Agricultural Safety and Health Education: Practices, Attitudes, and Needs of Iowa Agricultural Educators

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Abstract

This study sought to identify Iowa agricultural educators' practices, attitudes, and needs regarding agricultural safety and health (ASH). Nearly 85% of high school agricultural educators reported teaching ASH in some capacity. The most commonly taught topics included animal safety, welding safety and power tool safety. Iowa agricultural educators rated, using a Likert scale, the importance of topic within ASH education. All topics presented were believed to be important, with machinery safety, tractors safety, and ATV safety rated the most important. Personal health topics including hearing protection and thermal protection were perceived as less important. Most educators believe the ASH materials available to them were quality and age appropriate. When presented with the statement, "I believe there is adequate training and professional development for teachers on ASH," nearly 70% of educators disagreed. Lack of time was cited by nearly 75% of teacher as a major limitation to teaching ASH education in their classrooms. These finding have implications for professional development.

Introduction

Family farms continue to dominate American agriculture (Murphy, 1992). According to the 2007 Census of Agriculture, 88% of farms in the United States are still family owned (Nelson, 2010). Family farms raise specific safety and health issues. These operations are usually exempt from regulatory control, often do not make modifications to reduce the event of injury or death, and allow children to operate machinery and drive tractors (Murphy, 1992).

Farming has historically been a hazardous occupation (Rivara, 1985). Worker fatality statistics from 2007 suggest that forestry, agriculture and fishing are the nation's most hazardous work industries (Murphy and Lee, 2009). Work death rates in these industries are eight times higher than the all-industry average, and 80% of the work-related deaths in these industries occurred in agriculture alone (Murphy and Lee, 2009).

Unlike most industries, children and young adults make up a significant portion of the agricultural workforce (McCallum et al., 2005) and their exposure to agricultural hazards is routine and extensive. In 2006, it was projected more than 29 million youth under the age of 20 were exposed to agricultural hazards as either farmworkers, visitors, farm residents, or children of farm workers (Levy et al., 2011). Recent agricultural injury and fatality statistics reported a fatality rate of 43 per 100,000 youth (NIOSH, 2007). While the farm injury death rates have declined (Rivara, 1997), the rate is still higher than all other industries (Murphy and Lee, 2009).

There are three established methods to combating fatalities, injuries, and illnesses in industries: 1) engineer hazards out of equipment and processes, 2) enforce regulations that prohibit work and working conditions, and 3) educate workers on hazard recognition and encourage adoption of behaviors that will reduce the potential for injury, illness, or death (Murphy, 1992). In agriculture and on family farms specifically, two of these methods are difficult. While engineering if often boasted as the most effective methods at reducing worker exposure to hazards, farmers often take liberties to remove safeguards or modify equipment to better meet their needs (Murphy, 1992). Given that a majority of farms in the United States are family owned, state and federal legislation to prevent agricultural injuries and fatalities are not applicable (Murphy, 1992). Education has been viewed as the weakest method to reducing agricultural injuries, illnesses, and fatalities. However, literature suggests educating youth could have great impact on attitudinal and behavioral changes within agricultural safety and health (Murphy et al., 1996). Many agricultural safety and health (ASH) professionals view

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youth as more adaptable to change and more readily able to change their behavior and also think targeting youth is an effective way of educating adults who are in contact with youth (Murphy et al., 1996).

Nonprofit organizations and governmental agencies educate people about the hazards associated with agriculture. However, one weakness of these efforts is agriculture's dispersed workforce, making it difficult to gather groups for education (Murphy, 2003). It has been suggested that agricultural safety and health (ASH) education should become part of secondary agricultural education programs (Dyer and Andreasen, 1999; Florio and Stafford, 1969) and, in fact, Lee et al., (2004) described and evaluated the effect of a National Rural Health and Safety Initiative implemented by the National FFA Organization for its local chapters. In their book Safety Education, Florio and Stafford (1969) stated, "*Education is the only feasible means of achieving this goal, and its failure to date indicates merely that initial efforts have not been sufficiently intensive and widespread. All schools in rural areas should provide training in farm safety and should support the activities of other organizations interested in this work"* (p. 341).

