reported percentage is an indicator of course instructors’ rating of importance for youth to learn this information in a tractor and machinery certification program.

With 77 competencies related to tractor operation, the researcher found it easier to break the list into more manageable portions. Table 4.31 reports tractor competencies for statements related to general tractor safety information. The three competencies receiving the highest level of importance included topics on tractor overturn. The competency with the lowest importance included that of describing how tractors were designed for work and that they vary in size, shape, and age.

Table 4.32 reports tractor competencies for statements related to general operation. The competencies of highest importance included those that addressed speed, hitching, operation in buildings, and bypass starting. The competencies with least significance included those addressing tractor maintenance, like locating and cleaning grease fittings, checking fuel levels, and battery maintenance.
<table>
<thead>
<tr>
<th>Competency</th>
<th>N</th>
<th>% Highly and Critically Important</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>To understand the safety concerns of operating a tractor on slopes or uneven terrain.</td>
<td>307</td>
<td>97.4</td>
<td>1</td>
</tr>
<tr>
<td>To recognize how to be protected during a tractor overturn.</td>
<td>308</td>
<td>97.1</td>
<td>2</td>
</tr>
<tr>
<td>To understand tractor dynamics, including operating on a hillside or turning on a slope.</td>
<td>307</td>
<td>96.7</td>
<td>3</td>
</tr>
<tr>
<td>To identify the mechanical hazards associated with agricultural machinery and how to avoid such hazards.</td>
<td>309</td>
<td>95.8</td>
<td>4</td>
</tr>
<tr>
<td>To recognize that personal reaction time is slower than the speed of a machine.</td>
<td>308</td>
<td>95.5</td>
<td>5</td>
</tr>
<tr>
<td>To recognize and avoid hazards of being run over.</td>
<td>305</td>
<td>95.4</td>
<td>6</td>
</tr>
<tr>
<td>To know why a tractor should be put in a lower gear when going down a hill.</td>
<td>304</td>
<td>94.7</td>
<td>7</td>
</tr>
<tr>
<td>To explain the role that center of gravity plays in a tractor overturn.</td>
<td>308</td>
<td>94.5</td>
<td>8</td>
</tr>
<tr>
<td>To ensure work area is clear of people, pets, obstacles; and watch for obstacles in the field.</td>
<td>308</td>
<td>94.5</td>
<td>8</td>
</tr>
<tr>
<td>To know not to operate the tractor under the influence of alcohol, drugs, or certain medications.</td>
<td>306</td>
<td>93.8</td>
<td>10</td>
</tr>
<tr>
<td>To recognize proper and improper uses of tractors.</td>
<td>309</td>
<td>92.9</td>
<td>11</td>
</tr>
<tr>
<td>To identify the top 3 causes of tractor fatalities and safe operations to prevent each.</td>
<td>304</td>
<td>92.1</td>
<td>12</td>
</tr>
<tr>
<td>To identify the top 3 causes of tractor injuries and safe operations to prevent each.</td>
<td>306</td>
<td>90.8</td>
<td>13</td>
</tr>
</tbody>
</table>

(Table 4.31 continues)

Table 4.31: Competencies for Tractor Safety: General Information.
Table 4.31 (continued).

<table>
<thead>
<tr>
<th>Task</th>
<th>Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>To understand the magnitude, nature, and lasting impacts of injuries associated with tractor and machinery operation.</td>
<td>307</td>
<td>90.6</td>
</tr>
<tr>
<td>To identify all safety features of a tractor.</td>
<td>309</td>
<td>90.3</td>
</tr>
<tr>
<td>To recognize common hazards of older equipment and their deficiencies of safety equipment.</td>
<td>308</td>
<td>89.9</td>
</tr>
<tr>
<td>To only operate the tractor when physically and mentally alert.</td>
<td>304</td>
<td>89.5</td>
</tr>
<tr>
<td>To know how to mount and dismount the tractor safely.</td>
<td>305</td>
<td>85.6</td>
</tr>
<tr>
<td>To know the location and check the condition of a fire extinguisher.</td>
<td>306</td>
<td>83.7</td>
</tr>
<tr>
<td>To know the location and check the condition of a first aid kit.</td>
<td>309</td>
<td>80.3</td>
</tr>
<tr>
<td>To check that steps and operator platform are free of dirt, grease, debris, and tools.</td>
<td>307</td>
<td>80.1</td>
</tr>
<tr>
<td>To adjust the seat for fit and comfort.</td>
<td>306</td>
<td>73.9</td>
</tr>
<tr>
<td>To know the eleven standard hand signals to communicate actions between tractor operator and persons on the ground.</td>
<td>305</td>
<td>73.4</td>
</tr>
<tr>
<td>To explain the primary types of information found in the tractor/machinery operator's manual.</td>
<td>307</td>
<td>72.3</td>
</tr>
<tr>
<td>To clean the windows and mirrors.</td>
<td>308</td>
<td>68.2</td>
</tr>
<tr>
<td>To describe how tractors are designed for work and that they vary in size, shape and age.</td>
<td>309</td>
<td>60.2</td>
</tr>
<tr>
<td>Competency</td>
<td>N</td>
<td>% Highly and Critically Important</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>----</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>To understand the safety concern of excessive speed.</td>
<td>304</td>
<td>94.4</td>
</tr>
<tr>
<td>To understand the operational safety concern of hitching properly.</td>
<td>305</td>
<td>93.4</td>
</tr>
<tr>
<td>To know not to operate the tractor in a closed building without adequate ventilation.</td>
<td>305</td>
<td>92.1</td>
</tr>
<tr>
<td>To understand the hazards of bypass starting; never start the tractor from the ground.</td>
<td>308</td>
<td>90.3</td>
</tr>
<tr>
<td>To negotiate the tractor between destinations; basic techniques of driving.</td>
<td>307</td>
<td>90.2</td>
</tr>
<tr>
<td>To be able to make operating decisions based upon the information, gauges, and tractor operation symbols and how to react to malfunctions when they occur.</td>
<td>309</td>
<td>90.0</td>
</tr>
<tr>
<td>To be able to safely drive in reverse gear to a specific location.</td>
<td>306</td>
<td>87.6</td>
</tr>
<tr>
<td>To safely start and stop the engine of a gasoline and diesel tractor.</td>
<td>305</td>
<td>86.9</td>
</tr>
<tr>
<td>To conduct pre-operational checks on a daily basis.</td>
<td>309</td>
<td>86.4</td>
</tr>
<tr>
<td>To be able to operate a tractor without stalling or jerking through proper use of the clutch pedal.</td>
<td>307</td>
<td>86.3</td>
</tr>
<tr>
<td>To identify and understand approved universal symbols, instruments, and gauges used to monitor tractor operation and performance.</td>
<td>309</td>
<td>85.4</td>
</tr>
<tr>
<td>To be able to park the tractor properly.</td>
<td>305</td>
<td>85.2</td>
</tr>
<tr>
<td>To be able to listen for unusual sounds and shut off engine if abnormalities are heard.</td>
<td>308</td>
<td>84.7</td>
</tr>
</tbody>
</table>

(Table 4.32 continues)

Table 4.32: Competencies for Tractor Safety: General Operation.
Table 4.32 (continued).

<table>
<thead>
<tr>
<th>Task</th>
<th>Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>When stuck, to know how to back out or have the tractor towed.</td>
<td>304</td>
<td>83.9</td>
</tr>
<tr>
<td>To safely refuel a tractor, making sure the engine is cool and refrain from smoking.</td>
<td>308</td>
<td>83.8</td>
</tr>
<tr>
<td>To recognize and use the proper types of tow ropes or chains.</td>
<td>308</td>
<td>82.5</td>
</tr>
<tr>
<td>To safely use booster cables to jump start a weak battery.</td>
<td>306</td>
<td>82.0</td>
</tr>
<tr>
<td>Check if equipment has been properly serviced and adjusted.</td>
<td>309</td>
<td>81.2</td>
</tr>
<tr>
<td>To safely check oil levels of any engine.</td>
<td>308</td>
<td>80.2</td>
</tr>
<tr>
<td>To safely check coolant levels of liquid cooled engines.</td>
<td>308</td>
<td>76.9</td>
</tr>
<tr>
<td>To warm the engine before applying a heavy load.</td>
<td>308</td>
<td>75.6</td>
</tr>
<tr>
<td>To become familiar with hazards of lead acid batteries, including identification of battery parts and their functions.</td>
<td>304</td>
<td>75.0</td>
</tr>
<tr>
<td>To safely use a battery charger to charge a weak battery.</td>
<td>303</td>
<td>71.6</td>
</tr>
<tr>
<td>Locate all grease fittings; clean and lubricate them.</td>
<td>309</td>
<td>69.3</td>
</tr>
<tr>
<td>To understand how to check fuel levels of common engines.</td>
<td>308</td>
<td>66.2</td>
</tr>
<tr>
<td>To explain the differences between gasoline and diesel engines.</td>
<td>307</td>
<td>63.2</td>
</tr>
<tr>
<td>To be able to check the battery's electrolyte level and add battery water as needed.</td>
<td>308</td>
<td>60.7</td>
</tr>
<tr>
<td>To be able to check, clean, coat, and tighten battery connections.</td>
<td>304</td>
<td>59.9</td>
</tr>
</tbody>
</table>
Table 4.33 reports tractor competencies for statements related to wheels and tires. The competencies within this section did not rate as high as other competencies, with the highest rating of significance given to the students’ ability to recognize low tire pressure (77.2%). According to course instructors, the competencies of least importance in a tractor safety curriculum included those of adding and removing weights and the ability to adjust wheel width.

<table>
<thead>
<tr>
<th>Competency</th>
<th>N</th>
<th>% Highly and Critically Important</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>To recognize low tire pressure.</td>
<td>302</td>
<td>77.2</td>
<td>1</td>
</tr>
<tr>
<td>To identify faulty tire and wheel situations and take corrective action.</td>
<td>300</td>
<td>75.7</td>
<td>2</td>
</tr>
<tr>
<td>To correctly check air pressure in both regular use and calcium filled tires.</td>
<td>302</td>
<td>72.2</td>
<td>3</td>
</tr>
<tr>
<td>To be able to check brakes.</td>
<td>303</td>
<td>67.0</td>
<td>4</td>
</tr>
<tr>
<td>To be able to add or remove weights.</td>
<td>303</td>
<td>40.9</td>
<td>5</td>
</tr>
<tr>
<td>To be able to adjust wheel width.</td>
<td>302</td>
<td>38.7</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4.33: Competencies for Tractor Safety: Wheels and Tires.

Tractor competencies for statements related to lighting, marking, and road travel are reported in Table 4.34. The competencies of highest importance included those that addressed speed, hitching, operation in buildings, and bypass starting. The competencies with least significance included those addressing tractor maintenance, like locating and cleaning grease fittings, checking fuel levels, and battery maintenance.
<table>
<thead>
<tr>
<th>Competency</th>
<th>N</th>
<th>% Highly and Critically Important</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>To use safe and courteous traffic driving practices to prevent collisions with motor vehicles.</td>
<td>303</td>
<td>93.4</td>
<td>1</td>
</tr>
<tr>
<td>To safely make left and right turns.</td>
<td>300</td>
<td>93.0</td>
<td>2</td>
</tr>
<tr>
<td>To safely cross an intersection.</td>
<td>303</td>
<td>92.1</td>
<td>3</td>
</tr>
<tr>
<td>To know how to safely select a place to pull over to let traffic pass.</td>
<td>303</td>
<td>92.1</td>
<td>4</td>
</tr>
<tr>
<td>To know why and how to lock brakes for roadway travel.</td>
<td>305</td>
<td>92.1</td>
<td>5</td>
</tr>
<tr>
<td>To select a safe speed for roadway travel based on size and weight of towed equipment.</td>
<td>305</td>
<td>89.2</td>
<td>6</td>
</tr>
<tr>
<td>To identify the requirements for road operation.</td>
<td>304</td>
<td>88.5</td>
<td>7</td>
</tr>
<tr>
<td>To check the slow moving vehicle emblem for proper placement and that it is clean and not faded.</td>
<td>305</td>
<td>83.3</td>
<td>8</td>
</tr>
<tr>
<td>Check the lighting system to ensure all lights work.</td>
<td>302</td>
<td>79.1</td>
<td>9</td>
</tr>
<tr>
<td>To explain the slow moving vehicle emblem and its usage.</td>
<td>306</td>
<td>78.4</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 4.34: Competencies for Tractor Safety: Lighting, Marking, and Road Travel.

Table 4.35 reports the competencies related to the tractors’ auxiliary features. The competencies received high ratings of importance, with the exception of one. Instructors did not place high importance on the youths’ ability to clean and oil PTO stub shafts and splines (66.3%).
<table>
<thead>
<tr>
<th>Competency</th>
<th>N</th>
<th>% Highly and Critically Important</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>To ensure the Power Take Off (PTO) master shield is in place.</td>
<td>306</td>
<td>95.4</td>
<td>1</td>
</tr>
<tr>
<td>To recognize safety shields and guards on tractor.</td>
<td>303</td>
<td>92.7</td>
<td>2</td>
</tr>
<tr>
<td>To engage the PTO slowly, check for operation, and disengage properly.</td>
<td>303</td>
<td>89.8</td>
<td>3</td>
</tr>
<tr>
<td>To understand the safety concerns of adding auxiliary equipment to tractor like loader buckets, saddle tanks, dual tires, or ballasting.</td>
<td>304</td>
<td>85.5</td>
<td>4</td>
</tr>
<tr>
<td>To operate hydraulic features and check hydraulic controls for proper operation.</td>
<td>306</td>
<td>85.3</td>
<td>5</td>
</tr>
<tr>
<td>To understand the safety concern of adding weights and towing heavy loads.</td>
<td>303</td>
<td>81.8</td>
<td>6</td>
</tr>
<tr>
<td>To clean and oil PTO stub shaft and splines.</td>
<td>306</td>
<td>66.3</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 4.35: Competencies for Tractor Safety: Auxiliary Features.

Machinery safety competencies were rated by community instructors and reported in Table 4.36. The competencies of highest importance included those that address connection, disconnection, and operation of agricultural equipment. Similar to the tractor competencies, the machinery competency receiving the lowest ranking dealt with cleaning and oiling the PTO shaft.
<table>
<thead>
<tr>
<th>Competency</th>
<th>N</th>
<th>% Highly and Critically Important</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>To develop PTO safe use habits.</td>
<td>300</td>
<td>97.3</td>
<td>1</td>
</tr>
<tr>
<td>To identify the hazards involved with PTO use.</td>
<td>300</td>
<td>96.3</td>
<td>2</td>
</tr>
<tr>
<td>To know it is not safe to unclog, adjust, or service equipment while it is running.</td>
<td>301</td>
<td>96.0</td>
<td>3</td>
</tr>
<tr>
<td>To safely use drawbar implements during transport, field use, turns, and backing operations.</td>
<td>294</td>
<td>92.5</td>
<td>4</td>
</tr>
<tr>
<td>To safely connect/disconnect a PTO driveline.</td>
<td>299</td>
<td>92.3</td>
<td>5</td>
</tr>
<tr>
<td>To safely connect/disconnect an implement to the tractor's drawbar.</td>
<td>298</td>
<td>91.9</td>
<td>6</td>
</tr>
<tr>
<td>To know how to enter a roadway safely with a towed implement.</td>
<td>298</td>
<td>91.9</td>
<td>6</td>
</tr>
<tr>
<td>To know how to drive down the road while keeping the implement in the lane of travel.</td>
<td>296</td>
<td>91.9</td>
<td>8</td>
</tr>
<tr>
<td>To safely connect/disconnect an implement to the 3-point hitch.</td>
<td>300</td>
<td>91.0</td>
<td>9</td>
</tr>
<tr>
<td>To know how to turn off and let a machine spin down to a stop before approaching.</td>
<td>302</td>
<td>90.7</td>
<td>10</td>
</tr>
<tr>
<td>To recognize safety concerns associated with stationary equipment like augers, grinder-mixers, &amp; farmstead equipment like motor driven pumps, etc.</td>
<td>302</td>
<td>90.7</td>
<td>10</td>
</tr>
<tr>
<td>To know how to watch and listen to equipment; shut power off at first sign of malfunction.</td>
<td>299</td>
<td>90.6</td>
<td>12</td>
</tr>
</tbody>
</table>

(Table 4.36 continues)

Table 4.36: Competencies for Machinery Safety.
General health and safety competencies were identified by the Delphi panel and rated by community instructors (Table 4.37). While the competencies ranged in their breadth of subject matter, they received high levels of agreement with the course instructors. The three competencies deemed less significant for youth to know at the
completion of a DOL program were their ability to: (a) understand the variability of agriculture and how such variability relates to farm safety, (b) become aware of regulations affecting agricultural workers, and (c) identify growth traits by age groups and how these traits affect the jobs young workers should be assigned.

