12-2021

Developing and Piloting an E-learning Module on Respiratory Protection

Emily Girard
University of Nebraska Medical Center

Developing and Piloting an E-learning Module on Respiratory Protection

Emily Girard

Environmental, Agricultural, and Occupational Health

Committee

Chandran Achutan, PhD, CIH

Stephanie Langel, MA

Elizabeth Lyden, MS

ABSTRACT: Respiratory diseases are one of the most common causes of occupational illnesses in the United States. Many occupations use personal protective equipment (PPE) in the form of respirators to protect against respiratory hazards when other control methods are not effective. However, some workers may not have had adequate training on their use. An e-learning module was developed to provide information about respirators and their use in agriculture. The interactions of matching, sorting, and review questions require the user to be an active participant with the goal of reinforcing the information. It was hypothesized the average summative assessment score would increase as the completed education level of the module users increased. It was also hypothesized the module users with previous respirator experience would have a higher average summative assessment score for the module. Outcomes were analyzed using descriptive statistics and the Kruskal-Wallis test. The latter was used compare the median summative assessment scores between gender, age, education, occupation, and respirator experience groups. The results indicated there was not a statistically significant difference between the medians of these groups. Post-module survey responses were mostly positive regarding the benefit of the E-learning module. In the future, a larger sample size with a more varied population will be needed to determine if the hypotheses are supported.

KEYWORDS: Respiratory Hazard, Respirator, Agriculture, E-Learning Module

INTRODUCTION

Occupational Respiratory Hazards

The World Health Organization Global Status Report on Non-communicable Diseases identified that 11.7% of deaths in 2008 were the result of respiratory diseases (Moitra, 2015). Occupational exposures are a major risk factor along with air pollution and tobacco use. While occasionally respiratory diseases develop from acute exposures, they are more often the result of chronic exposures (Donham, 2016). A century ago, respiratory diseases such as pneumoconiosis from coal mine dust exposure were prevalent. Today in Europe, the most common reported respiratory disease is occupational asthma caused by exposure to low-dose allergens or irritants (De Matteis, 2017). Other respiratory diseases that have been associated with occupational exposures include chronic obstructive pulmonary disease (COPD), mesothelioma, and lung cancer. As new technologies emerge, new hazards arise whether it is in manufacturing, mining, construction, agriculture, healthcare, or office settings. One example is nanoparticles, as it is not yet understood what effect they may have on respiratory health for individuals who are exposed.

When it is not possible to remove a respiratory hazard, it is best to use engineering controls designed to keep the hazard away from the workers. However, these can be costly, especially for small businesses. In addition, administrative controls can be utilized to reduce the amount or duration of exposure. When these control methods are not feasible or effective at lowering the exposure to a safe level, personal protective equipment (PPE) is used. The personal protective equipment used for respiratory hazards are respirators and the requirements are detailed in the Occupational Safety and Health Association (OSHA) Respiratory Protection Standard (OSHA, 2011).

Agriculture exposures

Respiratory diseases are one of the main conditions affecting agricultural workers (Kirkhorn, 2000). There are a variety of tasks that a worker may complete daily or occasionally, and each one may have a different respiratory hazard. These tasks include handling animals, grains, chemicals, and even welding (Donham, 2016). Exposures vary depending on the task but may include inorganic and organic dusts, microorganisms, and toxic gases/vapors.

Inorganic dust can be generated by tractors plowing or tilling. Enclosed cabs with a properly maintained air filter can decrease the respirable dust from about 2-20 mg/m^3 to 0.1-1 mg/m^3 (Kirkhorn, 2000). Organic dust includes many components including grain dust, animal dander, feces, and microorganisms. The OSHA permissible exposure levels (PELs) are 15 mg/m^3 for total dust, 5 mg/m^3 for respirable dust, and 10 mg/m^3 for grain dust. However, research has shown adverse respiratory effects at 2.4-2.5 mg/m^3 for total dust and 0.23 mg/m^3 for respirable dust in swine confinement operations and 0.16 mg/m^3 for respirable dust in poultry house operations (Kirkhorn, 2000).

Exposure to animals whether they are livestock or wild can lead to transmission of zoonotic diseases to humans. Workers in swine confinements are at risk of contracting swine influenza and the task of cleaning sheds can expose workers to hantavirus when rodent excrement is aerosolized (Kirkhorn, 2000). Larger confinement buildings could also lead to increased exposure duration.

Toxic gases that agricultural workers may be exposed to include nitrogen oxides, hydrogen sulfide, and ammonia. Nitrogen oxides are formed during silage fermentation and can cause acute hemorrhagic pulmonary edema (Kirkhorn, 2000). Hydrogen sulfide (H_2S) and ammonia are byproducts of animal waste and are common in animal confinements. Hydrogen sulfide can cause pulmonary edema at 250 ppm and unconsciousness at 500 ppm. Concentrations of H_2S as high as 1,000 ppm can be detected when liquid manure pits are agitated (Kirkhorn, 2000). Ammonia is an irritant associated with sinusitis, COPD, and mucous membrane inflammation syndrome. Adverse health effects have been observed at levels below the PEL of 25 ppm (Kirkhorn, 2000).

Although OSHA does not enforce standards for small farming operations with 10 or fewer employees, they still apply (OSHA, 2007). Therefore, it is necessary to train and educate employees. There are resources available through the United States Department of Agriculture (USDA) and other organizations to aid agricultural workers. Some training can be accomplished in-person at meetings/conventions while some can be done online.

