Proposed Performance Standards for the Agricultural Hazardous Occupations Order Certification Training Program

B. F. French, W. E. Field, R. Tormoehlen

ABSTRACT. The performance standards that accompany Gearing Up for Safety, the agricultural production safety training curriculum for youth, were designed to meet the certification testing requirements of the Agricultural Hazardous Occupations Order (AgHOs) certification training program. The AgHOs requires that certain youth who are older than 13 and younger than 16 years of age complete a prescribed training program before being eligible for employment on farms to perform certain tasks considered hazardous. These training resources will be available for implementation and can be accessed by contacting the second author. To our knowledge, up until this time, few, if any, standardized testing procedures or instruments have had the necessary psychometric evidence to support use of the resulting scores to assess the readiness of youth to meet the basic certification requirements contained in the AgHOs. This article describes the rationale, methods, and key findings from a standard-setting session held to establish minimum passing scores for a proposed testing process. The test will be used as a component of the Gearing Up for Safety certification process for youth workers seeking employment to perform job functions as specified under the AgHOs. Readers may be able to apply this standardized testing process, or similarly accepted processes, to other or future testing and certification projects involving agricultural safety and health.

Keywords. AgHOs, Education, Farm safety, Safety certification, Standard setting.

This article describes the rationale, methods, and key findings from a standard-setting session held to establish minimum passing scores for the testing process associated with Agricultural Hazardous Occupations Order (AgHOs) training. The purpose of the AgHOs training programs is to provide systematic and necessary training for persons working in agricultural production to ensure that they meet the minimum safety and health training requirements prescribed under Subpart E-1, Part 1500, Title 29 of the Code of Federal Regulations (i.e., AgHOs), which is an amendment to the 1938 Fair Labor Standards Act (U.S. DOL, 1970, 1996). The Act (1) applies to all states, although some states have stricter rules (e.g., Missouri); (2) identifies certain tasks in agricultural workplaces considered to be particularly hazardous and disallowed for persons under the age of 16 who are not working on a parent or guardian’s farm; and (3) contains provisions that allow 14 and 15 year olds to be employed for specific tasks if certain training requirements are met.

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A major goal of the AgHOs training requirements is to reduce the frequency and severity of injuries to youth ages 14 to 15 working in agricultural production. There are currently no provisions to employ youth on non-family farms to perform tasks involving agricultural tractors and machinery prior to age 14, and there are no restrictions to employment once the youth reaches the age of 16. Over the past four decades, these requirements have provided the impetus for providing safety training for tens of thousands of youth seeking agricultural employment. Additionally, it is likely that more youth have received valuable safety training as a result of participating in the AgHOs training even though they were exempt from AgHOs requirements due to their status as a member of a farm family and limited their work to their family farm (U.S. DOL, 1996). Quantifying this benefit empirically is difficult, as a standardized tracking system has never been put in place. A wide variety of programs and curricula (i.e., content, format, duration, and outcome expectations) have been developed at the local, state, and national level to meet the AgHOs training requirements. However, there has been no centralized oversight for these programs, and consequently current training programs have evolved into diverse instructional activities. In some cases, the programs (1) do not meet the minimum requirements of the AgHOs regulations, or (2) do not have clearly defined or measurable outcomes (Carrabba et al., 2000).

In light of this variation, a project was undertaken, with support from the National Institute for Occupational Safety and Health (NIOSH), to identify the minimum instructional components and the minimum core content that should be included in all training programs intended to meet the AgHOs training requirements (Ortega et al., 2003). These minimum standards were utilized to develop program evaluation criteria and were translated into a testing procedure to assist with knowledge and skills assessment of youth who completed an AgHOs training program. Participation in the training was thought to lead to the student acquiring and being able to demonstrate certain knowledge and hands-on skills prior to being certified for employment on a farm. The outcome of this effort was used to design and prepare the Gearing Up for Safety curriculum, which is intended to provide the core instructional and testing components for meeting the AgHOs training requirements (Tormoehlen et al., 2003).

Youth who complete training provided by either local Extension services (4-H) or agricultural science and business (agricultural education) instructors are required to pass written and practical examinations to be certified to operate tractors and machinery under the exemptions allowed by the AgHOs. However, the AgHOs regulations provide little guidance on the assessment process for examinee performance or achievement (e.g., how to test, and what is an acceptable mastery level) on specific or desired core competencies. The AgHOs only specifies that an examinee be able to pass a written examination and demonstrate the ability to operate a tractor and two-wheeled trailer/implement over an obstacle course similar to those employed in 4-H tractor operator contests (U.S. DOL, 1996).

