

Online PPE Training

Developing a Pilot Program for Secondary Schools

By Koshy Koshy, Derek G. Shendell, Lindsey J. Milich and Alexa A. Patti

The use of PPE remains an important control measure for reducing occupational injuries and illnesses. PPE includes various protective devices used to create a barrier between the individual worker and a potential hazard. Employers are required to pay for and provide employees PPE and train them on its proper uses and limitations (OSHA, 2016a).

The New Jersey Safe Schools (NJSS) program offers an online career-cluster-specific PPE course to increase awareness of fall, electrical, transportation and public safety hazards in the construction, transportation and law enforcement careers. Delivering the training in an online, asynchronous format, with information available anytime, allows participants to work at their own pace (e.g., in one sitting, in multiple 40- to 45-minute school-day class periods). Contrary to classroom-based in-person training, online training differs as the content is delivered through the use of online platforms on multiple types of hardware (e.g., desktop and laptop computers, tablets, smartphones) without any face-to-face interaction (Shendell, Apostolico, Milich, et al., 2016).

Initial and refresher training with mandated curriculum and contact hours are required for workers in many high-hazard industries (City of New York, 2008). Such courses including the OSHA outreach training and hazardous waste training are offered online; therefore, participants must understand the awareness nature of this training, and how it would not meet regulatory requirements for PPE use at the work site (OSHA, 2016b).

Online learning is a growing trend in education. Notably, online college enrollment has grown nearly 30% since 2010 (CCRC, 2013). Online learning has many advantages such as lower initial costs and management costs; consistency in material taught; standardized delivery methods; convenience for users; and the ability for students to dictate their pace of learning in consideration of course assignment deadlines (Massa, Vallieres, Kehrhahn, et al., 2005; Strother 2002). Evidence exists on the benefits of online education for degree programs

IN BRIEF

- Young workers in high-hazard industries need career-cluster-focused PPE training.
- Online PPE training for high-hazard career clusters is an effective use of limited resources as well as an effective delivery mechanism.
- Case-study-oriented PPE training is a good refresher for adult OSHA outreach training.

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This study investigated the effectiveness of using an online delivery mechanism to deliver just-in-time PPE training to select career clusters, viewed as high-hazard industries.

(Appana, 2008); however, little has been published on the benefits or challenges of online safety and health training (Nakayama & Jin, 2015).

OSHA provides guidance and enforcement for private-sector employers regarding their responsibilities for worker safety and health protection. New Jersey Public Employees Occupational Safety and Health Program is the state plan approved by OSHA for New Jersey for public-sector employees with similar or stricter provisions. NJSS offers courses including those required for secondary school vocational-career-technical education teachers to become school-sponsored structured learning experience supervisors in both hazardous and nonhazardous occupations (Shendell, Hemminger, Campbell, et al., 2009).

This study investigated the effectiveness of using an online delivery mechanism to deliver just-in-time PPE training to select career clusters, viewed as high-hazard industries. Numerous resources including curriculum developed by the OSHA Training Institute, OSHA Harwood Grant Program and the states are available to these stakeholders. The challenge is to assimilate this volume of information and focus it to the needs of these learners and allow them to finish a course online in about one school week, which meant for students using five single periods of 40 to 45 minutes each, or two or three double periods of 80 to 90 minutes each.

Materials & Methods

Course Format & Content

The Moodle learning management system (LMS) online platform was used to deliver the training.

Table 1 presents the five sections comprising the course. Lesson 1 provides a general introduction to what constitutes PPE, a guide to assessing when PPE is needed, embedded videos and images illustrating proper PPE use in industry, examples of potential injuries caused by not wearing PPE, and additional resources for further study. The other four lessons are dedicated to targeted high-hazard industries requiring PPE. Among them, Lessons 2 and 3 are dedicated to construction-related careers, where Lesson 2 focuses on hazards that architecture and construction related workers may face in careers including carpentry, drywall installation, insulation work and surveying, Lesson 3 is exclusively dedicated to the major hazards in construction, falling and working at elevations (Macario, Hannon, Baker, et al., 2015). Lesson 4 offers insight into several industries clustered around transportation, having employees spend significant time in transit (e.g., sales, delivery, roadway inspections, construction). Lesson 5 concentrates on PPE used in careers dedicated to law enforcement, public safety and emergency response.

Participants were expected to spend an average of about 3 hours on the course, including time dedicated to downloading and reviewing OSHA fact sheets and other supplemental materials. Teachers, supervisors and other school administrators received 3.0 professional development units (PDU) upon successful completion of this course, as allowed by the New Jersey Department of Education via NJSS. Senior-year students supervised by teachers in classrooms or computer labs received certificates of completion signed by NJSS leadership at the end of the course.