E-learning

E-learning is a broad term that can have different meanings, but fundamentally, it is defined as online access to learning resources. The most common models of e-learning include an adjunct model, a blended model, and a fully online model. The adjunct model assists traditional classroom learning and the blended model integrates traditional classroom learning with online learning (Regmi, 2000). In addition to academics, E-learning has been used for distributing health information to patients and caregivers. In one study, parents who completed an e-learning module improved their ability to correctly identify infantile hemangiomas and whether their infant was at risk of developing complications (de Graaf, 2014). Another study demonstrated children with celiac disease and type I diabetes increased their knowledge after completing an E-learning module on implementing a gluten-free diet (Connan, 2019). Since data supports E-learning is beneficial in academia and healthcare, it would appear to be an asset in other areas of public health education.

The purpose of this study is to develop and pilot an E-learning module on respiratory protection. It is hypothesized the module users with a higher completed education level will have higher average test scores for the summative assessment. It is also hypothesized the module users with previous respirator experience will have a higher average test score for the summative assessment of the module.

METHODS

Module development

The learning module was adapted from a classroom presentation. (Achutan 2020). It was developed using Articulate Storyline 3 software (Articulate, 2021). In addition, the online software Vyond was utilized to create short animation videos (GoAnimate, 2021). Images for the module were taken by a developer or obtained from Shutterstock (Shutterstock, 2021) and the Central States Center for Agricultural Safety and Health Flickr page (Central, 2016). The module is available at this link: https://www.unmc.edu/elearning/egallery/respirators-and-their-use-in-agriculture/.

Recruitment and Data collection

The participants were recruited using a poster flyer distributed through e-mail and on the social media platform Facebook. The data was collected from the module using xAPI statements collected in Watershed Learning Record Store (Watershed, 2021). The data collected included demographics, module usage, and a post-module survey. The demographics included gender, age range, education, occupation, and respirator experience. The module usage collected was how often the user visited a section, answers to summative questions, formative question success, and total time spent in the module. The post-module survey used a Likert Scale with the options strongly disagree, disagree, agree, and strongly agree. The statements were:

- Overall, the module increased my knowledge of respirators.
- The module was easy to navigate.
- I prefer the interactive module over more traditional presentations (listening only).
- I would recommend this module to others interested in learning more about respirators.

Qualitative date was collected from a comment box and was summarized in themes and reported as a summary.

Data analysis

All statistical analysis was completed using IBM SPSS Statistics 25 (Armonk, NY). Descriptive statistics were collected for the summative assessment scores. Boxplots were created for a visual comparison of scores within groups. A Kruskal-Wallis test was used to compare group test scores to determine if there were any significant differences.

RESULTS

Twenty-seven participants completed the module including the summative assessment. However, one participant's data was removed because they completed the summative assessment twice. Therefore, the final number of module participants was 26. Of the participants, men accounted for 61.5%, and the age group 50-59 was the largest with 30.8%. A majority had a graduate degree (53.8%). Most study participants had used a respirator in the past as only four (15.4%) had never used a respirator. (Table 1).

Table 1. Module usage information divided by demographic groups.

Demographics	**Category**	**Count (%)**	**Average Score**	**Median Score**	**Min, Max Score**
Gender	Male	16 (61.5)	85.0	90.0	70.0, 100.0
	Female	9 (34.6)	83.3	90.0	60.0, 100.0
	Prefer not to answer	1 (3.8)	90.0	90.0	90.0, 90.0
Age group	19-29	1 (3.8)	100.0	100.0	100.0, 100.0
	30-39	7 (26.9)	88.6	90.0	70.0, 100.0
	40-49	4 (15.4)	75.0	75.0	70.0, 80.0
	50-59	8 (30.8)	85.0	90.0	70.0, 90.0
	60-69	3 (11.5)	80.0	90.0	60.0, 90.0
	70 or older	2 (7.7)	85.0	85.0	70.0, 100.0
	Prefer not to answer	1 (3.8)	90.0	90.0	90.0, 90.0
Education	High School/GED	2 (7.7)	85.0	85.0	70.0, 100.0
	Associate degree	2 (7.7)	75.0	75.0	70.0, 80.0
	Bachelor’s degree	7 (26.9)	91.4	90.0	80.0, 100.0
	Graduate degree	14 (53.8)	82.1	85.0	60.0, 100.0
	None of the above	1 (3.8)			
Occupation	Academic	8 (30.8)	86.3	90.0	60.0, 100.0
	Agriculture	5 (19.2)	82.0	80.0	70.0, 100.0
	Manufacturing	2 (7.7)	85.0	85.0	70.0, 100.0
	Other	11 (42.3)	84.5	90.0	70.0, 100.0
Respirator Experience	I have never used a respirator	4 (15.4)	92.5	90.0	90.0, 100.0
	I have used a respirator occasionally	15 (57.7)	82.7	80.0	60.0, 100.0
	I use respirators on a regular basis	7 (26.9)	84.3	90.0	70.0, 90.0

The average score for the entire module was 84.6, with scores ranging between 60.0 and 100.0, and the median was 90.0. The average time it took participants to complete the module was 29.5

minutes, with a range between 18.5-66.25 minutes. Unfortunately, nine of the module duration times were not documented accurately by the software. Table 2 is a summary of individual module usage information.

Table 2. Individual module usage information.