As part of the National Certification Information Clearinghouse and Administrative Management System project located at Purdue University and funded by the USDA, it was determined that a more consistent and objective testing procedure was necessary for the AgHOs certification process. Even though not required by the AgHOs, a clearly defined process would (1) enable assessment of skills against a set of standard performance criteria, and (2) potentially identify areas of weakness that must be addressed prior to certification and employment. The testing process was constructed to assess not only knowledge of the minimum core content areas specified by the AgHOs but also new agricultural workplace hazards not addressed by the 40-year-old law (Ortega et al., 2003). The validated testing procedure could also potentially be implemented with youth not covered by
the AgHOs exemptions and workers entering the agricultural work force with little prior safety training.

The testing process was designed so that each examinee must successfully complete each of three separate sections of the process prior to advancing to the next test section. (The testing process is further described in the Methods section of this article.) Failure to successfully complete any of the three testing sections prevents the examinee from moving to the next level and eventual certification for AgHOs exempted employment. Incorporating this progressive process sets a standard and communicates to parents and youth that certification cannot be achieved solely as the result of participation in the training program or simply by taking a written multiple-choice test. Rather, evidence must be obtained that a youth has acquired and demonstrated, as required by federal regulations, both the knowledge and skills necessary to safely operate agricultural tractors and machinery, and perform other allowable farm-related tasks considered hazardous. Research and experience have shown that not every 14 or 15 year old youth is prepared intellectually, emotionally, or physically to safely perform certain hazardous tasks (Carrabba et al., 2000). This limitation is reflected in the high injury rate reported for youth under the age of 16 who are involved in agricultural work. Thus, final certification of all examinees is not expected, as some may not successfully complete one or more of the test sections. In fact, the certification process is in place to prevent persons who do not have the requisite skills from being placed in employment environments where they may be at substantial risk of injury. The certification process has been incorporated as part of a comprehensive instructor package for the Gearing Up for Safety curriculum for national dissemination.

As the purpose of the testing process is to certify youth to work in agricultural environments, operate equipment, and drive a tractor within the constraints of the AgHOs, setting performance standards (i.e., passing scores) was necessary, as valid inferences depend on the evidence that the scores can make valid distinctions between acceptable and unacceptable performance. The use of an established standard-setting method is essential, as passing scores should not be decided arbitrarily (Cizek et al., 2004). Furthermore, the use of such a process aligns the Gearing Up for Safety curriculum with the Standards for Educational and Psychological Testing (AERA et al., 1999). Specifically, the Standards state that (1) the rationale and procedures for determining passing scores should be clearly demonstrated (Standard 4.19), (2) the judgmental process for establishing a passing score that concerns a level of proficiency should be such that the expert judges can use their knowledge and skills in a reasonable manner (Standard 4.21), and (3) the performance level for a passing score should reflect the necessary skills to adequately perform the job requirements and not reflect or be adjusted to determine the percent of examinees passing the test (Standard 14.17).

Standard setting, as defined by Cizek (1993), is “the proper following of a prescribed, rational system of rules or procedures resulting in the assignment of a number to differentiate between two or more states or degrees of performance” (p. 100). There are well over 40 methods that could be used for standard setting, and a new method or version of a method is introduced in the literature on a regular basis (Raymond and Reid, 2001). This study employed the widely used Angoff method, one of many test-centered performance setting methods (Angoff, 1971; see Cizek, 2001, and Cizek et al., 2004, for a discussion of the various methods and steps in the standard-setting process). The Angoff method relies on expert judges in the content domain measured by the test. The judges are familiar with the examinee population, they know how examinees should answer each item correctly, and they can identify exemplar performance in the case of constructed responses (e.g., a pre-operational checklist). To accomplish this, the judges develop a common understanding of minimally competent individuals. Recommended passing scores are obtained from the average of the judge’s individually estimated scores for the examinees.
Recommended scores are reviewed, and final passing scores are set by a governing body (e.g., policy makers, oversight board, etc.). The judgments by the panel of experts are generally made at a standard-setting session led by a psychometrician, where the judges are trained in the standard-setting process (i.e., how they should think about and approach such performance judgments).

The use of this process assisted in meeting the purpose of this study, which was to establish passing scores for each test section using a recognized and widely used standard-setting procedure. Specifically, the objective of this study was to develop performance standards (i.e., passing scores) for the three sections of the certification test: (1) a written examination, (2) a pre-operational inspection, and (3) actual operation of a tractor.