<table>
<thead>
<tr>
<th>Competency</th>
<th>N</th>
<th>% Highly and Critically Important</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>To identify factors and situations which contribute to agricultural hazards.</td>
<td>312</td>
<td>97.1</td>
<td>1</td>
</tr>
<tr>
<td>To learn when to use specific types of personal protective equipment.</td>
<td>309</td>
<td>94.5</td>
<td>2</td>
</tr>
<tr>
<td>To understand caution, warning, and danger signs.</td>
<td>312</td>
<td>92.3</td>
<td>3</td>
</tr>
<tr>
<td>To identify harmful workplace hazards and suggest specific corrective actions during a walk-around inspection.</td>
<td>310</td>
<td>91.3</td>
<td>4</td>
</tr>
<tr>
<td>To recognize the respiratory hazards associated with agriculture.</td>
<td>311</td>
<td>90.7</td>
<td>5</td>
</tr>
<tr>
<td>To use correct hearing protection.</td>
<td>309</td>
<td>89.6</td>
<td>6</td>
</tr>
<tr>
<td>To use correct respiratory protection.</td>
<td>310</td>
<td>89.0</td>
<td>7</td>
</tr>
<tr>
<td>To recognize the hazards associated with working around livestock.</td>
<td>312</td>
<td>87.2</td>
<td>8</td>
</tr>
<tr>
<td>To work with livestock safely.</td>
<td>310</td>
<td>86.1</td>
<td>9</td>
</tr>
<tr>
<td>To dress safely for work.</td>
<td>312</td>
<td>85.9</td>
<td>10</td>
</tr>
</tbody>
</table>

(Table 4.37 continues)

Table 4.37: Competencies for General Safety and Health Topics.
Table 4.37 (continued).

<table>
<thead>
<tr>
<th>Objective</th>
<th>Response</th>
<th>Confidence</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>To recognize symbols which indicate specific types of personal protective equipment.</td>
<td>310</td>
<td>85.5</td>
<td>11</td>
</tr>
<tr>
<td>To recognize when sound levels can become a threat to hearing.</td>
<td>312</td>
<td>84.6</td>
<td>12</td>
</tr>
<tr>
<td>To recognize housekeeping needs of the farm to prevent hazards.</td>
<td>311</td>
<td>81.7</td>
<td>13</td>
</tr>
<tr>
<td>To provide examples of why hazard control and mitigation are more effective approaches to prevent injuries than common statements like &quot;be careful&quot; and &quot;use common sense&quot;.</td>
<td>311</td>
<td>78.8</td>
<td>14</td>
</tr>
<tr>
<td>To protect one's personal health while working in changing weather conditions.</td>
<td>307</td>
<td>78.2</td>
<td>15</td>
</tr>
<tr>
<td>To understand the variability of agriculture and how it relates to farm safety and health.</td>
<td>312</td>
<td>66.7</td>
<td>16</td>
</tr>
<tr>
<td>To become aware of regulations that affect agricultural workers.</td>
<td>311</td>
<td>59.2</td>
<td>17</td>
</tr>
<tr>
<td>To identify typical growth traits by age groups and how these traits affect the jobs young workers should be assigned.</td>
<td>312</td>
<td>54.2</td>
<td>18</td>
</tr>
</tbody>
</table>

Summary of Survey Data of Community Course Instructors

The goal of the Research Objectives 5 through 8 were to describe the current condition of the tractor and machinery certification program in the U.S. Surveying a national population of community course instructors allowed the researcher to quantitatively assess the qualitative comments received from regional focus group
discussions. The results will help refute or substantiate the informal claims made at national, state, and local levels that the DOL program is in need of improvement.

Results from Research Objective 5 reported the majority of DOL programs were administered through an Extension program (68.7%), a vocational agricultural program (24.7%), or as a combination of the two agencies (6.0%). The predominant type of DOL program was the Tractor and Machinery Certification program, and the weighted average of the course (30.09 hours) exceeded that prescribed in legislation.

Research Objective 6 identified teaching methods and curriculum resources utilized by community instructors. The primary course book used in tractor and machinery safety courses was the HOBAR Publication, *Safe Operation of Agricultural Equipment*. Resources used to supplement the training program included dealer publications (28.6%), state or locally developed curriculum (28.4%), and 4-H curriculum (11.4%).

The top ranked teaching aids utilized by community instructors were hands-on activities, video tapes, student workbooks, guest lecturers, and DVD’s. The aids least selected by instructors were flip charts, textbooks, on-line computer instruction, and overhead transparencies.

Research Objective 7 fleshed out a multitude of perceptions held by community course instructors. Educators strongly believed the course was beneficial to students, and they reported that students take the course seriously. Of other significance, instructors supported a written test and driving test that meet nationally identified standards, agreed additional teaching aids were needed for the DOL program, and felt the course had potential to attract new audiences in landscaping and horticultural services. The
instructors did not feel the course could be offered in its entirety as a self-study program, but were slightly more amenable that portions of the course could be offered as self-study.

Factors that affected the instructors’ abilities to offer a DOL program included lack of time to teach the course in the required of hours, the lack of support or awareness from employers or labor groups to encourage students to receive certification, and lack of enforcement on employers to comply with the certification requirement. The majority of instructors (59.9%) indicated they did not lack support from their administration in order to offer a training program. Three items thought to somewhat influence the instructors’ abilities to offer a DOL training program were the lack of teaching resources (42.4%), not enough students interested in the course (40.85), and lack of enforcement on employers to comply with the certification requirement (40.1%).

Overall, instructors believed the top three issues that would increase the effectiveness of the DOL program included community awareness of the program, employer support for the program, and access to teaching resources. Issues that closely followed these included enforcement of the legislation, in-service training for instructors, and additional learning activities for students. Interestingly, instructors believed standardization of teaching material was slightly more effective than standardization of testing requirements. They also did not believe that lowering the required number of course hours would be an effective measure for program improvement.

With respect to the two named agencies in the current legislation, Extension and Agricultural Education programs, the majority of course instructors (65.4%) were in agreement for these to remain the sole agencies responsible for administering the
certification. Only 17.1% (n=54) did not agree, and another 17.5% (n=55) were not sure.

Only 26.7% of course instructors believed there to be other agencies qualified to teach the program. These included Farm Bureau, equipment dealers, tractor industry representatives, technical colleges, universities, insurance companies, farm safety coalitions, rural volunteers and farmers. The remaining course instructors did not believe there were other agencies qualified to certify the youth (24.1%), or responded they did not know if there were agencies qualified to certify youth (49.2%).

Results showed agreement between course instructors’ opinions and panel of experts’ opinions for the DOL requirements. The majority of community instructors (73.9%) were in agreement with the panel of experts (70.0%), supporting the combination of hours of participation and student competency.

Research Objective 7 also determined management strategies of the DOL program. Course instructors reported their average passing grade for the written exam was 72.74%, and the skill and driving exam was 77.24%. The majority (59.0%) of course instructors assessed participation fees for the program, and these fees were primarily used for workbooks, supplemental teaching materials, and student refreshment or activities.

The average class size reported was 19.7 students, with a higher proportion of boys. Students’ age followed a normal distribution curve, where the majority were 14- and 15-year-olds.

Research Objective 8 utilized opinions of community course instructors to validate DOL program objectives and competencies identified by a panel of experts. Course instructors rated each of the eight program objectives with high levels of
agreement. Seven out of the eight objectives had frequency reports greater than 90%, while the eighth scored 87.1%.

The 117 competencies identified in the modified-Delphi process were rated by community course instructors. The ratings indicated the significance for that competency to be included in a DOL training program. From the 77 tractor competencies, only 23 received scores lower than 80.0%. Of the 22 machinery competencies, only three received scores lower than 80%; and of the 18 general safety and health topics, five received scores lower than 80%. This indicated that overall, 73.5% of the competencies identified by the panel of experts were considered highly or critically important for youth to learn, when rated by community course instructors.
CHAPTER 5

SUMMARY, DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS

Purpose of the Study

The purpose of the study was to comprehensively explore the multiple levels of stakeholders’ perceptions of the DOL Tractor and Machinery Certification program and to describe its status within the various geographical regions of the U.S. The first national study of its kind, the descriptive research in this report sets a baseline for future evaluation studies of this widely adaptive program. Taking a multi-faceted approach, the research provides a description of the Tractor and Machinery Certification program as it exists at the turn of the twenty first century. This is a crucial step in the evaluation process to assist national policy makers, occupational safety specialists, agricultural researchers, and curriculum developers for future decision-making and resource allocation. It is also significant to understand the program on the state and local levels to assist administrators and course instructors on implementation strategies and perceptions of program worth. To provide this baseline information and chart the future of the DOL program, the researcher was guided by eight research objectives.
Objectives of the Study

The objectives of the study were to:

1. Determine the program’s youth enrollment status over a five-year period, as reflected in the USDA-CSREES reporting system;

2. Identify attributes of the Tractor and Machinery Certification program offered in various geographic regions and stakeholders’ perspective on the need for program improvement;

3. Describe perceived objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by a panel of experts;

4. Quantify the number of instructors offering the program in each state according to their certifying agency: USDA-CSREES Extension Service and the United States Department of Education vocational agricultural programs;

5. Describe the type of certification, Tractor or Tractor and Machinery, offered by the certifying agency including the number of educational hours: 10-, 15-, 24-, or 25-hours;

6. Identify teaching methods and curriculum resources used in the certification program by community-based instructors;

7. Examine community instructors’ perceptions and management styles of the Tractor and Machinery Certification program; and

8. Determine perceived program objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for
youth to be certified after participation in such a program, as identified by community-based instructors.

Research Design

This study employed a combination of descriptive research techniques to portray the incidence, distribution, and perceptions of the national Tractor and Machinery Certification program. The researcher utilized multiple methods to answer the fundamental question, “What is the current status of the Tractor and Machinery Certification program in the United States?”

The primary objectives driving the study were inquiring into the nature, incidence, and distribution of variables involved in the certification program. The researcher addressed eight research objectives through four phases of investigation. The three types of design methods employed were unobtrusive data collection, qualitative methods in the form of focus groups and a modified-Delphi technique, and quantitative methods through survey research.

The target population for the study included multiple stakeholders of the Tractor and Machinery Certification program. Each method required a different population and recruitment strategy. Likewise different data collection methods and analysis were used for each research objective.

Objective 1

Unobtrusive data collection techniques were used to answer Research Objective 1. No human subjects were questioned; rather, agency reports were ascertained from
USDA-CSREES federal program leaders in the 4-H and Agriculture Programs. While both units maintain databases for tractor and machinery safety, their sources are different. One collects data from the states’ 4-H Program Leaders and the other from the states’ Agricultural Program Leaders. These data sets were collected annually from 1999 to 2003 to help familiarize the researcher with the scope of the national program and to help identify pockets of the nation with strong or weak program participation rates.

Data tables were constructed using the USDA agency reports. Tables portrayed the number of youth enrolled in the program by year and by state. No reports were available from the State Department of Education.

Objective 2

Focus groups were established in eight geographic regions of the U.S. Participants were identified in two ways, either through organizational directories or by nominations from state agricultural safety specialists. Representatives included Extension professionals, vocational agricultural teachers, Farm Bureau safety directors, equipment dealers, farm employers, and parents.

A 14-question moderator guide was developed for use with the eight regional focus groups. During the focus groups, several methods were employed to maintain consistency between session groups; they included (a) the researcher moderated each discussion session, (b) a moderator assistant served as a note-taker, and (c) sessions were audio recorded and transcribed by an outside contractor.

Transcriptions from the eight sessions were compiled and imported into NUD*IST N6 Software (QSR N6, 2002), a statistical package for qualitative data. The
transcripts were coded by topic areas and participant comments were categorized into themes.

Objective 3

The modified-Delphi technique utilized a homogenous panel of agricultural safety specialists with national geographic representation. Ten experts were recruited through the NIFS directory; selection criteria were based on Tractor and Machinery Certification program knowledge, including the history of the legislation, the condition of existing curriculum, the operational components of the certification process, the type and competency of instructors and program volunteers, as well as the traditional demographic type of student participants.

A 3-question instrument was developed by the researcher for the modified-Delphi technique. Data was collected weekly over a 6-week period. Electronic mail was used to disseminate and collect Delphi participants’ comments. Responses were copied into a Microsoft® Word 10.0 document for easy formatting.

Data sets were collected and summarized into an aggregated pool. This was done for two reasons, (a) to maintain anonymity of experts’ responses, and (b) to provide a concise collection of statements, void of repetitious comments.

Objective 4

Qualitative survey data were collected by two independent sources at the state level. The Code of Federal Regulations specifies two agencies as sources for Tractor and Machinery Certification, Extension and vocational agricultural education programs. Within each agency, there are two populations, those that provide administrative support
at the state level and those that teach the course at the community level. Therefore, state program leaders of the Cooperative Extension Service and Departments of Education were surveyed to determine the number of instructors offering courses in each state of the nation, as well as the type of certification offered.

An 8-item instrument was developed by the researcher for use by state program leaders in Extension and Departments of Education. Two separate surveys were used, one for each population. While syntactically identical, they varied only by reference to educators in their agency.

The surveys were administered through Zoomerang®, a web-based survey management program. This system allowed for efficient survey development, implementation, collection, tracking of non-responders, and coding. The process was also highly accepted by busy administrators. Data sets were downloaded from the survey package into a Microsoft® Excel 10.0 worksheet. Data were coded and transferred into SPSS 11.0© for analysis. Contingency tables of the descriptive statistics were created by agency and geographic region of the U.S. Responses from open-ended questions were compiled into a Microsoft® Word 10.0 document. State leaders also provided contact information of instructors in their state teaching the course. A directory of community instructors was organized into a Microsoft® Excel 10.0 spreadsheet for easy management of the information.

Collection of Objectives 5, 6, 7, and 8

Community Extension educators and secondary school agricultural teachers were surveyed to identify methods and curriculum resources used in their local programs, as
well as additional curricular needed to teach effective programs. The study also sought to identify perceptions, management styles, and perceived objectives of the Tractor and Machinery Certification program.

A 43-item survey instrument, divided into three sections, was created by the researcher for use with local community instructors of the Tractor and Machinery Certification program. Questions were created from data collected in earlier research phases from focus groups, Delphi techniques, and state program leader surveys.

This survey was also administered through Zoomerang®, a web-based program which allowed for efficient survey development, implementation, collection, tracking of non-responders, and coding. Data sets were downloaded from the survey package into a Microsoft® Excel 10.0 worksheet. Data were coded and transferred into SPSS 11.0© for analysis. Contingency tables were created to report descriptive data.

Summary and Discussion of Findings

Objective 1:

*Determine the program's youth enrollment status over a five-year period, as reflected in the USDA-CSREES reporting system*

Summary

Two USDA-CSREES agencies collected youth participation data for tractor and machinery safety programs. While managed by the same agency, their data sources were different. One collects data from states’ 4-H Program Leaders, and the other from states’ Agricultural and Natural Resources (AGNR) Program Leaders. These data sets were
collected annually from 1999 to 2003 to help familiarize the researcher with the scope of the national program, and help identify pockets of the nation with strong or weak program participation.

Program participation reports varied between the two databases. Drastic difference was observed when comparing the 4-H reports to those submitted by AGNR. Over the five years of data collection, the 4-H database reported 80,902 program participants, while the AGNR database reported 22,716 participants. These differences were largely due to the fact that the 4-H database includes all safety programs, not just Tractor and Machinery Certification programs.

However, reporting errors may exist in the AGNR database. Of notable interest, the AGNR database for year 2002 showed Texas youth enrollment at 4,325 when previous years reported a minimal number of students. While this may be an error within that state’s report, it indicates typical reporting errors that obtrusive data collection measures contain.

Discussion and Implications

Participation records for this study were collected from known databases of USDA-CSREES, the primary agency responsible for the youth exemption program designated through the Hazardous Occupations Order in Agriculture. No databases were identified from the Department of Education. It was not known how the numbers were derived within the states, or how the youth were counted. There was no distinction in the databases between those receiving certificates through Extension programs or those from vocational agricultural programs. No descriptive information about the students was available, for instance their ages or types of certification received. It has been speculated
that some state reporters use the number of textbooks sold as an indicator of student enrollment. It is also possible for participants attending any type of program containing a tractor safety topic to be counted as participants of a Tractor and Machinery Certification program. However, using this type of attendance record is not at all accurate in reporting the number of youth receiving DOL training.

This study attempted to quantify the number of students in the U.S. enrolled in a Tractor and Machinery Certification program. There was a difference of 58,186 youth between the 4-H \((n=80,902)\) and AGNR \((n=22,716)\) databases. The 4-H database collects information about all safety-related activities, of which Tractor and Machinery Certification is nested within this overall total. The AGNR database is dedicated to Tractor and Machinery Certification enrollment, but it may also contain undiscovered reporting discrepancies, including under-reporting. To place trust in either system’s enrollment report is highly risky. There can be no conclusions made to answering this objective with confidence.