User	Gender	Age	Education	Occupation	Respirator Experience	Time	Score
0630-1	Female	60 to 69	Graduate	Academic (staff)	Occasionally	24.8	60.0
0701-1	Male	50 to 59	Graduate	Academic (faculty)	Regularly	26.6	90.0
0701-2	Female	30 to 39	Graduate	Agriculture (11 to 20)	Regularly	18.5	70.0
0701-3	Female	50 to 59	Associate	Agriculture	Regularly	55.1	80.0
0702-1	Female	70 or older	Graduate	Academic	Occasionally	23.1	100.0
0702-2	Female	50 to 59	Graduate	Academic (faculty)	Never	23.7	90.0
0706-1	Female	19 to 29	Bachelor’s	Agriculture (1 to 5)	Occasionally	40.2	100.0
0707-1	Male	70 or older	Graduate	Agriculture (more than 20)	Occasionally	38.9	70.0
0707-2	Female	40 to 49	Graduate	Academic (faculty)	Occasionally		70.0
0713-1	Male	30 to 39	Graduate	Academic (student)	Regularly		90.0
0720-1	Female	50 to 59	Graduate	Other	Regularly	20.8	90.0
0722-1	Male	40 to 49	Graduate	Other	Occasionally		80.0
0723-1	Male	40 to 49	Graduate	Other	Regularly		80.0
0726-1	Male	30 to 39	Bachelor’s	Other	Occasionally	19.1	100.0
0727-1	Male	30 to 39	Associate	Other	Occasionally		70.0
0729-1	Male	30 to 39	Graduate	Academic (student)	Never	66.3	100.0
0729-2	Male	40 to 49	High School	Other	Occasionally	25.3	70.0
0729-3	Male	50 to 59	Bachelor’s	Other	Occasionally		80.0
0729-4	Male	50 to 59	Bachelor’s	Other	Never		90.0
0730-1	Prefer not to answer	Prefer not to answer	None of the above	Agriculture (more than 20)	Occasionally	21.4	90.0
0731-1	Male	60 to 69	Graduate	Academic	Regularly	29.4	90.0

				(staff)			
0801-1	Female	30 to 39	Bachelor’s	Other	Never		90.0
0801-2	Male	60 to 69	Bachelor’s	Other	Occasionally	26.2	90.0
0802-1	Male	30 to 39	High School	Manufacturing	Occasionally	22.3	100.0
0802-2	Male	50 to 59	Graduate	Manufacturing	Occasionally	19.8	70.0
0805-1	Male	50 to 59	Bachelor’s	Other	Occasionally		90.0

Table 3. Result of individual summative assessment questions.

Summative Assessment	**Correct**	**Incorrect**	**Learning Objective**
Question 1	23	3	3
Question 2	19	7	1
Question 3	11	15	1
Question 4	20	6	1
Question 5	24	2	1
Question 6	26	0	1
Question 7	26	0	2
Question 8	20	6	1
Question 9	26	0	2
Question 10	25	1	3

The medians of the group summative assessment scores were analyzed for associations using the Kruskal-Wallis test. The boxplots in figures 1-5 provide a visual of the group comparisons. The Kruskal-Wallis result for gender was $p=0.837$, age group was $p=0.355$, education level was $p=0.338$, occupation was $p=0.890$, and previous respirator use was $p=0.352$. The differences between groups were not found to be statistically significant as $p>0.05$.

Figure 1. Boxplot of summative assessment scores by gender.

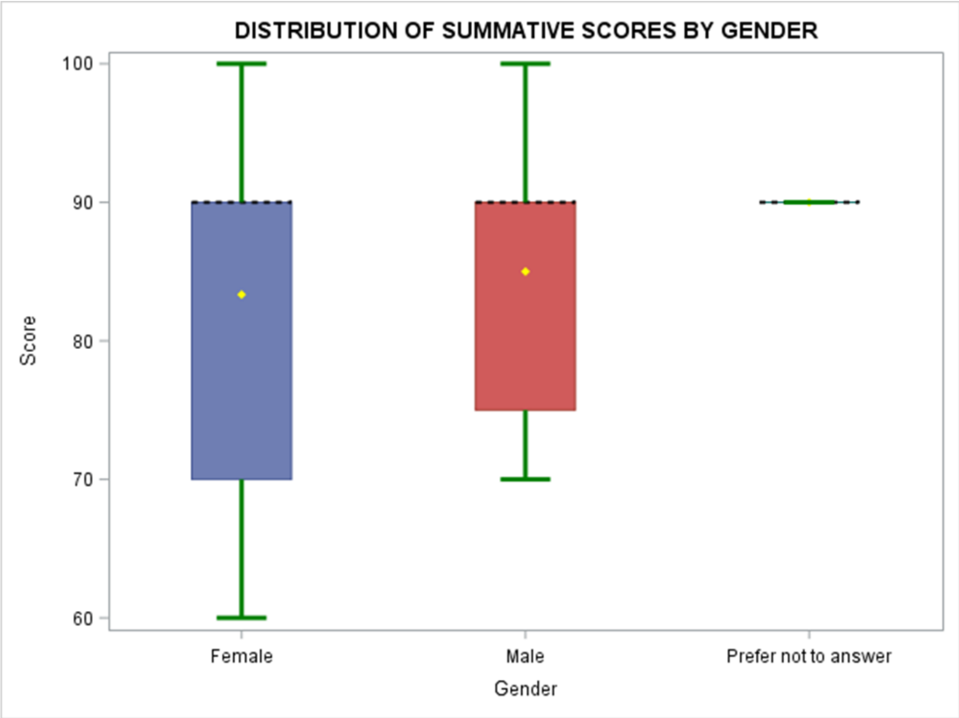


Figure 2. Boxplot of summative assessment scores by age group.