Methods

Participants

A critical feature of test-centered performance setting procedures, as used in this study, is the selection of the judges who will provide the assessments of predicted examinee performance on the test items or performance tasks. Qualifications of the judges are important, as they will influence the passing score decisions and influence the perceived value of the passing score by various constituents (Raymond and Reid, 2001). A relatively large and representative panel of judges is desired so that similar passing scores will be obtained upon study replication. Judges generally (1) are content experts in the domain being assessed, (2) understand the examinee population, (3) have knowledge of the instruction that examinees receive, (4) have a reasonable understanding of the consequences of standards, and (5) represent various communities of interest. For additional information and discussion on judge selection, see Jaeger (1991) and Raymond and Reid (2001).

A panel composed of individuals from the curriculum advisory committee for the Gearing Up for Safety program and the National Certification Information Clearinghouse and Administrative Management System project was used as judges. Committee members (N = 16) participated in the two-day standard-setting session. The panelists were selected for their experience with youth, agricultural education, agricultural youth workers, and the safety issues related to this population and environment. The panelists also represented the desired characteristics of judges. For instance, some panel members had extensive experience with the development of materials and curriculum for the AgHOs training programs, while others worked directly with youth in training programs. The panel represented a range of professionals and experts in the content area (e.g., academicians, agricultural equipment designers, educators, government officials, insurance professionals, and safety experts). These panelists allowed the passing scores to be derived based on experience and qualification rather than mere authority, as is common when a few policy makers determine the standards (Jaeger, 1991).

Testing Instrument

The three test sections developed by the Purdue researchers for the AgHOs certification process are described below. Samples of each section may be obtained by contacting the second author.

Written Examination

The written examination consists of carefully selected and empirically tested questions that were designed to assess the knowledge of the most important information that youth need to know to work safely in agricultural production. An item pool of over 350 dichotomously scored items was developed to assess the examinee’s knowledge re-
lated to AgHOs certification requirements. Test questions cover the contents of the AgHOs regulations, the tasks that have been identified as having the greatest risk of injury, critical farm hazards, and the desired minimum competencies needed to safely operate agricultural tractors and equipment and perform other hazardous farm work. The questions were reviewed by a panel of agricultural safety and health specialists and educators to establish content validity. A representative set of 70 items (randomly drawn based on content specifications) and administered to over 400 examinees resulted in an internal consistency reliability coefficient (Cronbach’s alpha) of 0.90.

Pre-Operational Inspection

The pre-operational inspection involves a skilled tractor operator (e.g., experienced agricultural worker or agricultural safety leader) observing the examinee conducting a pre-operation safety inspection of a typical agricultural tractor. The Pre-operational Safety Inspection Scoring Form (44 items) is designed to provide a consistent method for determining if the examinee is able to (1) identify key components and controls, (2) point out critical areas for inspection, (3) recognize significant potential hazards, and (4) physically access the tractor operator station and controls prior to starting and operating the tractor. Items included in the inspection reflect the standard pre-operational inspection guidelines included in most operator manuals.

Operator Skills

Based on the current AgHOs certification requirements, as interpreted in the Gearing Up for Safety curriculum, a youth seeking certification must, in addition to passing a written examination and a pre-operational inspection test, demonstrate his or her ability to operate a tractor safely with a two-wheeled, trailed implement (trailer) on a course similar to one used for 4-H tractor operator contests. Several courses have been designed by state and national organizations, and each has been used at some time as part of the certification process. To provide uniformity in scoring examinee performance, a standardized scoring sheet was designed. This scoring sheet is usable on any of the published courses that include components of, for instance, standard courses used for 4-H tractor operator contests. The scoring form is a modified version of the Purdue Safe Tractor Operation Score Card and is based on research that examined the effectiveness of 4-H tractor operator programs to instill safe tractor operator behavior and attitudes in youth (Carrabba et al., 2000). The modified form reflects recent research and input from teams working on the AgHOs curricula. The scoring sheet contains items that would cause automatic failure (e.g., tractor leaves the course) for this test section if the examinee failed to demonstrate the specific skill correctly or performs an unsafe procedure. Items resulting in automatic failure reflect behaviors that have a high potential of injury or death if performed in an agricultural workplace.