Obtaining accurate enrollment numbers through unobtrusive data collection methods was difficult. Without information about enrollment status, it is difficult to monitor trends or establish a baseline to calculate change in participation rates. Standardized reporting mechanisms are important for verifying the training program is available and used by the intended youth audience. Informal reports from state safety leaders and community instructors indicated the program has limited availability in certain geographic regions and sporadic attendance when offered. Inconsistent database reports substantiate these claims.
Objective 2: 
Identify attributes of the Tractor and Machinery Certification Program offered in various geographic regions and stakeholders’ perspective on the need for program improvement

Summary

Focus groups provided insight into the Tractor and Machinery Certification program’s existence, how it was managed, and how it was perceived by community stakeholders. Conducting eight sessions allowed for identification of any regional or commodity specific differences. The results allowed the researcher to learn about issues surrounding the certification program through interactive, qualitative observations. Discovering firsthand, the researcher was able to gain a clearer picture of the comprehensive program, including underlying concerns surrounding the national program, barriers for implementation, and perceived needs for improvement. A written survey could have revealed priorities and perceived needs in quite a different manner than the discussion groups generated. Through qualitative methods, the researcher was able to interact with community stakeholders and achieve a richer perspective of the problem, more than reading a quantitative report of results.

Qualitative, interpretive research helped the investigator obtain a first impression of the types of certification programs available in communities around the nation. Three topical areas were explored: educational structure, student evaluation, and program marketing. Five primary themes emerged from this process, including youth training, knowledgeable instructors, current teaching resources, existing legislative support, and program marketing. Interestingly, stakeholder opinions were similar, both within and between the eight regional discussions.
Discussion and Implications

Youth training. A reoccurring theme was the importance that employees, particularly those in their teens, receive training when hired in agricultural operations. Training was deemed necessary for all tasks, especially those that involved tractor and machinery operation. All tractors regardless of horsepower should be included in the training programs. Other equipment not included in the original legislation, but that should be incorporated into the training included combines, skid steer loaders, and ATV’s. These opinions are congruent with findings in the agricultural safety literature that agree training is an important part of injury prevention strategies (Donham et al., 1997; Myers, 1998; Wilkinson et al., 1993). Education has been a traditional approach practiced in the injury prevention model (Murphy, 2003), and the Tractor and Machinery Certification program is one example of this need.

Knowledgeable instructors. Focus group participants also felt strongly that Tractor and Machinery Certification programs be led by knowledgeable instructors, familiar with equipment and agricultural operations. While Extension and vocational agriculture educators are likely instructors with this type of knowledge, there may also be others in the community with this same knowledge. Such persons can be from Farm Bureau, community colleges with agricultural programs, equipment dealerships, or the farming community. Regardless of affiliation, a general consensus among focus group participants was for instructors to receive regular training updates. These train-the-trainer programs would be twofold in that they could offer instructors an opportunity to get industry updates on technology and equipment upgrades, as well as provide administrative announcements from state and federal program personnel.
The idea that instructors possess certain knowledge is supported in educational research literature, and is explicitly stated in the works of Polyanyi (1967) and Shulman (1987). The foundation of these educational researchers believed the importance of content knowledge, pedagogical knowledge, and tactic (experiential) knowledge. The underlying premise that teaching quality is affected by instructors’ content knowledge is an important concept for gaining the respect of the students and the community.

The need for instructors to receive regular updates through in-service programs is a viable approach to transferring safety and health knowledge to community instructors (Donham, Kross, Merchant, & Pratt, 1989; Pierson & Murphy, 1996). Such workshops are most effective when they incorporate experiential learning methods and target pre-professionals, current educators, and industry specialists (Pierson & Murphy, 1996).

*Current teaching resources.* Focus groups also revealed the need for updated curriculum, one that would reflect current technology in agricultural equipment, as well as include learning activities relevant to modern-day tasks. This outcry for updated teaching resources for use in the tractor and machinery certification program has been echoed throughout the agricultural safety profession; the void has also been cited in the literature (Carraba et al., 2000; Ortega et al., 2003; Yarosh, 1993).

Focus group participants could not agree on the incorporation of computer instruction as a viable teaching method for a tractor and machinery certification program. It was noted that web-based or CD ROM materials would be helpful as a teaching resource, similarly to a published handbook or VHS video program. In this context, such electronic resources would be especially helpful in reducing print fees or costs of student workbooks. Likewise, these resources would be helpful in situations to improve self-
directed learning and allow for students to spend additional time on a topic of weak knowledge. However, focus group participants felt there was still a need for hard copy materials for the rural youth audience who do not have reliable access to computers or efficient connections to internet. It was also important for the certification program to be led by an instructor, as opposed to a complete self-study course offered online. The strong message offered by focus group participants consistently supported the need for qualified instructors, especially during the hands-on portion of the training program. This same result was identified by Tormoehlen, Sheldon, and Reeder (1999); their NIOSH-sponsored project evaluated possible formats for tractor safety curriculum, including the efficacy of computer-supported curriculum.

Existing legislative support. Two topics, student evaluation strategies and qualified certification agencies, were discussed by focus groups participants; the results of these discussions matched those currently included in the legislation. There was agreement among participants that the best way to measure performance among students of the training program is for them to take a combination of tests, one that incorporate written knowledge and another that measures skill.

It was also agreed that the two identified agencies, Cooperative Extension and secondary agricultural education programs, remain the primary certifying agencies. Even though additional coordinators were identified, these should not be replacements to the existing agencies included in the legislation.

Program marketing. Marketing the Tractor and Machinery Certification training is necessary for program longevity. Focus group participants identified multiple audiences that should be made familiar with the program, including youth, their parents,
and agricultural employers. Others with interest in these programs may include insurance agencies, equipment dealers who sell tractors to families with children, commodity groups, and farm organizations. With such diversity in the agricultural industry, focus group participants felt it was important to have training programs encompass the breadth of commodities. They recommended the Tractor and Machinery Certification program be structured similar to the pesticide applicators’ training program, where there is one general core course (in this case it would be tractor operation), and then satellite courses would be available to supplement the program. These additional courses would be relevant to the geographic or commodity focus where the youth is interested in working.

A study conducted by Wilkins (2001) attempted to estimate enrollment potential of Ohio’s Tractor and Machinery Certification program. While this study did not intend to be a proponent for marketing, it highlighted the obvious gap in program awareness, which could also result in low program availability or flat out lack of program availability. Concurrently, Wilkins’ study demonstrated the need for additional curriculum to match youths’ educational and employment objectives.

Community instructors are another target audience that could benefit from a marketing campaign. This population is in need of information addressing program requirements, available curriculum, and certification guidelines. As the critical link in certification availability, the service providers require recruitment and program services in order for them to dedicate time for teaching the program.
Objective 3:

Describe perceived objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by a panel of experts

Summary

The modified-Delphi technique used in this research phase generated scholarly discussion between a panel of experts in the agricultural safety arena. The primary goal of this research objective was to flesh out perceived overarching curriculum objectives of the national Tractor and Machinery Certification program, as well as to identify core competencies and skills youth could demonstrate after participation in such a course.

Through their discussions, the panelists developed a written goal and eight supporting objectives for the DOL program. They recommended that the overall goal of the Tractor and Machinery Certification program is to provide an educationally-based certification process for youth ages 14 and 15 who seek agricultural employment, whereby instructors, evaluation, and certification is consistent with the Hazardous Occupations Order in Agriculture. Upon successful completion of a Tractor and Machinery Certification program, the participants will understand the magnitude, nature, and lasting impacts of potential hazards and injuries associated with agricultural tractor and machinery operation. Specifically, they recommended that students should be able to:

1. Make informed and safe decisions about the operation of agricultural tractors and machinery;
2. Demonstrate mastery of a tractor and attached implement through a series of common obstacles;
3. Identify hazardous work environments and tasks in agricultural production;
4. Apply accepted and standard operational techniques used with agricultural tractors and machinery, focusing on those that relate to the presence and maintenance of safety-related systems and components;
5. Understand farm safety principles in general;
6. Integrate equipment safety information in any personal decision;
7. Identify protective equipment related to tasks assigned to specific age groups;
8. Understand basic equipment maintenance.

Currently the legislation calls for students to complete a training program with a specified number of hours; these hours vary based on the type of certification and the administering agency. Criteria for student achievement were also stated in the legislation -- that the student should pass a written exam and successfully drive a tractor and two-wheeled implement through an obstacle course. Through the modified-Delphi process, the majority of panelists (7 out of 10) agreed with the legislation in that they too recommended the program be based on a combination of hours of participation and performance of competency. The minority (30%) voted to remove the hours of participation and base certification solely on competency and student performance outcomes.

The final outcome of the modified-Delphi process was to generate a comprehensive list of curriculum topics. Through their discussions, a comprehensive list of 117 curriculum competencies was identified for the Tractor and Machinery Certification program. These competencies were grouped into three categories as they related to tractor operation (77
competencies), machinery operation (22 competencies), and general safety or health topics (18 competencies).

Discussion and Implications

In the 37 years since legislation (Hazardous Occupations Order in Agriculture) went into effect, serious deficiencies have occurred in the quality of the training and the system by which agencies properly document certification. Focus group discussions alluded to the confusion that currently exists among instructors who do not understand the training guidelines and cannot access up-to-date training materials. The problem is confounded in that no national standards exist for what constitutes a sound educational format for the Tractor and Machinery Certification program. Course instructors at the community level are empowered to develop their own training and performance standards. Such variability makes the certification program flexible for instructors, but inconsistent for student learners and hiring employers.

The behaviorist model (Bandura, 1971; Gagne, 1985; Thorndike, 1928; Watson, 1925) provides a theoretical framework for competency-based education. In developing new curriculum to train or instruct students, especially for occupational settings, curriculum developers can be guided by the principles set forth by early behaviorist proponents (Bloom, 1956; Pratt, 1994; Tyler, 1949). The foundation of their theory begins with well-stated goals and objectives followed by specific, measurable competencies that conform to the level of taxonomy created by the instruction.

Within occupational training programs, and more specifically the Tractor and Machinery Certification program, it is essential that the strategies to achieve a desired level of mastery must be the focus of the certification curricula; such strategies should be
evident, both to the trainer and trainee. Understanding the expected outcomes of a
certification course assists the trainer in teaching relevant subject material, as well as
explains to the student the criteria for achievement. If the implicit program objectives are
safety education, then certainly the curriculum should reflect articulated goals and
objectives for student learners.

The Tractor and Machinery Certification program would be best served by unified
curriculum goals and measurable outcomes. The current management structure of the
program does not accomplish this. A standardized program would benefit stakeholders at
all levels. Currently there is a national movement for industries to voluntarily develop skill
standard systems for their occupations (Hoachlander & Rahn, 1994; Hudelson, 1993;
Hudson, 1994). Such systems will then guide the training programs and certifications
required by workers in these industries. Among the many benefits of this system is that the
standards will emphasize a clearer set of goals for consistent and focused instruction and
course curriculum. Following this approach, the certification program will be unified
throughout the nation and quite possibly increase its effectiveness. Students and
agricultural employers will understand the basic competencies needed for employment, and
educators will be accountable to following a prescribed curriculum for certification.
Certainly this process will lend itself to creating a format for unified program evaluation, a
deficiency of current agricultural safety programs (DeRoo & Rautiainen, 2000; Zwerling,
Daltry, Fine, Johnston, Melius, & Silverstein, 1997).
Objective 4:

Quantify the number of instructors offering the program in each state according to their certifying agency: USDA-CSREES Extension Service and the United States Department of Education vocational agricultural programs

Summary

The researcher was unsuccessful in quantifying the number of instructors offering the Tractor and Machinery Certification program. At the national level, there is no database documenting names of course instructors. Similarly, there were no records of this nature found at the state level. Without a centralized program, a directory of course instructors was nonexistent. Because of this lack of documentation, the researcher attempted to use the certifying agencies’ state contacts to develop this list and quantify the instructors.

The researcher was able to classify the type of tractor and machinery safety programs available in the 50 states by each certifying agency, as well as distinguish those courses that were DOL certification programs. Among state Extension leaders, 32% (n=16) were able to report the educators in their state who offer the DOL program and issue training certificates, while 16% (n=8) had educators who offered the DOL program without issuing certificates. Among those leaders in the State Department of Education, 12% (n=6) reported having instructors that teach the DOL program and issue the training certificates, and 18% (n=9) had educators that offered the DOL program without issuing certificates.

The Central region had more educators training and issuing certificates to youth compared to those of any other region. These data support the results from Objective 1,
where student enrollment was also higher in the Central Region. It would make sense for regions with high student enrollment would also have high numbers of educators teaching the program.

Discussion and Implications

For the most part, state program leaders did not have an accurate account of the number of instructors in their state offering the certification program. In some states, the leaders were not familiar with the types of Tractor and Machinery Certification programs available in their state, or the overall availability of such programs. This was indicated in the high percentage of “Don’t Know” responses.

The impact of these results is twofold. Without a state or national registry of course instructors, it is difficult to quantify the number of educators teaching the program. Similarly, state program leaders do not accurately know who is offering the training, or the availability of such programs in their state.

Having an account of course instructors will assist administrators at the state and national levels to communicate with community course instructors. It is important to be able to reach community instructors to identify their needs related to curriculum resources, certificates of training, and any other legislative concerns. In the absence of a national headquarters for the Tractor and Machinery Certification program, state offices are the likely starting place to have a knowledgeable administrator familiar with the program. Working through state program leaders would be the most efficient mechanism to distribute policy updates, track student participation rates, and share updates about curriculum resources.
Objective 5:
Describe the type of certification, Tractor or Tractor and Machinery, offered by the certifying agency including the number of educational hours:
10-, 15-, 24-, or 25-hours

Summary
Lacking a national database or registry of Tractor and Machinery Certification instructors, the researcher relied upon state program leaders to provide the target population for community course instructors. Of the 330 respondents to a national survey, 44.8% did not teach a DOL Certification program. Of those who offered a DOL training, the certification was administered predominately through Extension (68.7%) and secondarily through the agricultural education program (24.7%). Eleven respondents (6.0%) indicated their certification program was through both the Extension and agricultural education program. Breaking down the DOL program into the two types, approximately 60% were Tractor and Machinery Certification programs, while 39% were Tractor Certification only. All regions, with the exception of the Eastern Region, indicated the Tractor and Machinery Certification course was offered most frequently.

The instructional hours varied between instructors of the DOL program. Classroom hours ranged from 0 to 36 hours, with an average time of 15.15 hours. Time spent driving or doing hand-on activities ranged from 1 to 45 hours, with an average of 6.96 hours. Homework assigned outside of class hours ranged from 0 to 24 hours, with an average amount of time on self-study as 6.94 hours. A time-weighted average of 30.05 hours indicates compliance was met with both programs and for both agencies.
Requirements for compliance do not distinguish between classroom, driving, or out-of-classroom study; rather, requirements are based upon the type of DOL program and the agency offering the program. Within Extension, the Tractor-only course is a 10-hour program, while the Tractor and Machinery course is a 24-hour program. In the agricultural education programs, the Tractor-only course is a 15-hour program, and the Tractor and Machinery course is a 25-hour program. In all cases, the time-weighted average reported by course instructors exceeds that of the required hours in the legislation.

**Discussion and Implications**

Data collected for Research Objective 5 included only responses from community instructors who offered a DOL course (55.2%). Upon closer inspection of the certifying agency administering the DOL course, there were a small percentage of respondents who did not know how to classify their programs. One instructor indicated the program was offered through a summer vocational agricultural program, which indicated a misclassification of the vocational agricultural program. Another instructor indicated the program was certified through the Farm Bureau; this is an obvious misconstrued classification, as this is not a bona fide certifying agency. There were 11 cases where instructors identified both the Extension and vocational agricultural programs as the certifying agencies. While it is possible for their programs to be certified by both agencies at different times, it is not possible for them to be certified simultaneously through both programs. It is probable for the instructors to believe the program to be eligible under both agency requirements, however the certificates of training ask the instructor to mark either Extension or vocational agriculture as the administrative agency.
If the course is taught in combination with instructors from both agencies, it is likely the instructors feel the certification could qualify under either structure, yet ultimately, one agency must take the lead role. Thus, confusion exists on the part of instructors.

Combining the observations made from this objective (# 5) as well as those from Objective 1 (where there were no national databases of student enrollment kept by State Department of Educations) and Objective 4 (where there was minimal administrative knowledge from state program leaders), the researcher believes the Tractor and Machinery Certification program would be best managed by one agency. This administrative unit would not necessarily have to be from either of the two existing administrative agencies named in the HOOA, merely it would serve as the headquarters for such agencies to report. Having one centralized head office responsible for certification records would alleviate any confusion on reporting requirements from both local and state levels.

With such a wide range of hours reported by community instructors, it is unlikely that instructional hours prescribed by legislation are strictly heeded by either agency. The time-weighted average of 30.05 hours reported by instructors indicated the likelihood that hours of instruction were based on time needed to instruct a comprehensive Tractor and Machinery Certification program, which according to legislation includes a 24- or 25-hour program. With such slight variations, just 1-hour differences, in the course instructional program between Extension and vocational agriculture, the researcher is unclear why the legislation made distinctions between the two agencies. In either organization’s program, the instructional requirements were met and exceeded.
Objective 6:

*Identify teaching methods and curriculum resources used in the certification program by community-based instructors*

Summary

Course instructors reported teaching methods and curriculum resources utilized in their community safety programs. The primary course book used in tractor and machinery safety courses was the HOBAR publication, *Safe Operation of Agricultural Equipment* (Silletto & Hull, 1976); this publication was reported by 66.0% of the instructors. When another course book was identified as the primary curriculum, the HOBAR publication was still reportedly used as a supplemental guide by 13.7% of the instructors.