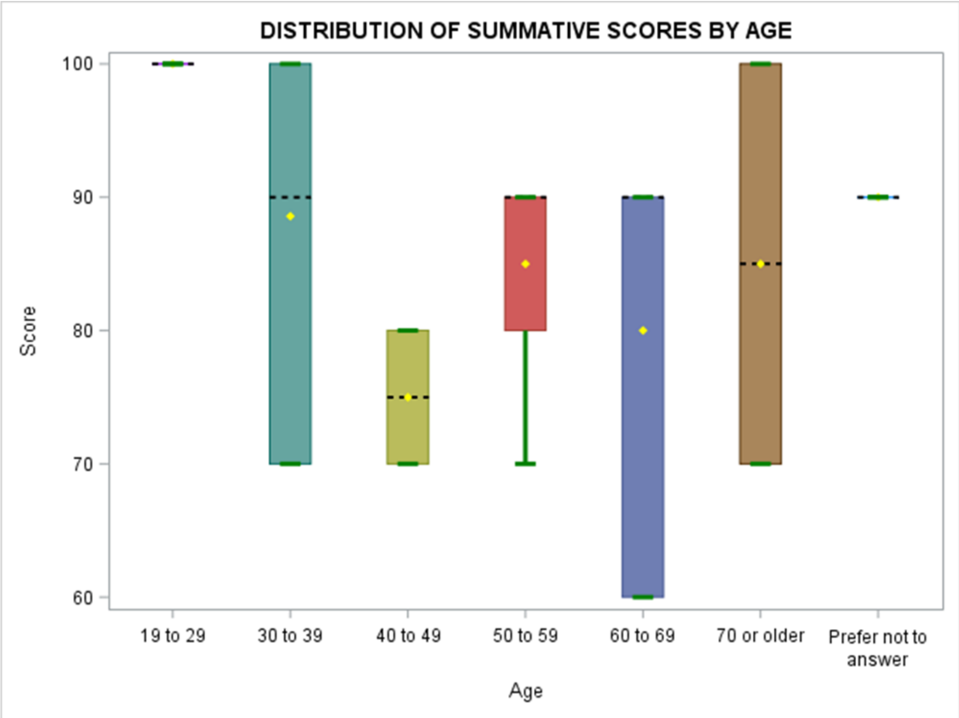


Figure 3. Boxplot of summative assessment scores by education.

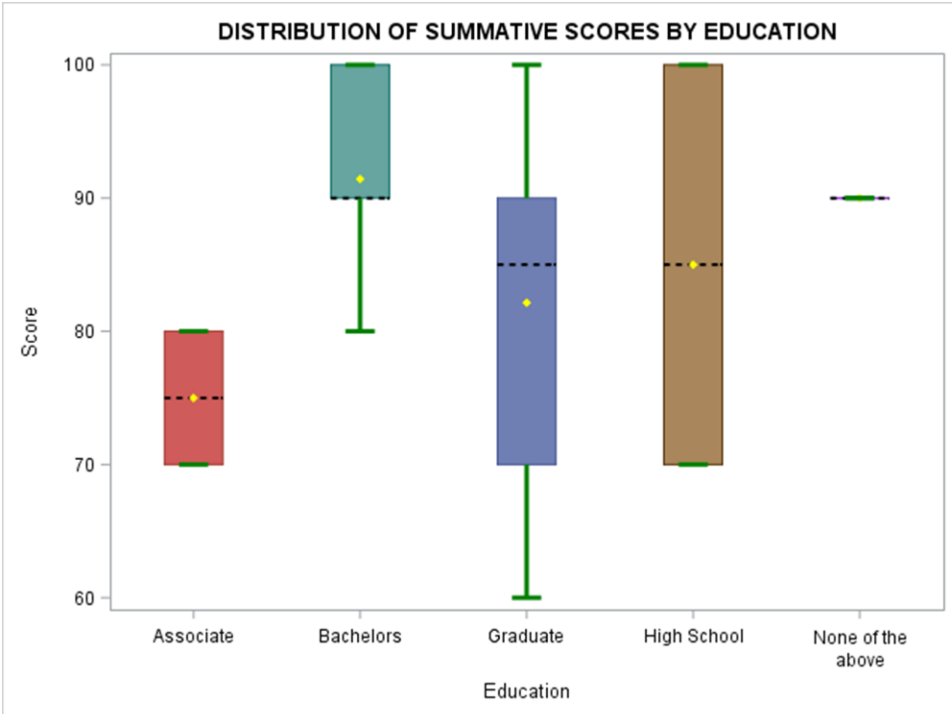


Figure 4. Boxplot of summative assessment scores by occupation.

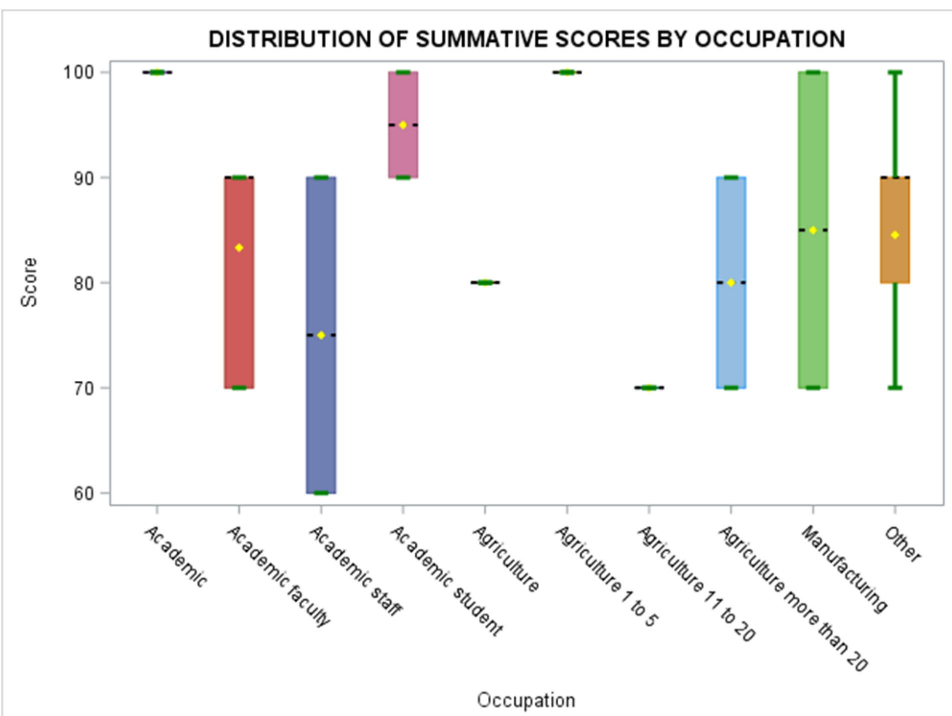


Figure 5. Boxplot of summative assessment scores by respirator experience.