Procedure and Analysis

The process followed to establish cutscores is known as standard setting. Specifically, the Angoff (1971) method was used to establish the passing scores for all three test sections. The panel of judges participated in a two-day session, where they became familiar with the testing process and made standard-setting judgments about each section.

Prior to establishing a score for each test section, the judges were instructed to focus on the skills and abilities of a hypothetical minimally competent individual. The panelists discussed this concept, composed lists of critical skills or knowledge that this individual would possess, and came to a consensus on the skills that a minimally acceptable youth worker would possess in the minimum core areas for each test section. The panelists completed practice items for each section prior to working on each section, and were given examinee performance data to reflect on their ratings. For instance, on the multiple-
choice items, panelists were given item difficulty values (i.e., proportion of examinees passing the item).

Following each discussion, the panelists independently rated the items for each section. To make standard-setting judgments for the written examination and the pre-operational inspection, the panelists answered the question, for each youth, “Would a worker with minimally acceptable ability answer this question or identify this component correctly?” The total number of items to which a panelist responded “yes” was recorded as that panelist’s first-round cutscore recommendation for the section. Items in the operator skills section were scored in terms of how many failures of a skill were acceptable to still consider someone adequately trained to operate a tractor. As an example, hitting a course boundary marker with a tire up to five times may be acceptable, while losing control of the tractor once, regardless of the circumstances, would be unacceptable. Lower scores (i.e., closer to zero) indicated fewer mistakes. On the pre-operational inspection and operator skills sections, a few items were marked “automatic failure” items. If panelists agreed that these should be automatic failure items, then the examinee who failed such an item would fail the test section and would not be certified.

The facilitator computed summary statistics for the first-round recommendations across the panelists for each section. Panelists were given summary statistics (e.g., range, mean and median values, standard deviation) and item difficulty information, where appropriate, to start the group discussion of their first-round recommendations. This information was explained to the panelists, and questions, answers, and discussion followed. Following this period, the panelists had an opportunity to re-evaluate and adjust their cutscore for the second-round recommendation. Final ratings were collected after the second-round recommendation. Based on these final ratings, summary statistics were computed. Once raw mean scores were obtained for the written examination and pre-operational inspection sections, corresponding percentages were computed. A percentage was not obtained for the operator skills section, as the number of possible errors does not have a set limit. The raw scores and percentages were the recommended performance standards (i.e., passing scores) for the respective test sections.

Results

Cutscores for Certification by Test Section

Table 1 provides the mean raw cutscores and the respective percentage cutscores based on the panelists’ second-round recommendations. Note that the number of panelists differs for the written section compared to the other sections. This was due to the standard-setting session being conducted over two days, and two panelists were not available for the second day. Note that this is common in standard-setting sessions.

There was variability in the ratings for the written (range = 37-62, SD = 7.74), pre-operational (range = 30-44, SD = 4.44), and operator skills (range = 8-40, SD = 8.73) sections, as expected with a diverse group of panelists representing different constituents. The operator skills section appeared to have the most variability in the number of mistakes that would be allowed before not allowing an examinee to pass that section. Based on the suggestion of a reviewer, ratings were compared between educators/academicians and policy makers, government officials, and non-profit safety organization employees. Statistical tests were not conducted between the groups, as the sample size was too small to have adequate statistical power. However, visual inspection of the results revealed an
Table 1. Recommended cutscores for the AgHOs certification training program test.

<table>
<thead>
<tr>
<th>Test Section</th>
<th>No. of Panelists Included in Calculation</th>
<th>No. of Items or Tasks</th>
<th>Raw Score Points Available</th>
<th>Mean Raw Cutscore</th>
<th>Percentage Cutscore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written</td>
<td>16</td>
<td>70</td>
<td>70</td>
<td>49</td>
<td>70%</td>
</tr>
<tr>
<td>Pre-operational</td>
<td>14</td>
<td>44</td>
<td>44</td>
<td>37</td>
<td>85%</td>
</tr>
<tr>
<td>Operator skills</td>
<td>14</td>
<td>32</td>
<td>N/A</td>
<td>20[a]</td>
<td>N/A</td>
</tr>
</tbody>
</table>

[a] In the operator skills section, the mean raw cutscore is used as the passing score. A score of zero indicates perfect performance. An examinee must have a score of 20 or less to pass.

interesting pattern. In the operator skills section, the two highest numbers of acceptable failure ratings came from non-academicians, whereas the two lowest ratings came from an academician and an agricultural equipment designer. In the other two test sections, there were no identifiable differences or patterns between groups.