Each section starts with objectives and a listing of the careers addressed, possible hazardous situations workers may encounter, and a selection of PPE they may use to reduce the hazard. Case studies and supplemental materials were integrated

within the curriculum to reinforce information. At the end of each module or section, students were required to complete a quiz before moving on to the next module. An overall course evaluation was presented after the final module. Each quiz was comprised of three multiple-choice or true/false questions allowing participants multiple attempts to achieve a minimum passing grade of about 70% (i.e., 66.7% to 70.0% depending on the number of questions).

Disclaimers were given in the introductory module, including the awareness-building nature of the training, and an explanation that current modules were not an exhaustive list of every potential hazard pertaining to each career cluster or each type of PPE.

Participant Population

The course was beta tested by Rutgers medical and public health graduate students ($n = 7$) in March 2016. Based on their input, additional edits were made to the content and reference materials were added to supplement the course content.

The final version of the course was pilot-tested by New Jersey teachers and supervisors from two school districts; one from an urban northern New Jersey school district ($n = 3$), the other from a southern New Jersey ($n = 4$) suburban/rural school district. Additionally, students from the same northern New Jersey school district ($n = 8$) and southern New Jersey school district ($n = 23$) also participated in the pilot-test, as well as students from a second southern New Jersey school district ($n = 14$) for a total of 52 participants in the pilot-test program.

Results

Participants were allowed to start the pilot test on April 7, 2016, and everyone completed it by June 24, 2016, the last day of the 2015-2016 school year. Thus, pilot-test results were further stratified in Tables 2 through 5 (p. 36) to identify how gender and experience level (i.e., teacher or students) affected their overall performance in terms of average scores in the respective five lessons and the number of attempts they made to complete the individual lessons. Attempts signified the number of times a participant tried to complete a lesson quiz.

Table 2 presents the average of the total scores (percent correct) per section's lesson. As noted, each quiz encompassed three questions. Participants completed the course from 1 to 10 days of starting the training. Participants were allowed to enter and attempt the quizzes multiple times. For each of the five sections, average quiz scores were well above passing (> 95%). Most participants were able to complete each quiz in one attempt; the fourth had the highest average number of attempts at 1.5; the other four were 1.2 or 1.3.

Table 3 (p. 36) presents the average scores (percent correct) stratified by gender. The average of the highest scores across the five module quizzes was 100% correct for both genders for Lesson 3 ("Construction/Architecture: Working at Eleva-

TABLE 1
Lesson Titles

Lesson	Title
1	Overview: PPE
2	Construction/architecture: General
3	Construction/architecture: Working at elevations
4	Transportation, distribution, logistics
5	Law, public safety, corrections and security

TABLE 2
Average Score & Attempts per Lesson per Participant

	Average score	Max attempts	Average attempts
Lesson 1	99.4	3	1.3
Lesson 2	96.2	3	1.3
Lesson 3	100	3	1.2
Lesson 4	98.1	3	1.5
Lesson 5	100	3	1.2
Course average	98.7		1.3

Sample Quiz Questions

- 1) Within the hierarchy of controls, PPE is the _____ because _____?
 - a) first choice; the employee is responsible for using it
 - b) last resort; because PPE does not eliminate the hazard
 - c) first choice; because it falls in the middle of the hierarchy of controls
- 2) In carpentry, wood dust and chemicals used for furnishing products may cause _____ and _____ disease.
 - a) skin; respiratory
 - b) respiratory; digestive
 - c) liver; skin
 - d) digestive; liver
- 3) Employers are required to provide hearing protection to all workers exposed to an 8-hour time-weighted average (TWA) noise level of _____ or greater.
 - a) 100 dB
 - b) 85 dB
 - c) 110 dB
 - d) 75 dB

tions") and Lesson 5 ("Law, Public Safety, Corrections and Security"). The lowest average score for male participants was for Lesson 2 ("Construction/Architecture: General") at 94.8%, and for female participants was for Lesson 4 ("Transportation, Distribution, Logistics") at 96.7%. The female participants also averaged 100% for Lesson 3 ("Con-

struction/Architecture: Working at Elevations”). The highest average number of attempts was observed for Lesson 4 (1.5) for both male and female participants. Female participants also averaged higher multiple attempts for Lessons 1 and 2, by 0.1 and 0.2, respectively, than their male counterparts. Overall, for the course, the average for the number of attempts for the five section lessons was 1.3 for both genders.