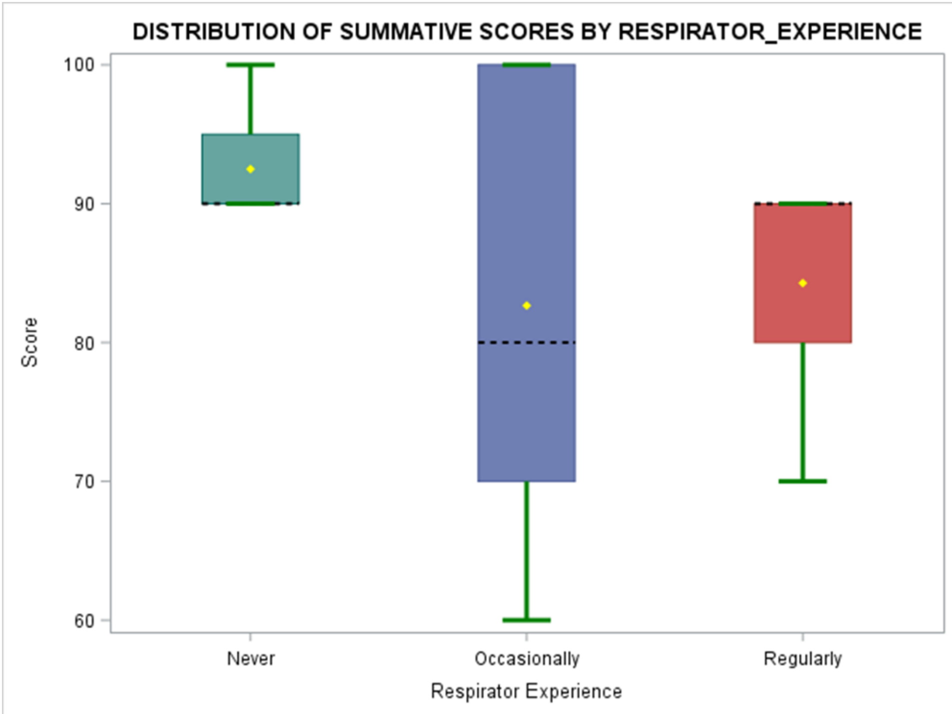


Table 4. Responses from the post-module questions.

Post-module Survey	Strongly disagree	Disagree	Agree	Strongly Agree
Overall, the module increased my knowledge of respirators	1	1	6	18
The module was easy to navigate	2	0	3	21
I prefer the interactive module over more traditional presentations (listening only)	2	1	5	18
I would recommend this module to others interested in learning more about respirators	2	0	4	20

For survey comments, 13 out of the 26 participants left a comment. The themes can be summarized as general praise, module content suggestions, module narration, module usage issues. Regarding module narration, there were three comments that stated the speed of the narration was too fast and one that stated the pace was good. For module usage issues, two comments stated the user had trouble with quiz questions not working properly.

DISCUSSION

The module was designed to provide information on respirator use in the workplace. The first section describes the differences between masks and respirators and continues to describe the attributes of different respirators. The second section discusses the storage and maintenance of respirators. Both these sections are relevant to anyone who uses respirators. Although the exposure examples in the third section focus on the agricultural industry, some of them can be found in other industries as well. For example, welding fumes were included as a possible exposure in agriculture. While not every agricultural worker has the ability, equipment, or desire to weld, it is not uncommon for it to be one of the many tasks performed. Welding is used in many industries, so it is still beneficial for people in other industries to learn about the respiratory exposures presented in the third section. A visual outline of the module sections can be found in Appendix A.

When it came to developing the module, the developers followed the UNMC E-learning criteria. This includes having the target time of completion of 15 minutes or less, providing learner navigation, having varied user interactions, including a summative assessment, and having narration and closed captioning. Because of time limitations, there was only so much information on occupational respiratory hazards and respirators that could be included in the module. Although the module was estimated by the developers to take 18 minutes to complete, it was accepted without the need to cut material. The passing score was set to 80% which coincides with a graduate-level grading scale at UNMC. Table 3 shows the results of each question of the summative assessment and which objective it addresses. The questions can be viewed in Appendix B. Questions 2, 3, 4, and 8 were the only ones that had at least 6 users choose an incorrect answer. Upon inspection, Question 2 is difficult in that it requires the user to remember specific terminology and the possible answers are similar to one another. Questions 3, 4, and 8 are in the style of choose all that apply. Failure to select all the correct answers results in the question being marked wrong even if some of the correct answers were selected. These four questions test information in the first section which addresses the objective of respirator terminology and classification. It is the longest and most content-heavy section of the module. It may be beneficial to divide the module into several, shorter modules. They would be less time consuming, and there would be less information to retain at once. In addition, the narration speed could be decreased because the shorter modules would come in way below the target time.

The participant who completed the module twice had their data thrown out to remove bias. It would otherwise be difficult to determine which score to keep as they varied greatly and would having differing effects on the results. There were eight individuals who filled in the demographic information but decided not to proceed with viewing the module. Module completions fell short of 30, which is the minimum number needed to give strength to statistical analysis according to the Central Limits Theorem. So, the data was assumed to be non-parametric, and the Kruskal-Wallis test was used to determine if there was a significant difference between any groups. Chi-squared analysis could not be performed due the absence of at least 5 counts in each bin. The sample population may contribute some bias to the results. The population recruited to complete the module largely consisted of individuals associated with the University of Nebraska Medical Center, the Central States Center for Agricultural Safety and Health, and the American Society of Safety Professionals. However, a benefit to having this population complete the module is they can provide suggestions on how the module can be improved. The module was originally intended for an audience less familiar with respirators, such as agricultural workers on small operations or public health students.