More recently, Dyer and Andreasen (1999) concluded that safety of students is the most important job of an agricultural educator. However, little is known about the practices, attitudes, and needs of agricultural education instructors when it comes to ASH.

Purpose and Objectives

The purpose of this study was to identify agricultural educators' practices, attitudes, and needs regarding ASH education. The study had five specific objectives:

1. Determine Iowa secondary agricultural educators' current practices in ASH education.
2. Determine Iowa secondary agricultural educators' perceived importance of ASH topics.
3. Determine Iowa secondary agricultural educators' attitudes toward ASH education based on their responses to six belief statements.
4. Identify factors that limit ASH education in secondary agricultural education classrooms.
5. Identify types of resources Iowa secondary agricultural educators would be interested in using to teach ASH.

Literature Review

Educating youth to adopt safe behaviors when working in agricultural settings can be effective. Youth are moldable and still capable of changing behaviors, which becomes more difficult with age (Murphy et al., 1996). A number of reputable non-profit organizations, academic institutions and government organizations target young people with educational interventions.

Educational interventions aimed at reducing the number of agricultural injuries, illnesses, or deaths among young people come in many forms including farm safety day camps, interactive exhibits, demonstrations at country fair, and guest speakers in schools. However, the effectiveness of such interventions is questionable. Community and farm-based interventions (i.e., farm safety day camps) often yield increases in short-term knowledge. However, long-term knowledge and behavior changes are unknown. Tractor training programs produced inconsistent results; with one study citing no change in behavior and another reporting change in safety behavior but no change in attitude (Hartling et al., 2004).

Seven school based interventions were evaluated and reported either an increase in knowledge and/or changes in attitudes towards agricultural safety, especially when active, hands-on participation activities were included (Hartling et al., 2004). These studies suggest the potential for successful interventions when ASH education is incorporated into the secondary agricultural education classroom. This idea is further strengthened when teaching methods, learning theories, and audience members of the two (i.e., agricultural safety and health and secondary agricultural education) are compared.

When studying ASH education and secondary agricultural education, common learning theories, instructional methods, and audiences quickly emerge. In ASH education and agricultural education, behaviorism and constructivism have emerged as effective learning theories (Cole, 2002; Doolittle and Camp, 1999). Behaviorism is based on positive or negative consequences after a behavior or action following an antecedent condition (Cole, 2002). In constructivism, people construct knowledge as they interact with the world, building blocks of knowledge and understanding (Murphy, 2003). In ASH education, constructivism helps individuals recognize hazards and adopt safe practices (Cole, 2002).

Both agricultural education and ASH education use hands-on, real-word experiences to educate youth. In secondary agricultural education, a hands-on (i.e., tactile) teaching approach has been promoted (Cano and Garton, 1994) because it engages students' psychomotor skills, heightening education and understanding (Newcomb et al., 2004). Similarly, instructional methods for teaching ASH should appeal to all senses of a student, and students should learn in the physical environment when possible (Newcomb et al., 2004). Ensuring that individuals can recognize agricultural hazards and understand how to respond safely is vital to effective education and can be accomplished by using case studies and allowing students to have hand-on experiences in creating safer agricultural environments (Lehtola and Boyd, 1992). As previously stated, school based interventions that employed participation among students saw increases in knowledge and attitudes towards farm safety (Hartling et al., 2004).

Secondary agricultural education and ASH education share a common audience—young adults. Secondary agricultural education is focused on educating students in grades 9–12, and in some cases middle school students, about agricultural science. Like most states, Iowa has approved standards and benchmarks for

agricultural mechanics as part of its recognized state competencies (Iowa Department of Education, 1999).