Table 4 presents the overall number of attempts participants made with each section’s quiz followed by the total percentage of the population represented. These data are then further stratified to identify the number of attempts made by each gender per section lesson. Approximately 75% of participants completed the five lessons on their first attempt; furthermore, the only substantial increase

in the number of multiple attempts was Lesson 4. Approximately 58% of participants completed this lesson on the first attempt. Further review of the data suggests that female participants did slightly better on their first attempt at 60% compared to their male counterparts at 56%.

It should also be noted how males had a higher percentage of single attempts for Lessons 1 and 2 than females, and females had a higher percentage of single attempts for Lessons 3, 4 and 5 than males. Overall, males had a higher average percentage of single attempts compared to females. Furthermore, females had a higher average percentage of double attempts (23%), but lower percentage of triple attempts (4%) compared to males (18% double; 5.6% triple). Overall, females had higher percentages of repeating three quizzes (10%) or four quizzes (10%), but males had the highest percentage of needing to repeat the set of five quizzes (6.3%).

Table 5 compares position/experience, that is, the student’s performance on section lesson quizzes. Students had a higher percentage of double and triple attempts as compared to teachers across the five lessons. The quiz for Lesson 4 had higher percentage of triple attempts for students (8.9%). In contrast, teachers completed the quiz for Lesson 4 within two attempts. The majority of partici-

TABLE 3
Average Scores by Gender

	Male (n = 32)			Female (n = 20)		
	Average score	Max attempts	Average attempts	Average score	Max attempts	Average attempts
Lesson 1	99.0	3	1.2	100	2	1.4
Lesson 2	94.8	3	1.3	98.3	3	1.4
Lesson 3	100	3	1.2	100	2	1.2
Lesson 4	99.0	3	1.5	96.7	3	1.5
Lesson 5	100	3	1.2	100	3	1.2
Course average	98.6		1.3	99		1.3

TABLE 4
Attempts per Lesson by Gender & Percent of Population

	Attempts	Lesson 1		Lesson 2		Lesson 3		Lesson 4		Lesson 5		All lessons	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
All	1	40	76.9	39	75.0	42	80.8	30	57.7	44	84.6	39	75.0
	2	11	21.2	10	19.2	8	15.4	18	34.6	5	9.6	10.4	20.0
	3	1	1.9	3	5.8	1	1.9	4	7.7	3	5.8	2.4	4.6
Male	1	27	84.4	25	78.1	25	78.1	18	56.3	27	84.4	24.4	76.3
	2	4	12.5	5	15.6	5	15.6	12	37.5	3	9.4	5.8	18.1
	3	1	3.1	2	6.3	2	6.3	2	6.3	2	6.3	1.8	5.6
Female	1	13	65.0	14	70.0	17	85.0	12	60.0	17	85.0	14.6	73.0
	2	7	35.0	5	25.0	3	15.0	6	30.0	2	10.0	4.6	23.0
	3	0	0.0	1	5.0	0	0.0	2	10.0	1	5.0	0.8	4.0

TABLE 5
Attempts per Lesson by Position & Percent of Population

	Attempts	Lesson 1		Lesson 2		Lesson 3		Lesson 4		Lesson 5		All Lessons	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
All	1	40	76.9	39	75.0	42	80.8	30	57.7	44	84.6	39	75.0
	2	11	21.2	10	19.2	8	15.4	18	34.6	5	9.6	10.4	20.0
	3	1	1.9	3	5.8	1	1.9	4	7.7	3	5.8	2.4	4.6
Teacher	1	4	57.7	5	71.4	6	85.7	2	28.6	5	71.4	4.4	62.9
	2	2	28.6	2	28.6	1	14.3	5	71.4	2	28.6	1	14.3
	3	1	14.3	0	0.0	0	0.0	0	0.0	0	0.0	0.2	2.9
Student	1	36	80.0	34	75.6	36	80.0	28	62.2	39	86.7	34.6	76.9
	2	9	20.0	8	17.8	7	15.6	13	28.9	3	6.7	8	17.8
	3	0	0.00	3	6.7	1	2.2	4	8.9	3	6.7	2.2	4.9

pants (82.7%) were able to complete the course within two attempts for each of the five section lessons 1 through 5. Nearly half of the students (42%) were able to complete the course without having to repeat any quizzes.

Both groups of beta and pilot-test participants completed the overall course evaluation. The LMS provided student-level information related to their assessment, including quiz results, but only evaluation results in aggregate. Given that PDUs were awarded to teachers for the training, collecting quiz results was essential. Table 6 summarizes the post-course evaluation results. As the results were aggregated and de-identified, beta-test (7 participants) and pilot-test (52 participants) data were combined.