Dealer publications were not utilized as primary resources (3.2%) as much as they were reported used as secondary resources (28.6%). The same holds true with other resources. 4-H curriculum was reported as a primary resource by 8.3% of the instructors, while it was used as a secondary resource by 11.4%. State- or locally-developed publications were classified as primary curriculum by 14.6% of the instructors, while 28.4% of instructors indicated they used local materials as secondary resources.

The top ranked teaching aids utilized by community instructors were hands-on activities (21.4%), videotapes (18.5%), student workbooks (14.7%), guest lecturers (13.5%), and DVDs (10.4%). The aids least selected by instructors were flip charts (0.6%), textbooks (2.6%), on-line computer instruction (3.2%), and overhead transparencies (3.4%). Instructors identified other teaching aids such as demonstrations, toy equipment, games, worksheets, newspaper clippings of actual accidents, working
with an adult mentor, group discussion, and driving actual equipment. A commonly used strategy for teaching safety in the school system is to use agricultural education students as teachers for elementary audiences, and to have these students plan and prepare a safety lesson. This teaching method was identified as an “Other” type of teaching aid.

Preference for teaching aids was asked of all instructors. It was important for the researcher to identify all current teaching aids used in the modern classroom, not just those utilized by DOL instructors. Comparisons between the two groups, DOL instructors and non-DOL instructors, showed similar responses.

Discussion and Implications

Now some 30 years after its original publication, educators continue to have a love affair with the HOBAR manual, using it as their primary course book for the Tractor and Machinery Certification program, as reported by 66.0% of the study participants. While other resources were identified, the HOBAR manual remains the popular choice. Perhaps the greater astonishment is the fact that no national materials have been developed to replace or supplement the resource, as supported by claims of focus group participants and community course instructors. While some may argue that basic safety messages remain constant through time, it is difficult to engage youth in a safety manual that does not reflect the industry’s widespread use of technology or the diversity of modern tractors and machinery.

Likewise, educational technology has advanced. The HOBAR publication does not reflect the look of a modern day manual, nor has its accompanied slide set kept up with the technological changes in the classroom. Findings suggest additional teaching aids are needed for effective instruction, and have identified hands-on activities,
videotapes, student workbooks, and DVDs as the most popular choices to offer classroom educators. Although it can be argued that students of this generation have the need to be entertained, studies have shown a classroom that incorporates a variety of teaching strategies is more effective in student learning, than one that employs a single method (Rosenshine & Furst, 1971). With a student-centered, non-linear approach, teachers can be motivators and facilitators of the learning process (Cano, 1991). Utilizing a variety of teaching aids enables this process.

Teaching style is a combination of practical application of behaviors and theoretical frameworks derived by personal preferences (Stone, 1992). In a classroom setting, this interaction between teacher personality and the teachers’ past educational experiences enables them to develop certain strategies; such teaching strategies also facilitate the approach (lecture, discussion, demonstration) the instructor will employ (Smith, 1971). Because teaching style is as different as the teachers themselves, it is important for a curriculum to include multiple strategies for the instructor to utilize. Gregorc (1979) and Turner (1979) agree that it is a combination of the environment and the teacher’s style of teaching that has a profound effect on the learner’s ability to learn.

Evidence from this study support the findings of earlier state-focused investigations (Carraba et al., 2000; Wilkins, 2001; Yarosh, 1993) and documents the need for supplemental teaching aids for the Tractor and Machinery Certification program. Over the years, tractor industries and universities have produced several quality videos about safe tractor operation. These resources enhance the learning process. Recently an interactive CD-ROM and Internet-based curriculum was developed by Purdue University. However the developers of this resource admit that it is just one method, and that
additional teaching materials beyond their CAI/Multimedia curriculum is needed to integrate traditional and novel computer approaches to learning (Ortega et al., 2003). Also in the development phase is the National Safe Tractor and Machinery Operation Program; this program developed by Penn State University utilizes color-print task sheets, rather than a textbook format, to present the subject matter. Included with each topic area are a multitude of activities the instructor can use to enhance student learning. It is anticipated these new materials will be adopted and utilized in the classroom as they become available for national use. To say either of these newly developed curricula will replace the HOBAR manual, well, that will be the litmus test to be determined over time.

Objective 7:
Determine community instructors’ perceptions and management styles of the Tractor and Machinery Certification program

Summary

A collection of perceptions held by community course instructors was explored through this research objective. Utilizing the body of literature and qualitative data sets acquired from regional focus groups as the basis for the inquiry, the researcher set out to quantify instructors’ perceptions and management styles of the Tractor and Machinery Certification program.

Educators strongly believed the course was beneficial to students, and reported that students take the course seriously. Of other significance, instructors supported the concept of written tests and driving tests that meet nationally identified standards, agreed additional teaching aids were needed for the DOL program, and felt the course had
potential to attract new audiences in landscaping and horticultural services. The instructors did not believe the course could be offered in its entirety as a self-study program, but were slightly more amenable that portions of the course could be offered as self-study.

Factors that affected the instructors’ abilities to offer a DOL program included lack of time to teach the course in the required of hours, the lack of support or awareness from employers or labor groups to encourage students to receive certification, and lack of enforcement on employers to comply with the certification requirement. The majority of instructors (59.9%) indicated they did not lack support from their administration in order to offer a training program. Three items thought to somewhat influence the instructors’ abilities to offer a DOL training program were the lack of teaching resources (42.4%), not enough students interested in the course (40.85), and lack of enforcement on employers to comply with the certification requirement (40.1%).

Overall, instructors believed the top three issues that would increase the effectiveness of the DOL program included community awareness of the program, employer support for the program, and access to teaching resources. Issues that closely followed these included enforcement of the legislation, in-service training for instructors, and additional learning activities for students. Interestingly, instructors believed standardization of teaching material was slightly more effective than standardization of testing requirements. They also did not believe that lowering the required number of course hours would be an effective measure for program improvement.

With respect to the two named agencies in the current legislation, Extension and Agricultural Education programs, the majority of course instructors (65.4%) were in
agreement for these to remain the sole agencies responsible for administering the certification. Only 17.1% \( (n=54) \) did not agree, and another 17.5% \( (n=55) \) were not sure.

Only 26.7% of course instructors believed there to be other agencies qualified to teach the program. These included Farm Bureau, equipment dealers, tractor industry representatives, technical colleges, universities, insurance companies, farm safety coalitions, rural volunteers, and farmers. The remaining course instructors did not believe there were other agencies qualified to certify the youth (24.1%), or responded they did not know if there were agencies qualified to certify youth (49.2%).

Results showed agreement between course instructors’ opinions and panel of experts’ opinions for the DOL requirements. The majority of community instructors (73.9%) were in agreement with the panel of experts (70.0%), supporting the combination of hours of participation and student competency.

Research Objective 7 also determined management strategies of the DOL program. Course instructors reported their average passing grade for the written exam was 72.74%, and the skill and driving exam was 77.24%. The majority (59.0%) of course instructors assessed participation fees for the program, and these fees were primarily used for workbooks, supplemental teaching materials, and student refreshment or activities.

The average class size reported was 19.7 students, with a higher proportion of boys. Students’ age followed a normal distribution curve, where the majority were 14- and 15-year-olds.

Discussion and Implications

Community instructors recognize and support the need for safety education programs for youth working in agricultural operations. They offered valuable insight into
the strengths and weaknesses of the programs and the needs of community instructors. Their responses can be grouped into three broad categories: respect for public policy, need for curriculum to reflect current tasks of young employees, and support for a standardized curriculum and testing system.

*Respect for public policy.* Course instructors believed the Tractor and Machinery Certification program was a beneficial course for young employees. As public policy, it is important for the program maintain its credibility and presence in the community. To accomplish this, greater awareness is needed; sometimes the best way to create such awareness is to enforce the legislation. There are some occupations that require certification and specialized training. Agriculture, according to legislation enacted with the HOOA in 1968, was deemed one of those occupations that required training for young workers. Employers need to recognize this legislation, and understand it will be enforced if violated. It does not matter the seasonality or infrequencies of youth employment; if a young person is hired to perform work on the farm, and is operating equipment identified in the legislation, then that youthful employee should be certified. Employers hiring young persons under 16 years of age without certification are in violation of the law, and should be penalized. For the most part, farmers are willing to comply with regulations, but are similar to other employing agencies where if they are not monitored to comply, they will unlikely do it on their own.

Legislation should be recognized by employers as a benefit, not an impediment for youth employment. Knowing that students have received training would make that youth more valuable to the employer. Besides having a better safety record, the youth will understand the basics of equipment operation and the importance not to push older
equipment to its limits or drive with excessive speed when pulling machinery. These practices will not only increase the longevity of equipment, it will also increase the productivity within the operation.

Young people recognize and accept the fact that certification is an employment requirement for various occupations. Take for example the job of a pizza delivery driver. Students understand that without a valid driving license, it would be unlikely they would be hired to deliver pizzas. Another example is the job of a lifeguard. Students understand that without their lifeguard certificate, they would not be hired to protect lives around public bodies of water. These examples represent what educational research terms extrinsic motivation. When students are extrinsically motivated to learn, such as in the case of a license or certification card, they are more likely to participate in a training programs.

In the case of the Tractor and Machinery Certification program, public policy provided exemption for youth working on family operations. This indicates a serious ramification for agricultural employment. By making an exemption for family members gives the perception that agriculture work is not technically difficult nor is the safety of the worker important. Ironically the HOOA goes into great detail identifying the hazardous tasks youth should not be permitted to perform, as well as the training program needed before youth can perform such activities. But the significance of the policy is immediately undermined when it places the stipulation on “youth for hire.”

For agricultural employment, it may be possible that some individuals are not able to pass a certification program. Current HOOA regulations are not based on performance competencies; because of this, it is possible for instructors to pass a student, even with
low test scores. This is an unacceptable condition and supports the wrong impression that agriculture is not technically difficult or requires specialized skills. In fact the exact opposite is true. Students who do not possess the required knowledge to pass a written exam, or the skills to safely attach equipment and maneuver an obstacle course, should not be eligible to receive a certification of training that allows them into the workforce. While it may be unfortunate for that individual who cannot pass such exams, it strengthens the overall certification program by placing merit on the safety knowledge and skills needed for employment in one of the most dangerous occupations of the nation.

*Need for curriculum to reflect current tasks of young employees.* It is not surprising for educators to feel strongly about updated teaching curriculum. Student learners are unmotivated in subject content if what they believe they are learning is not relevant to their life. It is imperative that training be received for tasks they will be, or are likely to be, performing on the job. Curriculum should be specific in the types of equipment young operators will likely encounter. Cognizant of vast variation in equipment type, it would be acceptable for training programs to focus on the fundamental components of the machinery, including features and functions of the PTO, hydraulic, and electrical systems. This basic knowledge is transferable in the work environment to apply to different equipment.

The findings revealed course instructors placed a higher value on standardized teaching materials than on standardized testing procedures. Perhaps one justification is that for some 30 years the legislation has been outdated in naming obsolete teaching resources. Therefore there is an unspoken expectation for teachers to create a curriculum that meets the legislative requirements. And regardless of the type of curriculum used, it
must match criteria that is not specifically identified.

Data collected through multiple research objectives within this study shared concerns about the course being instructor led or available as self-study. As a certification course, the general feelings were to specify the course continue to be led by an instructor. Focus group discussions revealed instructors were spending more time teaching youth how to operate a tractor, when in actuality, the course is designed to teach *safe use* of the tractor and agricultural machinery. This then is an assumption that youth enroll in the course with some level of pre-existing equipment operation. According to the qualitative data, this was not happening. This phenomenon can be equated to that age-old proverb, “Which comes first, the chicken or the egg?” Should instructors spend their time teaching basic tractor operation, or focus on safety of such equipment operation? The Code of Federal Regulations provides some assistance to this question, in that it states the youth is familiar with the normal working hazards in agriculture” (1990, p 381). Set as a precondition for enrollment, instructors should understand their primary task is to teach safety during the DOL certification course. If they perceive the need to teach general agricultural safety, this can be accomplished as a pre-requisite course, perhaps offered at a younger age.

Comparing tractor certification to that of a state-issued driver’s license, it can be argued that students do not need a specific training agency to teach the safe use and operation of vehicles. There are multiple agencies that offer the programs, and depending upon the state requirements, an individual is free to select and attend a training program of their choosing. The ultimate achievement test lies within the individual’s ability to pass a written and a driving exam; attendance records are not an indication of passing
performance. Therefore, using this analogy, it would be possible for students to study on
their own or under the guidance of a mentor. Students could receive certification
credentials based on the criteria they are able to pass a written and a skill exam.

Earlier indications led the researcher to believe that community course instructors
would embrace the opportunity to eliminate or reduce the classroom hours required to
instruct the tractor and machinery certification course. These assumptions were based on
the following facts. Within the secondary school program, strict time limits were imposed
in the daily schedules (generally limited to a 50-minute period). Another confounding
variable was that teachers are obligated to follow state educational objectives (which do
not include safe operation of agricultural equipment). Likewise, the community programs
offered through Extension programs struggle with similar constraints on time and
teaching mission, albeit of a more informal nature. It was often difficult to schedule
programs around the after-school and weekend obligations of the modern-day teenager,
as well as the overwhelming schedules of county Extension field faculty. Based on these
obvious assumptions, the researcher felt positive the data would indicate a strong
acceptance for self-study programs, or at least opt for a program that reduced the number
of face-to-face hours of instruction. This conclusion was not supported from the data set.
Community instructors did not believe this course should be offered in its entirety as a
self-study program, and believed the amount of time prescribed in the HOOA was an
adequate amount for instructing a DOL training program.

Support for a standardized testing system. Achievement testing is a common tool
used in education to document student knowledge. State-based achievement testing has
emerged in the last decade as policy makers demand accountability in the educational
system. Within the Tractor and Machinery Certification program, it may be possible to develop standardized testing system, once a nationally accepted curriculum is developed.

However, to date, no standardized curriculum is available. The educational format of the program has relied upon localized efforts of the community instructors to develop and implement a certification program; likewise, instructors were responsible for evaluating student learners on the basis of their individualized curriculum. The testing format described in the HOOA was very loosely defined as the students will pass a written exam and successfully maneuver a tractor and pulled implement through an obstacle course. No criteria exist for what knowledge is expected in the written exam, the types of skills needed for successfully operating a tractor in the skills exam, or the level of acceptance (e.g., the passing grade) for student certification.

Once a nationally accepted curriculum is in place, support and merit of a standardized testing format can be reached. Testing criteria can be developed based on the learning objectives within the curriculum. Procedures for evaluating those objectives can be identified both for the written and skills exams. This process is currently being field tested in the HOSTA-NSTMOP program. While there is limited evidence of their program’s success, their testing structure could quite feasibly become a model for national testing criteria (Dennis Murphy, personal communication, August 28, 2004).
Objective 8:

Determine program objectives of the Tractor and Machinery Certification program and identify basic competencies and skills necessary for youth to be certified after participation in such a program, as identified by community-based instructors.

Summary

Research Objective 8 utilized opinions of community course instructors to validate DOL program objectives and competencies identified by a panel of experts. Course instructors rated each of the eight program objectives with high levels of agreement. Seven out of the eight objectives had frequency reports greater than 90%, while the eighth scored 87.1%.

The 117 competencies identified in the modified-Delphi process were rated by community course instructors on a 5-item, likert-type scale. The ratings indicated the significance for that competency to be included in a DOL training program. From the 77 tractor competencies, only 23 received scores lower than 80.0%. Of the 22 machinery competencies, only three received scores lower than 80%; and of the 18 general safety and health topics, five received scores lower than 80%. This indicated that overall, 73.5% of the competencies identified by the panel of experts were considered highly or critically important for youth to learn, when rated by community course instructors. A summary of competencies for each section is described below.

Tractor competencies. Upon close evaluation of the competencies, several trends became evident. Concepts involving tractor overturns received the highest ratings. Course instructors deemed the following competencies highly or critically important:

1. To understand the safety concerns of operating a tractor on slopes or uneven
terrain (97.4%);
2. To recognize how to be protected during a tractor overturn (97.1%);
3. To understand tractor dynamics, including operating on a hillside or turning on a slope (96.7%);
4. To know why a tractor should be put in a lower gear when going down a hill (94.7%); and
5. To explain the role that center of gravity plays in a tractor overturn (94.5%).

Course instructors rated other tractor competencies of high or critical importance. These included:

1. To identify the mechanical hazards associated with agricultural machinery and how to avoid such hazards (95.8%);
2. To recognize that personal reaction time is slower than the speed of a machine (95.5%);
3. To recognize and avoid hazards of being run over (95.4%);
4. To ensure the Power Take Off (PTO) master shield is in place (95.4%);
5. To ensure work area is clear of people, pets, obstacles; and watch for obstacles in the field (94.5%); and
6. To understand the safety concern of excessive speed (94.4%).