The target audience for ASH education is youth involved in agriculture. Many ASH educators view youth as more adaptable to change and more readily able to change their behavior (Murphy et al., 1996). Emphasis on high school students is critical, between 1995 and 2002, most of 907 farm youth fatalities occurred to youth 16-19 years of age (NIOSH, 2007). Parallels in learning theories, teaching methods, and audiences suggest the secondary agricultural classroom may be the appropriate avenue for agricultural safety and health education. However, instructor perception of, and integration of ASH curriculum is unknown.

Materials and Methods

For this census study, all 216 secondary agricultural educators in Iowa were contacted. A web-based survey was the most feasible and appropriate method to collect data for this study. Web surveys can be conducted quickly, reach large populations, and are inexpensive compared with other survey methods, such as telephone or mail surveys (Ary et al., 2010).

Following Dillman's (2006) Tailored Design Method, the survey included an introduction and three sections of questions. The introduction welcomed educators to the survey, collected consent, and defined ASH. For this survey, ASH was defined as the proper handling and operating of agricultural equipment, livestock, tools, chemicals, etc., as to ensure maximum safety of the operating individual and minimized rise of injury or death. Providing this definition ensured all participants had the same concept of ASH completing the instrument. The introduction also explained the three categories that ASH was divided into for the purpose of this study (i.e., agriculture, mechanics, and personal health). The agriculture category included traditional farming domains such as tractor and animal safety. The mechanics category included safety domains such as hand tool and power tool safety. The personal health category included topics such as heat/cold protection, personal protective equipment, and eye/hearing protection.

The first section of the survey asked questions regarding current ASH education practices. Educators were asked to identify what agriculture, mechanics, and personal health topics they had taught during the current school year, how they integrated ASH topics into their classrooms, and what resources they used to teach the topic. The second section asked five questions about teacher's attitudes towards ASH education. Safety and health education is focused on behavioral change, which is influenced by attitude (Murphy, 1992). Educators were asked to report their level of agreement with statements about ASH education and rate the importance of ASH topics.

The final section collected demographic information. Educators were asked to report their educational background, number of years in the profession, whether they had been raised on a farm, and if they ever sustained an injury as a result of an agricultural incident. The first, second, and third sections included seven, five, and 10 questions respectively.

The survey was piloted for comprehension and content validity. Four current agricultural education student teachers, a former secondary agricultural educator, and a university faculty member at Iowa State University with expertise in ASH deemed the instrument content and face valid. Cronbach's alpha coefficients were calculated post hoc for the five constructs in the survey (Table 1).

The survey was administered through SurveyMonkey. Dillman's (2006) recommended five-step contact approach for obtaining responses to Internet surveys, which was modified because of timing issues associated with the data collection. Iowa agricultural educators were contacted five times over a four week period beginning in late May. The first five contacts yielded a response rate of 55% (n = 118). Therefore, nonrespondents were contacted two more times in fall once they returned to their classrooms for the academic year. After seven contacts, the study had a useable response rate of 63.4% (N = 137). Early and late respondents were compared to determine nonresponse error. With the exception of one question regarding the importance of ASH education, the results of this study can be generalized to the entire population. The Iowa State University Intuitional Review Board approved the initial and modified data collection procedures.

Data were analyzed using SPSS 19.0 and Microsoft Excel. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated to determine the research objectives.

Table 1. Cronbach's Alpha Coefficients for the five constructs in the survey instrument

Construct	Cronbach's alpha coefficient
Agriculture safety topics	.93
Mechanics safety topics	.92
Health safety topics	.89
Agricultural safety and health belief statements	.80
Agricultural safety and health educational resources	.68

Results and Discussion

Iowa Agricultural Educators' Current Practices in ASH Education

Agricultural educators identified, from a list, which ASH topics they had taught in the last academic year. Topics were divided into three categories: agriculture,

Table 2. Agricultural safety topics Taught by Iowa agricultural educators (N =137)