There were almost twice as many men who completed the module compared to women with 61.5% and 34.6% respectively. The mean scores were similar between genders with men at 85.0 and women at 83.3, and the median scores were both 90.0. It is interesting to note that six out of eight of the individuals who filled out the demographic information but did not complete the module were women. So, an almost even number of men and women began the module, but the men had a higher completion rate. It is unclear why, as the recruitment flyer described the contents of the module and the purpose.

Examining the scores by age group, 19 to 29 had a single user with a score of 100.0, 30 to 39 had an average of 88.6, 40 to 49 had an average of 75.0, 50 to 59 had an average of 85.0, 60 to 69 had an average of 80.0, and 70 or older had an average of 85.0. The two largest age groups were the 30 to 39 and the 50 to 59 with 26.9% and 30.8% of the module users respectively. While the medians between these groups were both 90.0, the 30 to 39-year-old age group had a scores range from 70.0 to 100.0 while the 50 to 59-year-old group only had a range from 70.0 to 90.0. There may be some advantages for lower age groups when it comes to interactive module use. Lower age groups are likely to have used learning modules in their education and may feel comfortable with the format. However, licensed professionals are often required to accumulate continuing education hours, so if those are obtained through online modules, they would also be familiar with the technology.

When examining the summative assessment scores by highest level of completed education, high school had an average of 85.0, associate degree was 75.0, bachelor's degree was 91.4, and graduate was 82.1. The bulk of the module users had completed at least a bachelor's degree with, 26.9% having completed a bachelor's degree and 53.8% having completed a graduate degree. The medians for these two were 90.0 and 85.0 respectively. The greatest difference is the range for bachelor's degree is 80.0 to 100.0, while the range for graduate degree is 60.0 to 100.0. It was theorized the higher educated groups would have a higher average summative assessment score. The results from the module do not fit this theory, as the high school educated group have a higher average than the graduate group. However, the sample size is small and not representative of the general population, so the results are non-conclusive. This leads to examining occupation rather than education when it comes to module success.

The occupations module users were able to select included academics, agriculture, manufacturing, and other. These specific options were available because it was speculated the information in the module would be beneficial in these areas. The average for academics was 86.3, agriculture was 82.0, manufacturing was 85.0, and other was 84.5. The bulk of module users identified as working in academics, 30.8%, and other, 42.3%. The medians in those groups were both 90.0. with academics having a range of 60.0 to 100.0 and other having a range of 70.0 to 100.0. Considering the various respiratory hazards that are present in agriculture, there may be a need to increase opportunities for workers to learn more about the subject and how it affects their health.

Previous respirator experience was another piece of information collected. It was proposed that module users with previous respirator experience may have higher average scores. The results showed users who never used respirators averaged a score of 92.5, occasionally used respirators had an average of 82.7, and those who regularly wore respirators had an average of 84.3. Once again, the results did not match the hypothesis as the group who had never worn respirators scored the highest. The never group had a median of 90.0 and range from 90.0 to 100.0. The occasionally group had a median of 80.0 and range from 60.0 to 100.0. Lastly, the regular group had a median of 90.0 and a range from 70.0 to 90.0. Although only 15.4% of module users, it was unexpected those with no previous respirator experience scored higher than the other groups. However, it is important to acknowledge this question was asked before the module began. It is possible some module users may have incorrectly answered this question if they did not understand the difference between a mask and a respirator.

The post-module survey provided some qualitative data by using a Likert scale to gauge how the users felt about the E-learning module. A neutral option was not provided to force the users to pick a type of agreement or disagreement regarding the statement. Table 4 shows a count of the responses. All the statements were dominated by the selection strongly agree, followed by agree, strongly disagree, and finally disagree. The first statement may be susceptible to lower scores because it asked the module users if their knowledge of respirators increased. If a person has had a lot of experience with respirators, they may disagree with this statement even if they think the module contained beneficial information. However, the last statement asked if they would recommend the module to others interested in the subject, so it may be a more valuable indicator of a participant's impression. After the module survey, a comment box was provided to allow the users to give feedback. Suggestions for improving module content included adding more photos of people using respirators in a work setting. This may help users recognize similar situations in their personal lives. In addition, it was suggested to add carbon dioxide as an exposure hazard in the livestock section. This and other respiratory hazards not included in the module can be found in an agricultural setting, but not everything could be included because of module run time limitations. Comments on the module narration focused on narration speed. One user enjoyed the pace, while others expressed it was too fast. Module usage issues centered around quiz questions. Although the module was designed to work for computers and iPads, there was a problem for one iPad user who had some questions marked answers before they selected anything. If they had not noticed this, this would have impacted their score.

In conclusion, the scores from the module were most varied when looking at age, education level, and previous respirator experience, but the differences were not statistically significant. While the results did not prove the hypothesis, the small number of participants limits the study. Based on the post-module survey responses, the module succeeds in providing respirator information and most of the users would recommend others complete it. Future directions for the learning module would include fixing glitches that occurred for iPad users and obtaining a larger group in the intended population of agricultural workers and public health students.

HUMAN SUBJECTS

This project was approved by the UNMC Institutional Review Board (IRB# 462-21-EX).