Overall, course instructors rated tractor competencies high if they pertained to the general welfare of the student. Competencies that involved equipment maintenance or equipment settings tended to rank lower. This is reflected in the following items, listed here in ascending order:

1. To be able to adjust wheel width (38.7%);
2. To be able to add or remove weights (40.9%);
3. To be able to check, clean, coat, and tighten battery connections (59.9%);
4. To describe how tractors are designed for work and that they vary in size, shape, and age (60.2%); and
5. To be able to check brakes (67.0%).

*Machinery competencies.* Within the machinery section, concepts involving the Power Take Off (PTO) received the highest ratings. Similar to those ratings in the tractor sections, course instructors ranked competencies higher when they involved concepts immediately dangerous to life, compared to those involved with general attachment and maintenance. This was evident in the rankings of PTO concerns:

1. To develop PTO safe use habits (97.3%);
2. To identify the hazards involved with PTO use (96.3%);
3. To safely connect/disconnect a PTO driveline (92.3%);
4. To operate equipment at proper PTO speed (88.3%);
5. To identify components of a PTO system (78.7%); and
6. To clean and oil a PTO shaft (61.3%).

*General safety and health competencies.* Course instructors rated competencies for general safety and health topics between the ranges of 97.1% and 54.2%. Items of highest rank included the ability for the student to:

1. To identify factors and situations which contribute to agricultural hazards (97.1%); and
2. To learn when to use specific types of personal protection equipment (94.5%).

Items of lowest rank were:

1. To identify typical growth traits by age groups and how these traits affect the
jobs young workers should be assigned (54.2%); and

2. To become aware of regulations that affect agricultural workers (59.2%).
Discussion and Implications

Using a national panel of experts to determine initial goals and objectives of the Tractor and Machinery Certification program was an efficient and effective process to establish a framework for the curriculum. The second step utilized community course instructors to accept or refute the panel’s findings as appropriate content for a safety course. On a macro level, agricultural safety experts would be responsible for some phase of curriculum development. On a local level, the community instructors were able to interject their opinions of the course objectives, and were likely familiar with the needs and experience of the youth in their community. Combining the expertise of these two populations allowed for the development of a technical and practical curriculum structure. This approach is supported by earlier researchers of curriculum development (Pratt, 1994; Tyler, 1949) as well as users of expert panels in decision-making processes (Kingman, Yoder, Hodge, Ortega, & Field, 2005).

In an era of educational reform, performance standards and proficiency standards are commonplace (Cardwell, 2004). Curriculum is comprised of content standards, which typically describe the concepts, skills, and attitudes set forth by the subject matter. It is this content that sets the basis for the performance standards. “Performance standards determine how students will show they have met a standard and ultimately Proficiency standards indicate how well students must perform” (p. 8).

Within occupational training programs, the competency-based curriculum model prevails. This approach has been the traditional framework for the vocational agricultural programs in secondary schools. The competency-based approach models the behaviorists’ perspective in that it is very structured approach to teaching course content,
and it has easily measured outcomes for evaluating student performance. The rationale for this incorporating this approach in occupational training programs is simple; it prepares students for the occupational workforce.

Bloom’s Taxonomy is a hierarchical model in the educational system where learning is organized into six major classifications (Bloom, 1987). These classifications include (a) knowledge, (b) comprehension, (c) application, (d) analysis, (e) synthesis, and (f) evaluation. The strategy of the taxonomy is to stretch the teaching and learning process beyond the knowledge plane, and challenge students to think and solve problems at higher levels.

The hands-on or applied teaching approaches used within the Agricultural Education discipline strive to accomplish the strategies of Bloom’s Taxonomy. It can also be a worthy model to replicate the type of learning that is needed for the DOL programs. Currently the Tractor and Machinery Certification program incorporates three levels within the taxonomy, knowledge, comprehension, and application. But the program falls short thereafter. Additional research to measure the last three phases of analysis, synthesis, and evaluation utilized by the students is needed. This is the type of effectiveness research absent from so many of the agricultural training programs (DeRoo & Rautianinen, 2000).

A new curriculum, developed on the basis of sound competencies as identified through this research, is the initial requirement for future educational research of the DOL program. Once the standards are set, the criteria for accomplishments will be easily defined and measurable. Certification of students will truly achieve performance and proficiency objectives defined through the content standards. It is then, and only then,
that global measurements of knowledge transfer can progress to higher levels in Bloom’s Taxonomy. Program impacts can be evaluated on the basis of application in the workforce, and can also be monitored through injury statistics.

Implication of the Conceptual Framework

This study established a frame of reference for understanding the national Tractor and Machinery Certification program. Until this time, no large-scale attempt was taken to document what was so passionately discussed in small circles of agricultural safety and public health professionals. These discussions alluded to curriculum core content differing between states as well as within state safety programs; a lack of understanding for the program’s purpose; the disregard for course instructional hours, the non-availability of DOL courses in certain geographic regions, and the un-enforced legislation that was the foundation for establishing this program.

Using the conceptual framework developed for this study, the researcher was able to dissect the national program into various levels (Figure 5.12). Within each level, distinct confounding variables exist. These variables directly affect the quality and integrity of the DOL program. Descriptive findings of this study are presented for each level of conceptual framework.
Figure 5.12: Conceptual framework of the Hazardous Occupations Order in Agriculture

Public Policy

The Tractor and Machinery Certification Program was established as an amendment to the Fair Labor Standards Act. The amendment, known as the Hazardous
Occupations Order in Agriculture, allowed for an exemption for 14- and 15-year-old youth to perform certain agricultural tasks after they had completed a certification program. This legislation assigned administrative responsibility for teaching the course to two agencies, Cooperative Extension Service and secondary vocational agricultural programs. Two courses were, and still are, available, Tractor Certification and Tractor and Machinery Certification, each carrying a prescribed number of hours of instruction. Youth are issued certificates of training based on their abilities to pass a written test and drive a tractor with an attached 2-wheeled implement through an obstacle course.

The research found this program to still be in existence, but with limited national availability. The Central, midwest region of the U.S. is the predominant area to offer the program. States in the Southern region reported the second highest enrollment rate, with the Eastern and Western regions following respectively. Extension offers the program at a higher reported frequency than vocational agricultural programs, and the full Tractor and Machinery Certification program is the prevailing type. Instructors reported a wide range of time devoted to classroom, driving, and self-study assignments. The range spanned from 0 to 45 hours, with a weighted mean of 30.05 hours. This mean is beyond the required hours prescribed in the legislation. Average passing grades for the written exam was 72.74% and the skill/driving exam was 77.24%.

Instructors

Public law specifies Extension and vocational agricultural educators as the administrative agencies of the Tractor and Machinery Certification Program. There was widespread agreement among stakeholders for these agencies to remain the sole agencies
responsible for certification. However, focus group participants, program leaders, and community course instructors identified additional organizations and agribusinesses that, in their opinion, were qualified to teach. These included Farm Bureau, equipment dealers, technical colleges, insurance companies, farm safety coalitions, rural volunteers, and farmers.

It was difficult to establish a population frame of community course instructors. The majority of state program leaders were not confident they knew the availability of the Tractor and Machinery Certification program, or the instructors who offered them. This is an important finding to document. It is hoped that state program leaders understand the relevance and magnitude of tractor safety trainings. These leaders are the appropriate persons to distribute policy updates and curriculum resources to instructors in their states. In the case of Extension, it is likely they are the leaders involved in reporting the number of youth enrollment; thus it is assumed they are knowledgeable of the instructors offering the programs.

Community course instructors with experience teaching tractor and machinery safety programs reported receiving their expertise in a variety of methods, including practical experience, self-study, formalized trainings, or workshops. The majority reported they had experience with tractors and farm machinery before the age of 18. However, many of these instructors did not participate in the DOL program as a youth. Instructors did not believe experience alone should be enough to teach tractor and machinery operation to youth, and the majority felt instructors should be expected to complete a formal training program.
Instructors indicated they did not lack administrative support to teach the Tractor and Machinery Certification program, nor did they lack community support or teaching assistance. They were split in their opinions about their lack of time to instruct a Certification program, however both groups, Extension and vocational agriculture, agreed the hours prescribed in the legislation was sufficient to adequately teach the program.

*Curriculum*

With the absence of teaching resources identified in the legislation, the primary coursebook used in the Tractor and Machinery Certification program is the HOBAR publication, *Safe Operation of Agricultural Equipment*, authored by Silletto and Hull in 1976. Additional curricula used by community instructors included state or locally developed materials, 4-H curriculum, and dealer publications.

Research results indicated teaching aids were not up-to-date for the certification program. Teaching strategies identified to increase student learning included hands-on activities, videotapes, student workbooks, guest lecturers, and DVD’s. The least selected teaching aids were flip charts, textbooks, on-line computer instruction, and overhead transparencies. There was no support for the certification program to be offered as a complete self-study program, where there was little to no interaction with an adult leader. However, findings did support portions of the certification program capable of being offered as a self-study program.

Results supported a standardized curriculum and testing program. This concept would eliminate the reported regional differences and content deficiencies in some programs. Experts agreed that the overall goal of the Tractor and Machinery Certification
The program is to provide an educationally-based certification process for youth ages 14 and 15 years old who seek agricultural employment, whereby instructors, evaluation, and certification is consistent with the Hazardous Occupations Order in Agriculture. Upon successful completion of a Tractor and Machinery Certification program, the participants should understand the magnitude, nature and lasting impacts of potential hazards and injuries associated with agricultural tractor and machinery operation. Specifically, students should be able to complete eight program objectives.

In addition, this research identified 77 tractor and 22 machinery competencies to be the basis for the Tractor and Machinery Certification program. These competencies will form the core content of a national certification program.

*Training*

Findings reported a discrepancy between the 1968 legislation and the current activities and tasks performed by young workers on agricultural operations. Besides legislation being out of date with the types of antiquated equipment identified, legislation should broaden the exemption to include small horse-powered tractors and equipment commonly used in the twenty-first century. Additional equipment includes ATVs, skid steers, combines, and lawn mowers/landscape equipment.

As a whole, the Tractor and Machinery Certification program should address issues directly related to safety and health concerns. General equipment maintenance is important from an equipment operational perspective, but does not merit attention in a tractor safety program. With instructional time of the essence, it is important to focus the
training on factors affecting young workers ability to recognize and avoid hazardous situations.

Youth

The Hazardous Occupations Order in Agriculture allowed for an exemption for 14- and 15-year-old youth to work on agricultural operations after completing a safety program. This research found youth younger than 14 were included in DOL programs. While safety educational programs are encouraged for all ages, it is not necessary for persons under 14 to be enrolled in a DOL program. There was no indication these students were issued certificates of training, merely they were included in enrollment reports. The implication that instructors are certifying youth younger than that prescribed in legislation has serious ramifications to youth safety as well as employer violations of the Fair Labor Standards Act.

Summary of Conceptual Framework

The study was built on mixed-mode research strategies for the primary purpose of depicting the current state of the Tractor and Machinery Certification program. Understanding the components of a national certification program was a complex issue, one that could not be adequately performed with one single research approach. The researcher wished to accurately portray the incidence, distribution, characteristics, and perceptions of this program; she utilized the model to guide the research objectives and check for understanding along the investigative route.

The structure of the conceptual framework is one that carries great precedence. In order for the DOL program to accomplish what it was intended to do, it relies upon
interconnected variables within the model. The paradigm presented here was done to assist both the casual and the experienced user of the DOL program to conceptualize its structure and underlying components. Through this understanding, future strategies to develop and evaluate educational safety programs can be accomplished.

Recommendations

The findings of this study suggest the following recommendations. They are presented here as recommendations for practice and to guide future research.

Recommendations for Practice

1. Create one centralized and unified Tractor and Machinery Certification program for the nation. By having a national headquarters where the two agencies, Extension and vocational agriculture programs are represented, efforts can be undertaken to reduce the ambiguities of the DOL program, and increase the effectiveness of the HOOA training exemption. This approach would assist USDA-CSREES efforts in managing the comprehensive program. With one unified bureau, it would be feasible for subsequent recommendations to be implemented.

2. Create one unified Tractor and Machinery Certification database. This database would track both the number of youth participating in the program and the number of youth receiving certification. The database would also serve as a mechanism to identify course instructors. All DOL program participants and
instructors should be included in a federal reporting system if legislative exemptions are being administered to youth working in hazardous occupations.

3. Eliminate the Tractor-only course. The DOL program should be for Tractor and Machinery Certification. It is unrealistic that an employer will hire a young person to drive only a tractor, without attached equipment.

4. Maintain the current requirements prescribed in legislation that includes hours of participation and performance of competency. However, the opportunity for self-study programs should be considered. This addition to the current practice of a strict instructor-led course will enhance student-learning opportunities in geographic areas of limited course availability. It will also add flexibility for busy course instructors to assign learning activities outside of classroom hours.

5. Do not distinguish Tractor and Machinery Certification programs between the certifying entities. By creating one program, there is no need to differentiate an Extension program from a vocational agricultural program.

6. Broaden the Tractor and Machinery Certification course topics beyond the current legislation. With no difference in design or function, smaller horsepower tractors should be included in the training program. Similarly, the legislation should be reviewed and updated to include agricultural equipment commonly used in the twenty-first century. In addition, curricula should include safe use of equipment common in horticulture and landscaping services, not just those in production agriculture.

7. Create updated curriculum and teaching resources. Curriculum should include measurable learning objectives to indicate learner achievement. Additional
teaching aids will enhance the curriculum and should reflect the types of technology in the modern classroom. A variety will add flexibility to accommodate teaching and learning styles.

8. Create a standardized testing process. If curriculum incorporates a skill standard, then such skills would be easily measured in a standardized testing system. The tests should still include both a written and skill/driving component. This process would eliminate any regional differences, and strengthen those programs that were educationally unsound or loosely managed.

9. Broaden the scope of educational agencies, beyond Extension and vocational agricultural programs, to allow other instructors to teach the program. This recommendation is only suggested if there is a national standardized testing system in place. The skill standards will drive the curriculum, and make instruction uniform for all programs.

10. Offer regular training programs for course instructors. As a critical link in the program’s infrastructure, course instructors should be informed of the legislative requirements of the DOL program; they also should be kept apprised of available curriculum and teaching resources available to satisfy the DOL requirements. Such in-service programs would also serve as logistical trainings to assist community course instructors access youth training certificates and describe the process for reporting annual youth enrollment.
Recommendations for Future Research

1. Maintain surveillance of injuries occurring to youth performing work in agricultural environments.

2. Conduct periodic needs assessments for instructors, agricultural employers, and other stakeholders to determine the opportunities to strengthen the youth training programs.

3. Evaluate the effectiveness of Tractor and Machinery Certification programs for the ability to change behaviors and reduce morbidity and mortality rates. Studies should incorporate the types of knowledge acquired by youth through education and experience, identify youths’ beliefs about safety education, and youths’ self-efficacy for following safety rules.

4. Utilize the competency–based approach to develop, implement, and evaluate the effectiveness of tractor and machinery certification curricula. Comparisons can be tested between the competencies derived from this study, and those being developed under different funding sources to determine the best fit for a national competency-based program.

Conclusion

Utilizing education within a public policy structure is one approach to reduce agricultural injuries in youth populations. However, the program, in this case the Tractor and Machinery Certification program, must be done in accordance with the law. If either the program or the legislation fails to accomplish its goal, then alternative strategies and interventions should be devised.
This study was initiated because of repeated inferences and innuendoes of programmatic discrepancies occurring within the DOL program. Using inductive reasoning and exploratory research methods, a comprehensive research project was implemented to discover evidence of such claims. Data from various stakeholders corroborated that the phenomenon observed within the Tractor and Machinery Certification program was indeed chronic and widespread. The triangulated data quantified the program’s strengths and weaknesses, and provides insight into plausible opportunities. The findings offer a foundation for which future evaluations can begin. This infrastructure will guide future curriculum and public policy efforts in the agricultural industry, all in an effort to improve occupational training programs, reduce youth injuries, and ultimately increase agricultural productivity and the workforce’s quality of life.
LIST OF REFERENCES


Murphy, D. J. (1985). *Agriculture safety and health program effectiveness.* Paper presented at the summer conference of the National Institute for Farm Safety, St. Louis, MO.


268


272


APPENDIX A

FOCUS GROUP PRE-SCREENING SCRIPT
During the next 4 years, USDA is evaluating its national Tractor Certification program. For decades, this program was available through vocational agricultural courses in the local schools, or by Extension agents in the agricultural communities. This program has been essential training for young teenagers who sought employment in agricultural settings.

Ohio State University and Penn State University are collaborating with USDA to accomplish the evaluation process. During the first year of the program, there will be an aggressive attempt to talk with each state in the nation about their tractor-training program. As opposed to phone surveys or written questionnaires, Ohio State University will conduct focus group discussions within each region of the U.S. Through these discussion groups, we hope to gain an understanding of the type of agricultural tasks young people are doing and the type of training they need in order to be effective and safety-conscious workers. This input will assist project staff in making recommendations to USDA, and in the development of new curriculum.