To assist in understanding the results, examination of the “operator skills” line in table 1 shows that 14 panelists completed the scoring process. The score card for this test section contains 32 items. There is no possible raw score or percentage cutscore for this test section in the same manner as the other sections because this section is scored with 0 points to indicate perfect performance, as judged by the examiner. The raw cutscore for this section indicates that no more than 20 mistakes can occur, given that these mistakes are not automatic failure items, for the examinee to pass this section. To pass the other two test sections, an examinee must score at or above the stated cutscore percentages. Successful completion of all three sections is required for the examinee to pass the certification test.

Note that the separate test sections do not have the same scoring scale. Thus, for example, a certain score or percentage on one section cannot be considered equal to the same score or percentage on another section. These percentages are the panel’s recommendations, that is, they are the minimum scores for each section that the panel as a group considered necessary for certification.

Discussion

A major goal of the AgHOs training requirements, as addressed by the Gearing Up for Safety curriculum, is to reduce the frequency and severity of injuries to persons younger than 16 years of age working in agricultural production. One step toward that goal is for the youth in the target age group to successfully complete a certification training program. The purpose of this study was to establish performance standards (i.e., passing scores) for the AgHOs certification test designed for the use with the Gearing Up for Safety curriculum using established psychometric methods. This will allows the certification program to be in accord with educational and psychological testing standards. This research is an essential component in the development of the certification process (AERA et al., 1999). Performance standards should not be arbitrary, since arbitrary passing scores can result in a capricious certification process (specifically, see Standards 4.19, 4.21, and 14.17 of the Standards for Educational and Psychological Testing). The outcome of this research will provide instructors across the U.S. using the Gearing Up for Safety or similar curriculum a consistent way of assessing student performance.

The passing scores established in this article can be used in certifying youth workers and reflect the standards set by experts in the field. These scores reflect the level of knowledge and skills that these experts believe are essential, reflect the experts’ values and experiences in the content area, and reflect the expectations for youth working in agricultural production. It should be noted that there is no such thing as a “true” passing
These scores depend on values, and when different judges with different values participate in the process, it is likely that different scores will be produced (Zieky, 2001). The panel of experts used in this research had diverse backgrounds, this diversity was reflected in their various points of view, and the passing scores reflect these differing points of view. These standards begin to provide necessary validity evidence for the certification process. Future research will focus on validation of these scores using various methods (e.g., cluster analysis), an essential next step to ensure accuracy of performance standards. Future research will also evaluate the accuracy of these scores as more data become available.

With any certification process, there will be examinees who fail for a variety of reasons (e.g., lack of knowledge, classification error, etc.). Many certification programs do not offer follow-up information or training when an examinee has failed the process (e.g., automobile driving tests). The examinee may need to retake the test at a later date. However, given the type of training program and environment offered through many AgHOs training programs, and the narrow age window for the youth involved (14 to 15 years), it should be possible to enhance an examinee’s skills and knowledge before retesting. The process for dealing with an examinee who has failed the test should involve all stakeholders, including the youth, his or her caregivers, the instructor, and a responsible supervisor (e.g., Extension educator or agricultural educator/teacher). Possible solutions include (1) additional studying, training, and experience in target areas that appeared deficient based on test performance; (2) participation in remedial independent study; or (3) encouraging the examinee to wait until he or she has gained greater cognitive and physical maturity required for certain tasks (e.g., physically able to reach all tractor controls). Placing a young person, who has not demonstrated the appropriate mastery of essential competencies, in a hazardous work situation places the individual at considerable risk of injury or death. The AgHOs training programs and certification process, such as those similar to the Gearing Up for Safety curriculum, focus on minimizing this situation. Ongoing research on these issues will assist in continued progress toward reducing the probability of injury and death.

Conclusion

In summary, the results presented in this article are relevant to the understanding of the certification process and provide an example of a testing procedure that practitioners can use in assessing the readiness of youth within the stated age range to function safely when employed to perform duties within the guidelines of the AgHOs. The proposed performance standards provide empirically determined levels of ability deemed necessary by experts in the area. These proposed levels of ability should assist practitioners in the certification process when making decisions about youth seeking employment and completing the certification test. Continued evaluation of the technical issues related to performance standards requires further attention and continued validation. However, no process can ensure that youth who have completed any certification process will always perform assigned work tasks safely or as directed. We cannot ensure the safety of anyone, but we can attempt to assess their readiness to be employed.

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