LITERATURE CITED

Achutan, C. (2020). *Personal Protective Equipment-Respirators* [Video]. YouTube. https://www.youtube.com/watch?v=SKyeJQG-pEU

Articulate Global Inc. (2021) *Storyline 3* [Software.] https://articulate.com/perpetual/storyline-3

Central States Center for Agricultural Safety and Health. (n.d.). *Respiratory Protection Flyers, Aflatoxin* [PDF]. Retrieved November 30, 2020, from https://www.unmc.edu/publichealth/cscash/outreach/email-deployment-sept-2012.pdf

Central States Center for Agricultural Safety and Health. (n.d.). *Respiratory Protection Flyers, Agrisafe Respirator Guide* [PDF]. Retrieved November 30, 2020, from https://www.unmc.edu/publichealth/cscash/_documents/outreach_resp_selection_guide_jun14.pdf

Central States Center for Agricultural Safety and Health. (2016). [Farmer in dust mask] [Photograph]. *Flickr.* https://www.flickr.com/photos/cscash/

Connan, V., Marcon, M. A., Mahmud, F. H., Assor, E., Martincevic, I., Bandsma, R. H., ... & Walsh, C. M. (2019). Online education for gluten-free diet teaching: Development and usability testing of an e-learning module for children with concurrent celiac disease and type 1 diabetes. *Pediatric diabetes*, *20*(3), 293-303.

de Graaf, M., Knol, M. J., Totté, J. E., van Os-Medendorp, H., Breugem, C. C., & Pasmans, S. G. (2014). E-learning enables parents to assess an infantile hemangioma. *Journal of the American Academy of Dermatology*, *70*(5), 893-898.

De Matteis, S., Heederik, D., Burdorf, A., Colosio, C., Cullinan, P., Henneberger, P. K., Olsson, A., Raynal, A., Rooijackers, J., Santonen, T., Sastre, J., Schlünssen, V., van Tongeren, M., Sigsgaard, T., & European Respiratory Society Environment and Health Committee (2017). Current and new challenges in occupational lung diseases. *European respiratory review: an official journal of the European Respiratory Society*, *26*(146), 170080. https://doi.org/10.1183/16000617.0080-2017

Donham, K. J., & Thelin, A. (2016). *Agricultural medicine: rural occupational and environmental health, safety, and prevention*. John Wiley & Sons.

GoAnimate, Inc. (2021). *Vyond* [Software.] https://www.vyond.com/

IBM Corp. (2017). *IBM SPSS Statistics for Windows, Version 25.0*. Armonk, NY: IBM Corp.

Kirkhorn, S. R., & Garry, V. F. (2000). *Agricultural lung diseases*. Environmental health perspectives, 108 Suppl 4(Suppl 4), 705–712. https://doi.org/10.1289/ehp.00108s4705

Moitra, Subhabrata, Puri, Rajan, Paul, Devon & Huang, Yuh-Chin. (2015). *Global perspectives of emerging occupational and environmental lung diseases.* Current Opinion in Pulmonary Medicine, 21, 114-120. https://doi.org/10.1097/MCP.0000000000000136

Regmi, K., & Jones, L. (2020). A systematic review of the factors–enablers and barriers–affecting e-learning in health sciences education. *BMC medical education*, *20*, 1-18.

OSHA. (2011). *Respiratory Protection, 29 C.F.R. Sect. 1910.134*. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.134

OSHA. (2007). *Standard Interpretation: Small farming operations and exemption from OSHA enforcement activity under CPL 02-00-051*. Retrieved June 7th, 2021, from, https://www.osha.gov/laws-regs/standardinterpretations/2007-07-16.

Shutterstock, Inc. (2021). Shutterstock. https://www.shutterstock.com/

Watershed Systems, Inc. (2021) Watershed Essentials LRS. https://watershedlrs.com/app/index.html

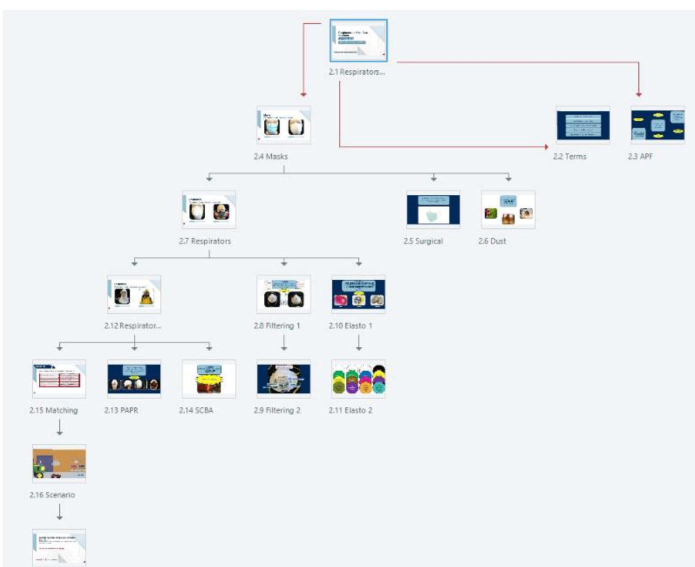
APPLICATION OF PUBLIC HEALTH COMPETENCIES

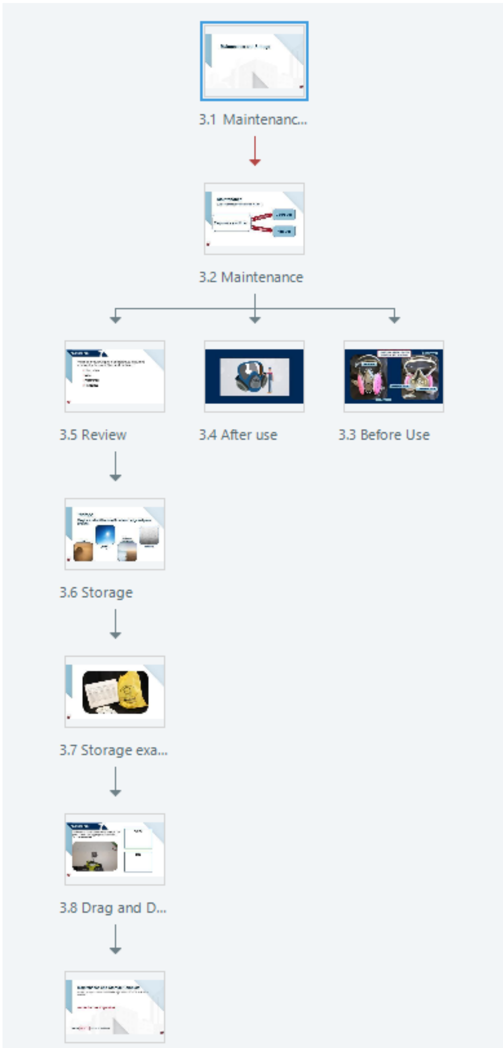
The first competency this project will integrate is the foundational competency MPHF4: Interpret results of data analysis for public health research, policy, or practice. The data that will be analyzed includes demographics, module usage, and post-module survey. The analysis of demographics will help determine if there are any commonalities among the people who complete the learning module. It is important to identify if some age groups are less likely to utilize learning modules, so another form of education outreach can be used. Analysis of module usage can aid in identifying weaknesses of the module that can be improved. Finally, analysis of the survey responses allows the user to provide feedback and the researcher to determine the efficacy of the module.