The invitation list to these group discussions includes vocational agricultural teachers, Extension agents, Farm Bureau Safety directors, machinery dealers, agricultural employers, and parents of youth working on farms. The purpose of each participant includes the following:

Vocational Agricultural Teachers – traditionally has served as one of the primary educational sources of the original program. May or may not be teaching the full tractor certification program, but involved with teaching certain components of tractor safety and maintenance. Is considered a major stakeholder for new curriculum and teaching methods for agricultural education programs for youth.

Extension Agent - traditionally has served as the one of the primary educational sources of the original tractor-training program. The county may or may not be teaching the program on a regular basis, but has been involved in the past with various components of the program, including program coordination or administering certification cards. The county agent is considered a major stakeholder for new curriculum or management ideas affecting this program.

Farm Bureau Safety Director – various states have personnel directly dealing with farm safety issues. The Farm Bureau director may not be teaching the tractor certification program, but has an understanding of the type of agriculture in that region and can provide input to the new program.

Machinery Dealers – in certain areas, machinery dealerships have assisted educators, either from the schools or Extension offices, with machinery for their educational events. Dealers have an understanding of the type of equipment that should be included in a...
training program, and will be able to assist with developing the skill course and evaluation of skills for the new program.

Agricultural Employers – serving as the practical reminder of what young people are being asked to do on farms in the various regions of the nation. The employer will be able to address liability concerns, as well as directing the curriculum towards the basic skills and competencies youth need to be safe and helpful employees.

Parents (of teenagers) - although these participants may not be able to address curriculum, delivery methods, or certification policy… they will be instrumental in helping shape the marketing and offering of a new program. Parents will be able to answer questions about logical community locations to hold the testing, and make suggestions for accessing educational materials.

Here are the details for your region:

Region 3 Group Discussion
Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Wisconsin

Date: Wednesday, June 12, 2002
Time: 6:00 p.m. – 9:00 p.m.
   Dinner and Discussion

Location: Holiday Inn - St. Louis Airport North
   4545 N. Lindbergh Blvd.
   Bridgeton, MO 63044
   Phone: 314-731-2100

Expenses for one representative from the above list will be paid by The Ohio State University. Mileage will be reimbursed at 36.5 cents/mile. A university issued check will be sent to the participant 2 - 4 weeks after the meeting. Airline trips will be pre-paid by OSU’s Travel Agency so no up-front costs will occur to the participant.

For those requiring overnight accommodations, expenses will be paid directly to the hotel by Ohio State University the evening of the meeting. Please make arrangements through Dee Jepsen if you require a room. All rooms will be pre-paid by OSU, so reservations are required.

Dinner is included in the evening agenda.

For additional questions, and reservations, please feel free to contact Dee Jepsen at (xxx) xxx-xxxx or email jepsen.4@osu.edu
APPENDIX B

FOCUS GROUP PARTICIPANT INVITATION LETTER
February 28, 2002

NAME
XXX
CITY, STATE

Dear NAME,

Thank you for your willingness to participate in the USDA-CSREES sponsored Tractor Certification Program discussion group. Your input from the Farm Bureau grass-root level will certainly be valuable to those working on this project as well as those recommendations that will eventually be made to USDA-CSREES. During year one of our project, we wish to include as many state’s perspective as possible on the issue: youth operating agricultural equipment. Having Virginia’s input will be most valuable as we strive for a nationally acceptable tractor certification program.

The meeting for your region will be held on Wednesday, March 6, 2002. We are meeting at the Holiday Inn in Erlanger Kentucky. The hotel is at the Cincinnati Ohio Airport (see enclosed map for directions). We ask that you arrive between 5:00 -5:30 p.m. to check into the hotel. Dinner and discussion will be conducted between 6:00 – 9:00 p.m.

As you already know, the common tractor manual used in the United States is Safe Operation of Agricultural Equipment, published by HOBAR. While it is not necessary that you are familiar with this publication, we will likely be discussing the types of information presented in it. Feel free to bring any materials that you currently use for your state’s tractor certification program. We will have time before and after our discussion time to review other state’s material. (Of course this is optional.)

If you have any questions before our meeting next week, please feel free to contact me. I can be reached by phone at (xxx) xxxxxxx or email, jepsen.4@osu.edu.
I look forward to the opportunity to meet with you personally and discuss the future of tractor certification programs. Your interest in farm safety has brought you to the table and I hope you share in my excitement as we explore the benefits of a new program for those young people wanting to stay involved in agriculture, and do it in the safest manner possible.

Best Regards,

Dee Jepsen
Extension Associate
Agricultural Safety and Health
APPENDIX C

FOCUS GROUP MODERATOR GUIDE
Focus Group Discussion Guide

Curriculum Aspects of the Tractor Certification Program

1. In your opinion, what type of agricultural tasks should young people be certified to perform?

2. Who should be the instructors of these certification programs?

3. What level of experience, or level of training should these instructors possess? 
PROMPT: Should these instructors be certified themselves through some type of training program?

4. In terms of how the youth are taught in the certification courses, what mode(s) of delivery are most favorable?

PROMPTS: web, CD-ROM, text, self study, instructor led, etc.

5. Is it important to have actual hands-on practice as part of the certification process. If yes, what suggestions do you have for facilitating this process.

6. How should costs be addressed?
   A. Workbook Fees
   B. Computer Fees
   C. Testing Fees
   D. Others added in Q 4

Evaluation of youth after completing a Tractor Certification Program

7. Is it feasible to have a central testing location for a county/district to administer the certification test?

8. If county or regional testing locations were established, what is a reasonable distance to ask youth to travel to reach these testing locations?

9. How frequent should these sites offer testing?

10. Can you identify a logical test location or facility that would be appropriate to conduct this testing?

11. Who should be able to proctor a certification test?

12. How should youth be evaluated for certification as a safe agricultural worker?

   A. Written Exam
   B. Skill Exam
   C. Driving Exam

Marketing Questions about the Tractor Certification Program

13. Knowing that we have youth operating tractors in non-traditional production ag settings, i.e. in the cases of landscape and golf courses, how do we attract these youth (and any other potential participants) into the program?

14. How do we generate an interest for farm families to voluntarily participate in the certification process?
FRONT SIDE OF THE EXIT QUESTIONNAIRE:

Name:__________________________________________________________

Gender:__________________________  Age:_______________

Background with Agricultural Issues (check all that apply):
As a Young Person I:
  ____ Grew up on a farm
  ____ Grew up in a rural area, but not on a farm
  ____ Had farm work experience
  ____ Participated in Tractor Certification Training Program

As an Adult I:
  ____ Live on a farm
  ____ Live in a rural area, but not on a farm
  ____ Work in an agricultural related field
  ____ Have coordinated or taught portions of the Tractor Certification Program

Occupational Relationship to Agriculture (check all that apply):
  ____ Teacher              Number of years:__________
  ____ Extension            Number of years:__________
  ____ Ag Business          Number of years:__________
  ____ Farm Bureau          Number of years:__________
  ____ Farm Owner/operator  Number of years:__________
  ____ Parent of a youth working an agricultural job
    Age of child(ren)________________________________________
  ____ Other – please describe

BACK SIDE OF THE EXIT QUESTIONNAIRE:

Thanks for contributing to the discussion!

In the space below, please make any suggestions or write any thoughts you might have that would help us implement a new national tractor and machinery certification program.
APPENDIX E

MODIFIED-DELPHI PANEL OF EXPERTS
Panel of Experts

**William Campbell**  
Agricultural Safety Specialist, South Dakota University

**Eric Hallman**  
Agricultural Safety Specialist, Cornell University

**James Hilton**  
Agricultural Engineer, Penn State University

**Ronald Jester**  
Agricultural Safety Specialist, University of Delaware

**Carol Lehtola**  
Agricultural Safety Specialist, University of Florida

**Murray Madsen**  
Agricultural Engineer, Program Consultant, University of Iowa

**Mark Purschwitz**  
Agricultural Safety Specialist, University of Wisconsin

**Charles Schwab**  
Agricultural Safety Specialist, Iowa State University

**John Shutske**  
Agricultural Safety Specialist, University of Minnesota

**Bruce Stone**  
Agricultural Safety Director, Virginia Farm Bureau
APPENDIX F

MODIFIED-DELPHI PANEL LETTER OF WELCOME
March 3, 2003

Dear NAME,

Thank you for your willingness to serve as a member of the expert panel to explore objectives of the Tractor and Machinery Certification programs offered in the nation. You are joining a panel of 10 agricultural safety enthusiasts actively involved in the National Institute for Farm Safety, a professional organization dedicated to providing leadership in preventing agricultural injuries. The study in which you will participate is being undertaken as a portion of my doctoral dissertation at The Ohio State University.

Using the Delphi Method, the panel will provide information and opinion about the Tractor and Machinery Certification program in order to determine:
1. What are the overarching objectives of the Tractor and Machinery Certification program?
2. What core competencies should be included in the Tractor and Machinery Certification program?

The Delphi Method is a structured communication process between an assigned group of individuals, to discuss and determine the future of a complex issue. Through this process, each individual will have the opportunity to contribute personal information and knowledge; the input will be pooled as group judgment; individuals will then revise these group views; and finally the group will evaluate and confer their findings.

The study will consist of two questions that will be discussed in several rounds. Using electronic mail, you will receive question one on Wednesday of the first week. You will have until the next Tuesday, almost one week later, to respond to the posed question. Answers will be collectively organized and re-distributed the next day. You will continue to receive feedback each Wednesday on the group's efforts, and your responses to this data are due the following Tuesday. In the third week of the study, you will receive question number two. Similar to the earlier rounds, weekly correspondence will continue until the panel attempts to gain consensus. It is anticipated that each question may take up to three rounds, for a total of six weeks.

This project will only be as good as the people I have identified as participants on the expert panel, and their willingness to take part in the discussion. Your commitment to return your responses each Tuesday is critical to the progress of the study, and even more important to the future of the Tractor and Machinery Certification program. Setting the objectives of a national program is a difficult task, however, the Delphi process can elicit intriguing feedback on curriculum planning. I hope you share my enthusiasm as we embark on this process. Thank you in advance for your participation.

Sincerely,

Dee Jepsen
APPENDIX G

MODIFIED-DELPHI PANEL EMAIL ANNOUNCEMENT
Hello Panel Members!
Yes it's Wednesday, and this is the first communication you will receive from me. As promised, I am listing your fellow panel members. They include:
Bill Campbell, Eric Hallman, Jim Hilton, Ron Jester, Carol Lehtola, Murray Madsen, Mark Purschwitz, Chuck Schwab, John Shutske, and Bruce Stone.

Our process will begin next Wednesday March 12. Be on the lookout for the first question. You will have until Tuesday March 18th to reply.

Towards April, you may need to have access to the HOBAR publication: "Safe Operation of Agricultural Equipment." If you do not have a copy, I will send you one. Please let me know, so I can get it in the mail for you.

Again, I appreciate your time and willingness to participate in this discussion. I look forward to working with each of you!

Dee Jepsen
APPENDIX H

MODIFIED-DELPHI ROUND 1
Date: Wed, 12 Mar 2003 10:19:26 -0800

Subject: Expert Panel - Round 1
To: jepsen.4@osu.edu, and compressed list.

Hello! Today is the beginning of our Tractor and Machinery Certification program discussion. As a member of the panel, your expertise and experience with the program is valuable to my research as well as the national Tractor Certification Program.

You are receiving two questions today. Please respond to these questions by noon on Tuesday, March 18, 2003. You will then receive a summary of how the panel responded to these questions. The panel will organize and rank these responses in the next round, Wednesday March 19. We will continue this process for approximately 3 weeks. In Week 4, you will be given another question and the process will be repeated for another 3 weeks.

Thank you in advance for your participation and thoughtful consideration of this topic. Please email your responses to jepsen.4@osu.edu.

Background for Question 1:

The Hazardous Occupations Order in Agriculture (HOOA) was signed into law January 1, 1968. Formulated by the Department of Labor, this legislation made it unlawful for persons under 16 years of age to be employed in agricultural occupations declared hazardous by the Secretary of Labor. Because of its strict wording, the legislation was met with much opposition; consequently the law was amended in June 1968 to allow 14 and 15 year old youth to perform certain tasks that were declared hazardous, providing they completed a prescribed course of safety instruction. This training has become popularly known as the Tractor and Machinery Certification program.

If you would like to read the precise legislation of the Hazardous Occupations Order in Agriculture, you may do so on-line at http://www.dol.gov/dol/allcfr/ESA/Title_29/Part_570/29CFR570.71.htm

Over time, resource materials for this program became out-dated as well as unavailable. The most widely used curriculum today, “Safe Operation of Agricultural Equipment,” is a composite of the earlier 4-H tractor books and is printed by HOBAR. However, many states have developed their own curriculum to match the evolving technology of agricultural equipment as well as meeting learners’ needs with effective teaching resources for certification.

Regardless of the format, it is important that curriculum objectives match the goals of the program.
Question 1:

Based on what you know of the legislation, and your past experience with the Tractor and Machinery Certification program, what do you feel is (are) the primary objective(s) of a certification program. You may list more than one objective, but no more than five.

Background for Question 2:

According to the U.S. Department of Labor, 14- and 15-year old students may be exempt from the Hazardous Occupations Order in Agriculture, if proper training occurs. Two independent agencies are identified in the legislation as sources of training, the vocational agriculture school-based program and the Federal Extension 4-H program.

In addition to the two agencies, there are two types of certification programs: Tractor and Machinery. Within each agency, the hours of training vary. The vocational agricultural program requires the Tractor course to be 15 hours and the Machinery course to be an additional 10 hours. The Extension program requires the Tractor course to be 10 hours, the Machinery course to be 10 hours, and a general orientation of farm safety to be 4 hours.

The law also specifies that all students, regardless of the training agency in which they are enrolled, demonstrate knowledge and performance before certification is issued. More specifically the law states the student shall: “Pass both a written test and a practical test on tractor safety, including a demonstration of his ability to operate safely a tractor with a two-wheeled trailer implement on a test course.”

Background on Competency:

I selected the term “Competency,” for this question, however there are many other words that describe this type of teaching method. Please don’t get caught up on the specific word. Other common labels given to this approach of training include:
- Competency-Based Instruction
- Mastery Learning
- Systems Approach to Education
- Performance-Based Instruction
- Criterion-Referenced Instruction
- Learning for Mastery
- Self-Paced learning
- Programmed Instruction

Although these terms are not used entirely synonymously, they are similar enough to use interchangeably for our purposes. Keep in mind that competency-based programs are focused on results and worthy accomplishments (or performances) that make the
employee valuable to the employer. Worthy performances (competencies) do not necessarily imply knowledge and attitudes that support them. As an example:

Knowing everything you need to know about taking a blood sample is useless unless the medical technician can take a blood sample properly (worthy performance), without too many costly behaviors (like time, damaged needles, or contaminated samples). Having a good attitude and treating the patient courteously is fine, but it’s the end results that count.

Knowledge and attitudes contribute to human competence only insofar as they aid the worker to produce worthy performances.

Question 2:

In your opinion, should the Tractor and Machinery Certification program be based on hours of program participation, performance of competency, or a combination of both? Explain your reason(s).
APPENDIX I

MODIFIED-DELPHI ROUND 2
Congratulations! We have finally made it to Round 4. I appreciate everyone's time and input. As you will see, we're making progress; and even more unbelievable, are able to agree on certain statements. You will notice the addition of Question 3 (our last question).

**QUESTION 3:**
Based on what we learned from Question 2, each panelist agreed that there should be some level of performance or competency associated with the student's certification process. (Remember from earlier rounds, no one selected the program to be based solely on hours of participation.)

Therefore, our next (and FINAL) step in this process is to identify some basic competencies that every student should possess after completion of the Tractor and Machinery Certification program.

Please put some thought into this process, and list some basic competencies of the certification program. Many of you have state programs or resource material that you currently use, of which will have competencies (or performance type standards) associated with them. Feel free to submit these. Some of you may review the HOBAR manual for ideas. I'm looking for broad-based competencies. Here are a few examples:
* Students should be able to start and stop the tractor
* Students should understand and be able to demonstrate hand signals

Let's see what the group can identify. As in earlier rounds, I will summarize the list and resubmit it back for review.

Again, many thanks and I hope you're getting some of the sunshine that Ohio is enjoying. Deej Jepsen
APPENDIX J

SURVEY FOR STATE PROGRAM LEADER
State Tractor & Machinery Certification Survey

In order to understand your state's youth tractor and machinery safety program, please answer the following.

1 For each question below, indicate the type of participation your state organization is involved.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Possibly, but without state personnel's knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Extension agents in my state TEACH the Department of Labor (DOL) Tractor and Machinery Certification program AND ISSUE the DOL certificates of training.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Extension agents in my state TEACH the Department of Labor (DOL) Tractor and Machinery Certification program BUT DO NOT ISSUE the DOL certificates of training.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Extension agents in my state SUPPORT the teaching of the Department of Labor (DOL) Tractor and Machinery Certification Program by either providing educational materials (i.e. curricula, slides, videos) or assist with the teaching in the classroom or on the driving course.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extension agents in my state TEACH general tractor &amp; machinery safety programs, but these trainings ARE NOT DOL certification programs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 This box is available for you to add comments about the type of youth tractor and machinery safety programs and/or trainings your state offers, if you feel the questions above need clarification.