	Respondents teaching	
Agriculture Safety Topics	*f*	%
Animal	115	83.9
Machinery	94	68.6
Chemical	87	63.5
Tractor	72	52.6
Grain handling	62	45.3
ATV	51	37.2
Combine	41	29.6
Confined spaces	37	27.0
Rural driving	29	21.2
Manure	24	17.5
Taught NO agriculture safety	5	3.6

Table 3. Mechanics safety topics taught by Iowa agricultural educators (N =137)

	Respondents teaching	
Mechanics Safety Topics	*f*	%
Welding	97	70.8
Power tool	96	70.1
Hand tool	94	68.6
Electrical	61	44.4
Fire	57	41.6
Small gas engine	53	38.7
Lawnmower	51	10.9
Chainsaw	26	19.0
Taught No mechanics safety	15	10.9
Ladder	10	7.3

Table 4. Health safety topics taught by Iowa agricultural educators (N =137)

	Respondents teaching	
Agriculture Topics	*f*	%
Personal protective equipment	80	58.4
Hearing protection	44	32.1
First aid	44	32.1
Back protection	29	21.2
Taught NO personal health safety	28	20.4
Heat/cold protection	14	10.2

Table 5. Integration of agricultural safety and health education in Iowa agricultural educators' Curricula (N =137)

	Respondents	
Integration technique	*f*	%
As part of an agrucultural science unit	120	87.6
As a workshop or lab in class	65	47.4
As an extracurricular activity outside the classroom	29	21.2
As its own unit	19	13.9

Table 6. Iowa agricultural educators' perceived importance of agriculture safety topics (N=137)

	Not important	Somewhat important	Important	Very important		
Topic	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*M*	*SD*
Machinery	1 (.7)	1 (.7)	50 (37.0)	**83 (61.5)**	3.59	.550
Tractor	1 (.7)	1 (.7)	54 (39.8)	**80 (58.8)**	3.57	.554
ATV	1 (.7)	9 (6.6)	45 (33.1)	**81 (59.6)**	3.51	.655
Chemical	1 (.7)	5 (3.7)	57 (41.9)	**73 (53.7)**	3.49	.608
Animal	1 (.7)	6 (4.4)	62 (45.6)	**67 (49.3)**	3.43	.617
Combine	1 (.7)	11 (8.0)	60 (44.1)	**64 (47.1)**	3.38	.666
Grain	1 (.7)	11 (8.0)	**62 (45.6)**	**62 (45.6)**	3.36	.663
Rural driving	3 (2.2)	13 (9.6)	58 (42.6)	**62 (45.6)**	3.32	.737
Confined Spaces	2 (1.5)	23 (16.8)	**62 (45.9)**	48 (35.6)	3.16	.752
Manure pit	1 (.7)	26 (19.3)	**63 (46.7)**	45 (33.3)	3.13	.767

Note. Scale: 1 = not important, 2 = somewhat important, 3 = important, 4 = very important.
Note: ***Bold*** = Mode

Table 7. Iowa agricultural educators' perceived importance of mechanics safety topics (N =137)

	Not important	Somewhat important	Important	Very important		
Topic	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*M*	*SD*
Power Tool	1 (.8)	6 (4.5)	59 (44.4)	**67 (50.4)**	3.44	.621
Welding	0 (0.0)	9 (6.7)	58 (43.3)	**67 (50.4)**	3.34	.619
Fire	2 (1.5)	9 (6.7)	60 (44.4)	**64 (47.4)**	3.38	.697
Lawnmower	1 (.7)	11 (8.0)	64 (47.8)	**64 (47.8)**	3.34	.660
Electrical	1 (.7)	12 (8.9)	64 (47.4)	58 (43.0)	3.33	.667
Hand tool	1 (.8)	21 (15.9)	58 (43.9)	52 (39.4)	3.22	.734
Chainsaw	2 (1.5)	16 (11.9)	73 (54.5)	43 (32.1)	3.17	.698
Small Gas Engine	1 (.8)	17 (12.8)	77 (57.9)	38 (28.6)	3.14	.653

Note. Scale: 1 = not important, 2 = somewhat important, 3 = important, 4 = very important.
Note: ***Bold*** = Mode