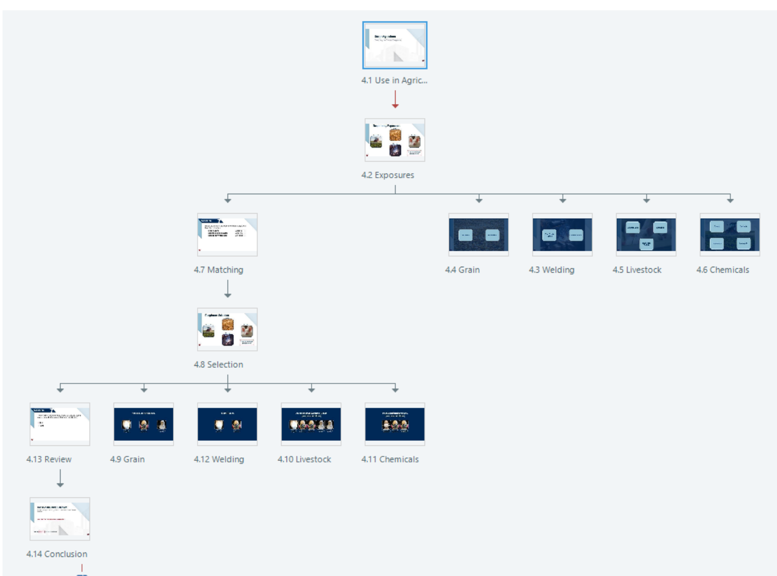
The second competency this project will integrate is the concentration competency EOHMPH1: Analyze sources of exposure in the workplace and the environment that can cause health risks to humans or degradation of ecosystems. For the module, occupational respiratory hazards were researched with an emphasis on agriculture. Some respiratory hazards in agriculture are naturally occurring, such as endotoxin, while others are man-made, such as zinc oxide. Understanding the source of an exposure that is harmful to health is vital in reducing or removing it.

The third competency this project will integrate is the concentration competency EOHMPH7: Employ measures to control workplace injury and illness including engineering, education, regulations, incentives, and best practices. The measure employed to prevent workplace injury and illness for this project is education. The learning module is open access through the University of Nebraska Medical Center’s E-Gallery webpage.

APPENDIX A: Outline of Module




3.1 Maintenanc...
3.2 Maintenance
3.5 Review
3.4 After use
3.3 Before Use
3.6 Storage
3.7 Storage exa...
3.8 Drag and D...


4.1 Use in Agric...
4.2 Exposures
4.7 Matching
4.4 Grain
4.3 Welding
4.5 Livestock
4.6 Chemicals
4.8 Selection
4.13 Review
4.9 Grain
4.12 Welding
4.10 Livestock
4.11 Chemicals
4.14 Conclusion

Appendix B: Summative Assessment Questions

1. True or False. The primary function of a respirator is to protect workers against respiratory hazards that may come in the form of chemical, biological, and radiological agents.

- Answer: True.

2. What does a respirator with an R100 designation signify?
   A. It is able to remove at least 99.97% of particles in an environment that is partially resistant to oil.
   B. It is used in environments that have an oil mist, and it removes nearly 100% of all particles.
   C. It can remove particles less than 100 micrometers in environments that are not resistant to oil.
   D. The R stands for "restricted" and the 100 stands for particle size.

- Answer: It is able to remove at least 99.97% of particles in an environment that is partially resistant to oil.

3. Respirators protect workers against: (Choose all that apply)
   a. Harmful dusts
   b. Vapors and gases
   c. Falls
   d. Oxygen-deficient atmospheres

- Answer: Harmful dusts, vapors and gases, and oxygen-deficient atmospheres.

4. Which of the following will compromise the effectiveness of a tight-fitting respirator's seal? (Choose all that apply)
   a. Beards
   b. Facial stubble
   c. Hair
   d. Lipstick

- Answer: Beards, facial stubble, and hair.

5. True or False. Respirator cartridges are color-coded and specific to certain types of chemicals.

- Answer: True.

6. True or False. Tight-fitting respirators are "one size fits all".

- Answer: False.

7. If you smell or taste contaminants inside of your air-purifying respirator, exit to a safe area immediately because:
   a. Your face-piece may not have a good seal.
   b. Your cartridges may be saturated.
   c. The levels of contaminants in the air may have increased.

d. All of the above

- Answer: All of the above.

8. Examples of respirators include: (Choose all that apply)
    a. N95
    b. Surgical mask
    c. PAPR
    d. 2-ply cotton face covering

- Answer: N95 and PAPR.

9. Respirators should be inspected for wear and tear:
    a. Daily
    b. Weekly
    c. Monthly
    d. Before and after each use

- Answer: Before and after each use

10. Respiratory hazards in agriculture that can be controlled by respirators include:
    a. Grain dust
    b. Hydrogen sulfide gas
    c. Paint fumes
    d. All of the above

- Answer: All of the above.