Next, some questions about the number of students certified. Please use any records or contact people you have available to answer accurately. As a last resort, if you cannot determine the number certified for a particular year, indicate DK (don't know).

3 For each year indicated below, how many students received DOL certification in Tractor operation through the Extension/4-H program?
<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td></td>
</tr>
</tbody>
</table>

4. For each year indicated below, how many students received DOL certification in Tractor and Machinery operation through the Extension/4-H program?

5. In your opinion, should these agencies remain the sole agencies responsible for certifying youth in the DOL Tractor and Machinery program?

- [ ] YES
- [ ] NO

Additional Comment

6. Are there other agencies, organizations, or businesses qualified to teach the DOL Tractor and Machinery Certification Program? If yes, please identify them.

- [ ] YES
- [ ] NO

Additional Comment

7. Should the DOL Tractor and Machinery Certification Program be available as a self-study program for youth?

- [ ] YES
- [ ] NO

Additional Comment

Currently the Code of Federal Regulations specifies the Federal Extension Service and vocational agricultural programs as the only 2 certifying agencies.
Unfortunately, no universal list of instructors is available to gain additional information about the certification program. I need your help to develop a list of instructors who teach any level of the tractor and machinery safety program to youth in your state. This includes teachers and/or extension agents who offer any type of tractor safety program, certified or uncertified.

8 Please take a few minutes to identify a list of instructors who teach tractor safety programs in your state. These instructors can be agricultural teachers and/or extension agents. Since they will receive an electronic survey, similar to this one, email addresses are preferred. Organizational listserves are acceptable if you do not have specific email addresses for the instructors; however, you may be asked to post a link to the survey if the listserv is closed to public postings. (U.S. mail addresses are also acceptable.)

9 If clarification is needed, may I contact you about your state's tractor certification program?

   YES   NO

10 If 'yes', please enter your name and contact information. If 'no', please enter the name of the appropriate individual to contact.

   Last Name:   
   First Name:  
   Email Address:   
   Phone:       

Thank you for your input!
APPENDIX K

STATE PROGRAM LEADERS’ INVITATION LETTER
Dear [USDA Farm Safety Contact] or [State Vocational Agricultural Leader]:

I would greatly appreciate your participation in a brief survey about the national Tractor and Machinery Certification program.

Over the past three years I have been involved at several levels evaluating this national program, working collaboratively with USDA Program Supervisor, Brad Rein and Program Specialist, Ivan Graff.

The survey you are receiving will satisfy yet another level of program inquiry. This data will support the USDA-CSREES’s mission to assess and update curricula, testing procedures, and certification means for youth working in agriculture. USDA-CSREES has expressed a commitment to support the national tractor and machinery certification program and is currently funding research in the areas of policy and program development, as well as programs for special needs.

All state [USDA Farm Safety] contacts, and in some cases [Extension Agricultural Program Leaders], are receiving this survey. An identical survey has been sent to the [state departments of education], to be completed by the appropriate person overseeing [vocational agricultural programs]. Information from these 2 certifying agencies will be combined into one report for a comprehensive picture of the Tractor and Machinery Certification program.

Thank you for providing the information USDA-CSREES needs to support the existing Hazardous Occupations Order pertaining to youth under 16 years of age working in agricultural settings.

Thank you.
--
Dee Jepsen
Program Director, Agricultural Safety and Health
The Ohio State University
590 Woody Hayes Drive
Columbus, OH 43201
Email: jepsen.4@osu.edu
APPENDIX L

STATE PROGRAM LEADERS’ WELCOME GREETING TO

ELECTRONIC SURVEY
You are about to enter into a survey for the national Tractor and Machinery Certification program. This research is being collected on behalf of a CSREES grant, USDA#2002-41521-1481.

The objectives of this survey are:
1) To identify the types of Tractor and Machinery Certification or other tractor safety programs available to youth in the U.S.
2) To quantify the number of students certified through the USDA/DOL certification program.
3) To identify instructors who teach any portion of a Tractor and Machinery Certification program for youth operators.

This survey will assist program personnel at the federal level to make critical decisions about the type of certification program available in the future. Your assistance to provide information about your state will be included as a part of a national report assessing the Tractor and Machinery Certification program.

Thank you in advance for your cooperation.

Some background about the Tractor and Machinery Certification program:
The Hazardous Occupations Order in Agriculture (HOOA) was signed into law in 1968. Formulated by the Department of Labor, this legislation requires 14 and 15 year olds employed in agricultural occupations to receive certification prior to employment. This training has become popularly known as the Tractor and Machinery Certification program.

If you would like to read the precise legislation of the Hazardous Occupations Order in Agriculture, you may do so on-line at http://www.dol.gov/dol/allcfr/ESA/Title_29/Part_570/29CFR570.71.htm

Two independent agencies are identified in the legislation as sources of training, the vocational agriculture school-based program and the Federal Extension (4-H) program. In addition to the two agencies, there are two types of certification programs: Tractor and Tractor/Machinery. Upon completion of training, youth must pass both a written and driving exam.
APPENDIX M

STATE PROGRAM LEADERS’ REMINDER LETTER
(May 7, 2004)

Dear [USDA Farm Safety Contact] or [State Vocational Agricultural Leader]:

I would greatly appreciate your participation in a brief survey about the national Tractor and Machinery Certification program. To date, I have not heard from you, and your input is important to the overall project.

We want your state represented in the national report that is being developed and submitted to USDA-CSREES. The survey will only take 5-10 minutes and can be accessed by clicking the link below.

http://www.zoomerang.com/weblink

Thank you for your assistance with this project.

--
Dee Jepsen
Program Director, Agricultural Safety and Health
The Ohio State University
590 Woody Hayes Drive
Columbus, OH 43201
Email: jepsen.4@osu.edu
APPENDIX N

COMMUNITY COURSE INSTRUCTORS’ SURVEY
The National Tractor and Machinery Certification Program

1. Select your state.

2. Please indicate the PRIMARY type of tractor and machinery certification program you teach.

   - I TEACH the Department of Labor (DOL) tractor and/or machinery certification program AND ISSUE the DOL certificates of training.
   - I TEACH the Department of Labor (DOL) tractor and/or machinery certification program but DO NOT ISSUE the DOL certificates of training.
   - I play a SUPPORTING ROLE with the Department of Labor (DOL) tractor and/or machinery certification program by either providing educational materials (i.e. fact sheets, slides, videos) or assisting with the teaching in the classroom or on the driving course.
   - I COORDINATE the Department of Labor (DOL) tractor and/or machinery certification program in my area, but do not actively teach students in the course.
   - I TEACH GENERAL tractor and/or machinery certification programs, but these trainings ARE NOT DOL certification programs.
   - I do not currently teach any tractor and/or machinery safety programs but can give some insight to help improve the national program.
program you teach or coordinate.

3. With regards to the DOL training program, how is certification of students administered?
   - Through an extension or 4-H program
   - Through a vocational or agricultural education program
   - Don't know
   - Other, please specify

4. Which type of DOL certification class do you instruct/coordinate MOST OFTEN?
   - Tractor certification - a course designed to teach students safe tractor operation.
   - Tractor and machinery certification - a safe tractor operation course with additional instructional hours in safe machinery operation.
   - Don't know
   - Other, please specify

5. In terms of program costs for DOL training, how do you assess fees? (Check any that apply.)
   - Students pay a participation fee.
   - Course is sponsored all or in part by a club, organization or business.
   - Course is provided as part of my organization's operating budget.
   - There are no costs associated with my program.
   - Other, please specify

6. If there is a DOL training fee, indicate the amount paid by each contributor. (Type in the dollar amount next to each item.)

   How much do students pay?
6. How much is contributed by a club, organization or business? How much is contributed by your organization’s operating budget?

7. If there is a DOL training fee, what does the fee cover? (Check any that apply.)
- Student workbooks
- Supplemental teaching materials
- Student activities/refreshments
- Guest speaker(s)
- Equipment rental
- Facility rental
- Instructor compensation
- Administrative costs/Cost recovery
- Don’t know
- Other, please specify

8. With regards to the DOL program’s final exam, what criteria do you set for passing? (Type a percentage in the box for each item that applies.) If no test is given, or you don’t know the testing requirements, indicate that in the appropriate boxes.

Written exam, minimum % to pass
Skill/driving exam, min % to pass
Other (specify) and include min. % to pass
If no test is given, type "no test given". If you don’t know test requirements, type "don’t know".

With regards to the amount of time spent teaching the DOL certification program, please indicate the approximate instructional hours associated with each activity over the entire teaching period.

Number of hours for classroom instruction
Number of hours driving/doing hands-on activities
Number of hours assigned to homework or self-study
If you don’t know how the course is structured, type "don’t know".

The questions on this page relate to the students in your class.
your teaching materials, and other factors that affect your ability to teach/coordinate a tractor and machinery safety program.

10 Indicate the average number of students enrolled in your tractor and/or machinery safety program(s) each year.

Number of males
Number of females
If you do not offer a course, type "Don't have a course."

11 What are the students' ages? (Check any that apply.)

- 10 years and younger
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years and older
- Not applicable

12 What is your PRIMARY course book used to teach tractor and machinery safety?

- Safe Operation of Agricultural Equipment, by Hobar Publications
- 4-H curriculum
- Dealer publications
- State or locally developed materials
- Not applicable

13 If you answered "Hobar Publications" for Question 12, you
may skip this question. However, if you selected another course book, please identify the title and author of the PRIMARY RESOURCE you use.

14 What OTHER course books do you use to teach tractor and machinery safety? (Check any that apply.)

- Safe Operation of Agricultural Equipment, by Hobar Publications
- 4-H curriculum
- Dealer publications
- State or locally developed materials
- Not applicable

15 If you answered "Hobar Publications" for Question 14, you may skip this question. However, if you use other resource(s) to teach your course, please identify their title(s) and author(s).

16 In your opinion, what TEACHING AIDS are the most effective for student learning? (Check any that apply.)

- Student workbooks
- Textbooks
- Video tapes
- DVDs
- Slide presentations
- Overhead transparencies
- Flip charts
- Guest lecturers
- Hands-on activities
- Computer assisted instruction or activities (includes software programs or CD-ROMS)
- On-line computer instruction or activities (includes websites, chat rooms, etc)
The National Tractor and Machinery Certification Program

The questions on this page are specific to the Department of Labor (DOL) tractor and/or machinery certification program. Your opinions are important, even if you do not offer a DOL program.

17 Currently the law states that Extension and Agricultural Education educators are the only two agencies responsible for CERTIFYING students in the tractor and machinery program. In your opinion should these agencies remain the sole agencies responsible for CERTIFYING youth in the DOL tractor and machinery program?

- Yes
- No
- Don't know or not sure

18 Are there other agencies, organizations or businesses QUALIFIED TO TEACH the DOL tractor and machinery certification program?

- Yes
- No
- Don't know or not sure

19 If you answered 'Yes' for Question 18, please identify such agencies, organizations, and businesses qualified to teach the DOL tractor and machinery certification program.
In response to the following statements about the DOL tractor and machinery certification program, please select the number that best describes your feelings.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>2</th>
<th>Disagree</th>
<th>3</th>
<th>Neutral</th>
<th>4</th>
<th>Agree</th>
<th>5 Strongly Agree</th>
<th>No experience with the DOL program to make a valid judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The course is beneficial for students.</td>
<td>1</td>
<td>2</td>
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<td>4</td>
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<td></td>
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<td>2. Students take the course seriously.</td>
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<tr>
<td>3. Students should be assessed a fee for receiving safety training.</td>
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<tr>
<td>4. Students should be assessed a fee for receiving certification credentials.</td>
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<td>5. Up-to-date teaching aids are available to instruct this course.</td>
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<td>6. Additional teaching aids should be developed for this course.</td>
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<td>7. Homework is appropriate for this course.</td>
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<tr>
<td>8. This course could be offered in its entirety as a self-study program.</td>
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<tr>
<td>9. Portions of this course could be offered as a self-study program.</td>
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<tr>
<td>10. The course is only beneficial to students when led by an instructor.</td>
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<td>11. The written test should meet nationally identified standards.</td>
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</table>
The skill/covering test should meet nationally identified standards.

The required course hours identified by law for school-based programs (15 hours for tractor, and 25 hours for tractor & machinery) are sufficient to adequately teach a safety training program.

The required course hours identified by law for 4-H/Extension programs (10 hours for tractor, and 24 hours for tractor & machinery) are sufficient to adequately teach a safety training program.

Instructor's experience of tractor and machinery operation should be enough to teach the certification course to youth.

Instructors should be expected to complete a formal train-the-trainer program in order to teach the certification course to youth.

This program should no longer be offered.

This program has potential to attract many more students than what it currently reaches.

This program could attract new youth audiences, like those in landscaping and horticultural services.

It's possible that EXTERNAL FACTORS influence your ability to offer the DOL tractor and machinery certification program. Using the following scale, indicate how these factors influence course availability in your area.

1. Never affects my ability to offer a program
2. Somewhat affects my ability to offer a program
3. Definitely affects my ability to offer a program
No opinion

Not enough students interested in the course.

1
2
3
Not enough students to justify my time offering a course.

Lack of support from administration to offer a course.

Lack of community support/awareness of the benefits of this course.

Lack of funding to offer the course.

Lack of teaching resources.

Lack of people to assist with teaching the course.

Lack of equipment to conduct the skills or driving portion of the course.

Lack of time to teach the course in the prescribed number of hours required by Dept. of Labor.

Lack of support/awareness from employers or labor groups to encourage students to receive certification.

Lack of enforcement on employers to comply with this certification requirement.

---

22 In your opinion, what would increase the EFFECTIVENESS of the DOL tractor and machinery certification program? Select 3 items that would contribute the most. ONLY SELECT 3.

- Community awareness of the program.
- Employer support for the program.
- Enforcement of the legislation.
- In-service training for instructors.
- Availability of more instructors.
- Standardized teaching materials.
- Access to teaching resources (curriculum, videos, slide shows, etc.).
Additional learning activities for students.
Ability for students to take the course as a self-study program.
Standardized testing requirements.
Increase the number of hours for course requirements.
Decrease the number of hours for course requirements.

23 In your opinion, how should the DOL tractor and machinery certification program be based?
- On hours of program participation.
- On performance of competency (includes written and skill).
- On a combination of hours of participation and competency.

24 In your opinion, what is the overall goal of the DOL tractor and/or machinery certification program?

25 Think about what you believe as the overall goal of the DOL tractor and machinery certification program. For each item listed, indicate whether it should be identified as an objective of the program. In other words, is it important for students to perform this objective after participation in the certification program?

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>No opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify hazardous work environments and tasks in production agriculture.</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Utilize accepted practices of equipment operation, focusing on the presence and maintenance of safety components.</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Make informed decisions about the operation of agricultural tractors and machinery.</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Understand basic equipment maintenance.</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
Demonstrate mastery of driving a tractor and attached implement through a series of common obstacles.

Apply equipment safety knowledge in matters of personal decisions.

Identify protective equipment related to tasks assigned to specific age groups.

Understand farm safety principles in general.

26 Are you AWARE of the following teaching materials produced for the DOL tractor and machinery certification program?

1 Yes 2 No

HOSTA (Hazardous Occupations Safety Training in Agriculture), written by Penn State, Ohio State, and National Safety Council

Gearing Up for Safety, written by Purdue University

27 Have you TAUGHT any portion of the following curricula?

1 Yes 2 No

HOSTA (Hazardous Occupations Safety Training in Agriculture), written by Penn State, Ohio State, and National Safety Council

Gearing Up for Safety, written by Purdue University

You're over the half-way point!
Only two sections remaining.
The National Tractor and Machinery Certification Program

The questions on this page are about you and some of your experiences.

28. What is your occupational relationship and tenure to agriculture? Indicate the number of years for any that apply.

- Agricultural teacher, number of years
- Extension educator, number of years
- Agribusiness, number of years
- Farm worker/owner, number of years
- Other (specify), number of years

29. How many years have you taught any type of tractor or machinery safety programs? Number of years do not have to be consecutive years.

- Do not teach at all
- 3 years or less
- 4-7 years
- 8-11 years
- 12-15 years
30 As an instructor, how have you obtained your expertise in teaching tractor safety? (Check any that apply.)

- Experience
- Self-study
- Formal course work
- In-service, training, or workshop
- HOSTA (Hazardous Occupations Safety Training in Agriculture) workshop
- Gearing Up workshop
- Other, please specify

31 As a young person under the age of 18, did you...

1 Yes
2 No

1 Have experience with tractors?

1 Have experience with farm machinery?

1 Participate in the DOL tractor and/or machinery certification program?

32 What is your age?

Thank you for your information and opinions in the first part of the survey. Your comments will be collectively pooled with other instructors in the U.S. so that stakeholders and federal sponsors gain an understanding of where the national tractor and machinery certification program is... and where it can grow.
After you submit this page you will enter the final section of the survey. This last piece will guide curriculum designers as new resource materials for this program are developed. Your information will help answer the question, "What competencies should youth have after participation in a tractor and machinery certification program?"