Table 8. Iowa agricultural educators' perceived importance of personal health safety topics (N =137)

	Not important	Somewhat important	Important	Very important		
Topic	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*M*	*SD*
First aid	2 (1.5)	10 (7.4)	61 (45.2)	**62 (45.9)**	3.36	.685
Personal protective equipment	1 (.8)	18 (13.7)	**57 (43.5)**	55 (42.0)	3.27	.721
Hearing protection	2 (1.5)	29 (22.0)	**60 (45.5)**	41 (31.1)	3.06	.769
Back protection	3 (2.2)	34 (25.2)	**67 (49.6)**	31 (23.0)	2.93	.755
Heat/cold protection	9 (6.7)	41 (30.4)	**64 (47.4)**	21 (15.6)	2.72	.807

Note. Scale: 1 = not important, 2 = somewhat important, 3 = important, 4 = very important.
Note: ***Bold*** = Mode

mechanics, and personal health. Of the three categories, agriculture topics were taught most often. The most-taught topics within the agriculture (Table 2), mechanics (Table 3), and personal health (Table 4) categories were animal safety (83.9%), welding safety (70.8%), and personal protective equipment (58.4%), respectively. Only 3.6% of agricultural educators did not teach any aspect of agricultural safety, whereas 10.9% did not teach any aspect of mechanical safety, and 20.4% did not teach any personal health safety topics.

Agricultural educators selected which of four options best described how they teach ASH (Table 5). They could select more than one option. Almost 90% of agricultural educators taught ASH as part of another agricultural science unit (e.g., animal safety as part of a larger livestock unit). Only 19 of 137 (13.87%) educators taught ASH as its own unit.

Agricultural educators selected from a list the resources they used to teach ASH in their classrooms. Textbooks (62.8%, n = 86) and nonprofit organizations (62.8%, n = 86) such as Farm Safety 4 Just Kids and the National Safety Council were the primary resources used to acquire information to teach ASH. Less than 10% of agricultural educators identified professional teaching organizations as a resource.

Iowa Agricultural Educators' Perceived Importance of ASH Topics

Agricultural educators rated the importance of ASH topics. Topics were again divided into three categories: agriculture, mechanics, and personal health. In the agriculture category, machinery safety, tractor safety, and ATV safety were rated most important, and confined space safety and manure pit safety were considered least important (Table 6).

All topics in the mechanics category were rated important. The top two topics were power tool safety and welding safety (Table 7).

All topics in the personal health category were rated important (Table 8). First aid and personal protective equipment were considered most important, and heat/cold protection was rated least important.

Iowa Agricultural Educators' Attitudes Toward ASH Education

Agricultural educators reported their level of agreement with six statements about ASH education (Table 9). Responses regarding teaching enough ASH in the classroom were nearly evenly split between agree and disagree. Most educators believe the ASH

Table 9. Iowa agricultural educators' agreement with agricultural safety and health (ASH) belief statements (N =137)

Statement	Strongly Disagree *f*(%)	Disagree *f*(%)	Agree *f*(%)	Strongly Agree *f*(%)	*M*	*SD*
I believe the materials available to me about ASH are quality educational materials	3 (2.2)	37 (27.0)	**92 (67.15)**	5 (3.7)	2.74	.548
I believe the materials available to me about ASH are age appropriate for my students.	7 (5.1)	40 (29.2)	**84 (61.3)**	5 (3.7)	2.64	.640
I believe there are enough resources available to me about ASH.	5 (3.7)	50 (36.5)	**74 (54.0)**	5 (3.7)	2.58	.640
I am knowledgeable on where I can find additional materials concerning. ASH should I want or need them.	6 (4.4)	52 (38.0)	**71 (51.8)**	6 (4.4)	2.57	.653
I believe I teach enough ASH in my classroom.	5 (3.7)	60 (43.8)	**67 (48.9)**	4 (4.4)	2.51	.620
I believe there is adequate training and professional development for teachers on ASH.	9 (6.9)	84 (61.3)	**38 (27.7)**	3 (2.2)	2.26	.612

Note. Scale: 1 = not important, 2 = somewhat important, 3 = important, 4 = very important.
Note: ***Bold*** = Mode

materials available to them are age appropriate and of quality. Nearly 70% of respondents disagreed with the statement, "I believe there is adequate training and professional development for teachers on ASH."