The National Tractor and Machinery Certification Program

This last section will ask you to rate basic competencies on a 5-point scale. Your responses will be pooled with others to answer the question: "How important is it that youth have this competency after participation in a tractor and machinery certification program?"

The sections are broken down into 3 categories: GENERAL SAFETY, TRACTOR SAFETY, and MACHINERY SAFETY.

The 5-point scale indicates the importance for each of these items to be included in a national program. Yes, the lists are long and comprehensive. However, this program is fairly comprehensive. Your ratings will assist program developers when designing a new curriculum.

The rating scale used in all three sections is:
1 - Not Important
2 - Slightly Important
3 - Moderately Important
4 - Highly Important
5 - Critically Important

Please review the list of competencies for GENERAL SAFETY. Rate each item as indicated.

<table>
<thead>
<tr>
<th>Item</th>
<th>Not Important</th>
<th>Slightly Important</th>
<th>Moderately Important</th>
<th>Highly Important</th>
<th>Critically Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dress safely for work.</td>
<td>1</td>
<td>2</td>
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</table>

Submit
To recognize housekeeping needs of the farm to prevent hazards.

To identify factors and situations which contribute to agricultural hazards.

To identify harmful workplace hazards and suggest specific corrective actions during a walk-around inspection.

To become aware of regulations that affect agricultural workers.

To provide examples of why hazard control and mitigation are more effective approaches to prevent injuries than common statements like "be careful" and "use common sense".

To identify typical growth traits by age groups and how these traits affect the jobs young workers should be assigned.

To understand the variability of agriculture and how it relates to farm safety and health.

To understand caution, warning, and danger signs.

To learn when to use specific types of personal protective equipment.

To recognize the symbols that indicate specific types of personal protective equipment.

To recognize when sound levels can become a threat to hearing.

To use correct hearing protection.

To recognize the respiratory hazards associated with agriculture.
To use correct respiratory protection.

| 1 | 2 | 3 | 4 | 5 |

To recognize the hazards associated with working around livestock.

| 1 | 2 | 3 | 4 | 5 |

To work with livestock safely.

| 1 | 2 | 3 | 4 | 5 |

To protect one's personal health while working in changing weather conditions.

| 1 | 2 | 3 | 4 | 5 |

34 Question 33 dealt with GENERAL SAFETY competencies. Thinking about a national curriculum, there may be regional or occupational variations to influence a curriculum. If there were areas or topics overlooked, please identify them here, including the rating (1, 2, 3, 4, or 5) of relevant importance. Limit your responses to GENERAL SAFETY; tractor and equipment competencies are in another section.

35 Please review the list of competencies for TRACTOR SAFETY: General Information. Rate each item as indicated.
<table>
<thead>
<tr>
<th></th>
<th>Not Important</th>
<th>Slightly Important</th>
<th>Moderately Important</th>
<th>Highly Important</th>
<th>Critically Important</th>
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<td>5</td>
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</table>

To describe how tractors are designed for work and that they vary in size, shape and age.

To recognize proper and improper uses of tractors.

To identify all safety features of a tractor.

To identify the mechanical hazards associated with agricultural machinery and how to avoid such hazards.

To explain the primary types of information found in the tractor/machinery operator's manual.

To identify the top 3 causes of tractor fatalities and safe operations to prevent each.

To identify the top 3 causes of tractor injuries and safe operations to prevent each.

To understand the magnitude, nature, and lasting impacts of injuries associated with tractor and machinery operation.

To recognize common hazards of older equipment and their deficiencies of safety equipment.

To understand the safety concerns of operating a tractor on slopes or uneven terrain.

To understand tractor dynamics, including operating on a hillside or turning on a slope.

To explain the role that center of gravity plays in a tractor overturn.

To recognize how to be protected during a tractor overturn.
To know why a tractor should be put in a lower gear when going down a hill.

To recognize and avoid hazards of being run over.

To ensure work area is clear of people, pets, obstacles, and watch for obstacles in the field.

To know the location and check the condition of a fire extinguisher.

To know the location and check the condition of a first aid kit.

To check that steps and operator platform are free of dirt, grease, debris, and tools.

To clean the windows and mirrors.

To adjust the seat for fit and comfort.

To know the eleven standard hand signals to communicate actions between tractor operator and persons on the ground.

To only operate the tractor when physically and mentally alert.

To know not to operate the tractor under the influence of alcohol, drugs, or certain medications.

To recognize that personal reaction time is slower than the speed of a machine.

To know how to mount and dismount the tractor safely.
<table>
<thead>
<tr>
<th>1</th>
<th>Not Important</th>
<th>2</th>
<th>Slightly Important</th>
<th>3</th>
<th>Moderately Important</th>
<th>4</th>
<th>Highly Important</th>
<th>5</th>
<th>Critically Important</th>
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</thead>
<tbody>
<tr>
<td>To identify and understand approved universal symbols, instruments, and gauges used to monitor tractor operation and performance.</td>
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<td>To be able to make operating decisions based upon the information, gauges, and tractor operation symbols and how to react to malfunctions when they occur.</td>
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<td>To conduct pre-operational checks on a daily basis.</td>
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<td>Check if equipment has been properly serviced and adjusted.</td>
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<td>To be able to listen for unusual sounds and shut off engine if abnormalities are heard.</td>
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<td>Locate all grease fittings; clean and lubricate them.</td>
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<td>To explain the differences between gasoline and diesel engines.</td>
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<tr>
<td>To understand how to check fuel levels of common engines.</td>
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<tr>
<td>To safely refuel a tractor, making sure the engine is cool and refrain from smoking.</td>
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<td>To safely check coolant levels of liquid cooled engines.</td>
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<td>To safely check oil levels of any engine.</td>
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<tr>
<td>To be able to check the battery's electrolyte level and add battery water as needed.</td>
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<tr>
<td>To be able to check, clean, coat, and tighten battery connections.</td>
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</table>
To safely use a battery charger to charge a weak battery.

To safely use booster cables to jump start a weak battery.

To become familiar with hazards of lead acid batteries, including identification of battery parts and their functions.

To understand the hazards of bypass starting; never start the tractor from the ground.

To safely start and stop the engine of a gasoline and diesel tractor.

To warm the engine before applying a heavy load.

To know not to operate the tractor in a closed building without adequate ventilation.

To understand the operational safety concern of hitching properly.

To be able to operate a tractor without stalling or jerking through proper use of the clutch pedal.

To negotiate the tractor between destinations; basic techniques of driving.

To understand the safety concern of excessive speed.

To be able to safely drive in reverse gear to a specific location.

To be able to park the tractor properly.

When stuck, to know how to back out or have the tractor towed.

To recognize and use the proper types of tow ropes or chains.
Please review the list of competencies for TRACTOR SAFETY: Wheels and Tires. Rate each item as indicated.

<table>
<thead>
<tr>
<th>Competency</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>To identify faulty tire and wheel situations and take corrective action.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>To recognize low tire pressure.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>To correctly check air pressure in both regular use and calcium filled tires.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>To be able to adjust wheel width.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>To be able to check brakes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>To be able to add or remove weights.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Please review the list of competencies for TRACTOR SAFETY: Lighting, Marking, and Road Travel. Rate each item as indicated.

<table>
<thead>
<tr>
<th>Competency</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the lighting system to ensure all lights work.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>To check the slow moving vehicle emblem for proper placement and that it is clean and not faded.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>To explain the slow moving vehicle emblem and its usage.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>To select a safe speed for roadway travel based on size and weight of towed equipment.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
To know why and how to lock brakes for roadway travel.

To identify the requirements for road operation.

To safely make left and right turns.

To safely cross an intersection.

To know how to safely select a place to pull over to let traffic pass.

To use safe and courteous traffic driving practices to prevent collisions with motor vehicles.

Please review the list of competencies for TRACTOR SAFETY: Auxiliary Features. Rate each item as indicated.


To recognize safety shields and guards on tractor.

To ensure the Power Take Off (PTO) master shield is in place.

To clean and oil PTO stub shaft and splines.

To engage the PTO slowly, check for operation, and disengage properly.

To operate hydraulic features and check hydraulic controls for proper operation.

To understand the safety concern of adding weights and towing heavy loads.

To understand the safety concerns of adding auxiliary equipment to tractor like loader buckets, saddle tanks, dual tires, or ballasting.
Questions 35 - 39 dealt with TRACTOR SAFETY competencies. Was there an area(s) overlooked? If so, please identify the area or topic here, including the rating (1, 2, 3, 4, or 5) of relevant importance. Limit your responses to TRACTOR SAFETY; equipment competencies are in the next section.

**The National Tractor and Machinery Certification Program**

You made it to the last section of the survey!

This final question will have you rate competencies related to MACHINERY SAFETY.

Using the same 5-point scale, please rate the basic competencies. Your responses will be pooled with others to answer the question: "How important is it that youth have this competency after participation in a tractor and machinery certification program?"

41 Please review the list of competencies for MACHINERY SAFETY. Rate each item as indicated.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Highly Important</td>
<td>Critically Important</td>
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</table>

To identify the hazards of improper hitch pins.

| 1 | 2 | 3 | 4 | 5 |

To recognize safety concerns associated with stationary equipment like augers, grinder-mixers, and farmstead equipment like motor driven pumps, etc.

| 1 | 2 | 3 | 4 | 5 |

To know how to turn off and let a machine spin down to a
<table>
<thead>
<tr>
<th>Task</th>
<th>Difficulty</th>
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</thead>
<tbody>
<tr>
<td>Stop before approaching.</td>
<td></td>
</tr>
<tr>
<td>To safely connect/disconnect an implement to the tractor's drawbar.</td>
<td></td>
</tr>
<tr>
<td>To safely connect/disconnect an implement to the 3-point hitch.</td>
<td></td>
</tr>
<tr>
<td>To safely connect/disconnect hydraulic components.</td>
<td></td>
</tr>
<tr>
<td>To safely connect/disconnect electrical components.</td>
<td></td>
</tr>
<tr>
<td>To safely connect/disconnect a PTO driveline.</td>
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<td>To identify components of a PTO system.</td>
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<td>To identify the hazards involved with PTO use.</td>
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<tr>
<td>To develop PTO safe use habits.</td>
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</tr>
<tr>
<td>To clean and oil a PTO shaft.</td>
<td></td>
</tr>
<tr>
<td>To operate equipment at proper PTO speed.</td>
<td></td>
</tr>
<tr>
<td>To know it is not safe to unclog, adjust, or service equipment while it is running.</td>
<td></td>
</tr>
<tr>
<td>To know how to watch and listen to equipment; shut power off at first sign of malfunction.</td>
<td></td>
</tr>
<tr>
<td>To know how to spot the tractor drawbar to the hitch of the machine.</td>
<td></td>
</tr>
<tr>
<td>To understand safe pulling/towing techniques; gently start a heavy load.</td>
<td></td>
</tr>
<tr>
<td>To select the right gear for the load and terrain.</td>
<td></td>
</tr>
</tbody>
</table>
To maneuver a towed implement through a gate or other opening.

To know how to enter a roadway safely with a towed implement.

To know how to drive down the road while keeping the implement in the lane of travel.

To safely use drawbar implements during transport, field use, turns, and backing operations.

42 Question 41 dealt with MACHINERY SAFETY competencies. Was there an area(s) overlooked? If so, please identify the topic or subject matter here, including the rating (1, 2, 3, 4, or 5) of relevant importance. Limit your responses to MACHINERY SAFETY.

43 Now that you have had a chance to read the competencies from all three sections, it is possible you were waiting for a topic to show up. This space is available for you to identify ANY AREA or SUBJECT MATTER that you feel relevant to include in a tractor and/or machinery safety program. Remember to include the rating (1, 2, 3, 4, or 5) of relevant importance.

Thank you for your valuable input!

Your responses will be collectively pooled with others to give guidance for future youth tractor and machinery safety programs.

In order for me to mail your $10, I need to have an address. This is the ONLY reason I need to know who you are, or where you live/work. There is no other reason behind asking this question.
44. Where would you like your cash sent?

<table>
<thead>
<tr>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company:</td>
</tr>
<tr>
<td>Address:</td>
</tr>
<tr>
<td>City:</td>
</tr>
</tbody>
</table>

**SUBMIT**
APPENDIX O

COMMUNITY COURSE INSTRUCTORS’ INVITATION LETTER
To: [Extension Educators or Agricultural Educators] Who Teach, Coordinate, or Have Experience with Tractor Safety Programs for Youth

Dear [Extension Educator or Agricultural Educator]:

If you teach any type of youth tractor and/or machinery safety programs, I would like to hear from you. And because I know your time is valuable, I will send you a cash incentive!

The focus of this study is the tractor and/or machinery safety programs, including the Department of Labor tractor and/or machinery certification program. I am interested to learn if this program is still being offered in your state, the type of teaching resources you use (if it is offered), and your suggestions for future curricula.

You are being asked to complete this survey for 2 reasons:
1. As a current instructor, it is likely that you are familiar with basic agricultural safety subject matter and how to teach these concepts to youth.
2. You are likely able to identify basic competencies that youth should be expected to demonstrate at the completion of a tractor and machinery safety program.

New educational safety resources are being developed to assist with agricultural safety training, and we need your input to make the materials useful for instructors and relevant for students.

This project is in continuation of efforts over the past 5 years to evaluate the national Tractor and Machinery Certification program. Several projects were funded by USDA-CSREES in cooperation with U.S. Department of Labor to improve the tractor and machinery certification program. This final piece of research is being administered by my own funding, in an attempt to fulfill my dissertation research requirements as a doctoral candidate at The Ohio State University. If I have worked with you in the past on data collection strategies, I thank you for progressing with me through this rigorous process of evaluation. If this is your first interaction with me, I look forward to learning about your local program and your opinions for improvement.

Thank you in advance for lending me your time and support. I have a cash incentive ready to mail you for 20 minutes of your time.

Sincerely,
Dee Jepsen
Program Director, Agricultural Safety and Health
The Ohio State University
590 Woody Hayes Drive
Columbus, Ohio 43210
Email: jepsen.4@osu.edu

<http://www.zoomerang.com/survey.weblink>
APPENDIX P

COMMUNITY COURSE INSTRUCTORS’ WELCOME GREETING TO ELECTRONIC SURVEY
WEB GREETING before entering the survey page

You are about to enter into a survey for the national Tractor and Machinery Certification program. The focus of the study is on current content and teaching pedagogy used in the tractor and machinery certification program. This research is collected on behalf of a dissertation research project at The Ohio State University.

As a current or past course instructor, you are familiar with the course content as well as the needs of youth. You are also able to recognize key competencies that youth should be expected to demonstrate at the completion of course participation. Your input is essential for the accurate evaluation of the current program and for future development of educational materials.

The objectives of this survey are:
1) To identify the types of Tractor and Machinery Certification or other tractor safety programs available to youth around the U.S.
2) To identify current pedagogy and curriculum resources used by instructors of the Certification program.
3) To describe perceived objectives of the Certification program, and
4) To identify basic competencies and skills youth possess after their participation in the Certification program.

This evaluation is just one piece of a greater project that will assist program personnel at the national level make critical decisions about the type of certification program available in the future.

The information you provide will be grouped with other responses from your state as well as from your represented agency (for example, agricultural teacher responses and extension educator responses). Your honest assessment of the program is appreciated. You can be confident your responses will be held anonymous, in that your identity will be withheld from all reports.

If you would like the specific background information about the regulations surrounding the Tractor and Machinery Certification program, you may access the following website: http://www.dol.gov/dol/allcfr/ESA/Title_29/Part_570/29CFR570.71.htm

Thank you in advance for your cooperation. After your completed survey is received, you will receive $10 in appreciation of your participation.
APPENDIX Q

COMMUNITY COURSE INSTRUCTORS’ REMINDER LETTER
Dear Educator:

For the past few weeks, I have had a survey posted on Zoomerang®, an on-line survey website. However, I have not heard from you. I realize spring is a busy season, so for your time and completion of the survey, I will send you $10 cash.

The survey will likely take 20 minutes to complete. You can access it electronically through the link below.

Please be sure to log in and share information about your program in the next 7 days. I want to be sure that your input is included in our final report to USDA-CSREES.

Thank you for your time,
Have a good holiday weekend.

Dee Jepsen
Program Director, Agricultural Safety and Health
The Ohio State University
590 Woody Hayes Drive
Columbus, OH 43201
Email: jepsen.4@osu.edu

<http://www.zoomerang.com/survey.weblink>
APPENDIX R

AVAILABILITY OF TRACTO SAFETY TRAINING REPORTED BY
STATE PROGRAM LEADERS

(GROUPED BY REGIONS)
<table>
<thead>
<tr>
<th>STATE</th>
<th>USDA or VoAg</th>
<th>Teach DOL and Issue DOL Cert</th>
<th>Teach DOL and Do Not Issue DOL Cert</th>
<th>Support DOL</th>
<th>Teach General not DOL</th>
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## EASTERN REGION

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