Limiting Factors in ASH Education

Agricultural educators identified limitations they face in teaching ASH. Time was an issue for nearly three-fourths of the educators (73.3%). Availability and quality of resources were less limiting (43.8% and 40.1%, respectively), and teacher understanding of the content and the importance of agriculture safety were limitations for only 11.7% and 4.4% of educators, respectively.

Resources of Interest for ASH Education

Agricultural educators identified from a list the teaching tools they might be interested in using to teach ASH. Using a three point Likert-type scale where 1= would not be interested in and 3 = would be interested in, Videos (M=2.76), simulators (M=2.75), and PowerPoint presentations (M=2.63) received the highest interest ratings, whereas guest speakers (M=2.40) and literature (M=2.38) were of least interest.

Summary

Agricultural educators in Iowa see ASH education as part of their role and content that should be taught in their programs. It was evident that what agriculture teachers value (i.e., see as important) is what they teach. Moreover, those safety topics seem to focus on traditional, production-oriented ASH areas like animal, machinery, chemical, and welding safety as well as general PPE. Although the student body enrolled in agricultural education continues to become more diverse (Retallick, 2010), agriculture teachers seem to place less value on health safety and other mechanic and agricultural safety topics that would be appropriate and applicable to broader audiences.

This study has implications to agricultural teacher education programs and the faculty in departments who offer agricultural mechanics training to preservice agricultural teachers. Similar to Ullrich et al., (2001) recommendation, ASH training should be a vital component of the preservice program and should extend beyond traditional agriculture and mechanic safety to include a larger focus on related personal health safety which would have a broader impact on the diverse school-based agricultural education population. It is also recommended that the preservice training go beyond ASH training to include methods of teaching ASH as part of the required preservice coursework. The result of these recommendations will not only improve school-based ASH education, but it could potentially impact informal ASH education in local communities. College graduates who receive this training as part of their coursework may also be in the individuals who help to sponsor and facilitate community farm safety-related events in their communities.

These findings have implications for ASH professionals providing resources to inservice high school agricultural educators. Based on results of this study, improved communication between ASH professionals and secondary agricultural educators is necessary. While most respondents agreed ASH education materials are quality, nearly 40% do not know where to find materials. In addition, the problem is perpetuated if teachers are unable to obtain adequate training and professional development as reported by the agriculture teachers in this state. Improved communications and collaboration as well as required professional development would impact the teachers' attitudes toward and ability to deliver ASH.

Improved professional development could increase the integration of ASH education in secondary agricultural education classrooms, thus improving ASH practices in secondary agricultural education and further improving the health and safety of agriculturalists. Iowa agricultural educators recognize a need for additional training and professional development.

Additionally, ASH curriculum should be created that is easily integrated into the secondary agricultural classroom and engages students. Educators in this study cited availability of time and resources as major limitations to ASH education. Integrating ASH into existing curricula is consistent with current knowledge about student learning and brain-based education, which suggests that teaching in context is beneficial (Bransford et al., 2000). Although Iowa agricultural educators are most interested in teaching ASH using videos and PowerPoint presentations, literature suggests that students respond better to hands-on and experiential learning activities (Murphy, 2003). The resources most appealing to educators might not be effective in teaching ASH topics.

Finally, additional emphasis should be placed on personal health and safety. Nearly 20% of teachers are not teaching any personal health safety topics. Prolonged exposure to health risks could be as devastating to a worker's livelihood as a machinery or livestock incident, and ASH professionals should consider increasing educators' awareness of the importance of personal health safety, including heat/cold protection and personal protective equipment.

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