More than 75% of participants were very satisfied or satisfied with elements of the course. Looking at the individual components, 88.1% of participants were very satisfied or satisfied with the course overall. Other elements that scored above 80% included course instruction at 86.7%, knowledge check (quizzes) at 84.7%, graphics and pictures at 83.3%, course content at 83.0% and additional course readings at 81.4%. The elements that scored slightly below 80% included course organization at 78.0%, course activity and satisfaction with the course navigation each at 79.7%. None of the participants were very dissatisfied with the course; however, two reported that they were dissatisfied with the additional readings and one with the course navigation.

Discussion

Between April 7 and June 24, 2016, 52 participants pilot-tested the online career-cluster-specific PPE course, which has since been released statewide. Only seven (13.5%) participants were teachers, but their participation was helpful in gauging overall progress of the training and identifying technical issues.

Participants completed the course in 1 to 10 days of starting the program. Nearly half of the trainees were able to complete the lesson quizzes within the first attempt. Trainees who previously completed the OSHA outreach training may have affected their performance in the online career-cluster-specific PPE training (Taylor, 2015); this is only potentially true of the seven teachers. Two of the required modules within the outreach training are Introduction to OSHA (minimum 2 hours) and PPE (minimum 1 hour). The online career-cluster-specific PPE course may be a good refresher for these topics.

The fourth section, Lesson 4 on transportation, distribution and logistics (TDL), had the highest average number of multiple attempts. PPE for TDL-specific careers are not discussed in detail in the outreach training like the topics covered in the other lessons. This training may have been the first time these participants reviewed safety issues

TABLE 6
Course Evaluation Summary

	Course satisfaction n (%)			
	Very satisfied	Satisfied	Neutral	Dissatisfied
Level of satisfaction with:				
Course content	21 (35.6)	28 (47.5)	10 (19.2)	0
Knowledge checks	16 (27.1)	34 (57.6)	9 (17.3)	0
Course activities	17 (28.8)	29 (49.2)	13 (25.0)	0
Additional readings provided	19 (32.2)	29 (49.2)	9 (17.3)	2 (3.4)
Course organization	25 (42.4)	21 (35.6)	13 (25.0)	0
Graphics and pictures	26 (44.1)	24 (40.7)	9 (17.3)	0
Course instructions	21 (35.6)	31 (52.5)	7 (13.5)	0
Course navigation	23 (39.0)	24 (40.7)	11 (21.2)	1 (1.7)
Online course overall	22 (37.3)	30 (50.8)	7 (13.5)	0

Note. No participants were "very dissatisfied."

specific to TDL careers. Although this evaluation did not have sufficient evidence to determine that these participants were better prepared for PPE use after completing the outreach training, these results suggest connection in terms of knowledge retention and how this online training is a good refresher for PPE training.

Further review of the data suggests that students had a higher number of multiple attempts of the quizzes than the teachers. This may be attributed to the fact that these seven teachers have more experience in the subject area. Comparing this to the findings from the Lesson 4 quiz, teachers in the pilot test may have been able to recall previous knowledge and, therefore, performed better than their students. Thus, this online cluster-specific PPE course served as a refresher for them.

Elements of course navigation had one dissatisfied participant and additional readings had two dissatisfied participants. Although this is only a small subgroup of participants, it is worth addressing these issues for future users to have more positive experiences. The LMS platform used for course delivery by NJSS at Rutgers School of Health (Rutgers Biomedical and Health Sciences) has limited functionality in terms of animation and graphics. Previous studies with young workers have suggested for overall satisfaction and knowledge retention training is best when it is interactive (Linker, Miller, Freeman, et al., 2005).

Additional resources provided through the lessons were downloadable files (PDF format) or hyperlinks to public websites. Given the limited budget for the project, this was the best alternative for providing additional support. Again, based on Linker, et al.'s (2005), findings, students may not have been receptive to this learning platform; however, this course was set up as an introduction for both students and their supervisory teachers for PDUs.

Conclusion

Providing safety and health training to young workers in high-hazard industries is essential.

Although it is the control of last resort on the industrial hygiene hierarchy for workplace safety and health, PPE is essential. Therefore, training on PPE must address the specific needs of the respective industry (career cluster) and their limitations. The NJSS online career-cluster-specific PPE training course was well-received by the pilot-test participants. The overall performance in each section's lesson quiz demonstrated knowledge retention and the user friendliness of the LMS as both a delivery platform for asynchronous online training and as a cost-effective alternative to in-person training. The students who completed the PPE training received a certificate of completion and the teachers received PDUs from NJSS as authorized by the New Jersey Department of Education. The course will continue to be available to teachers and students in career-technical-vocational education throughout New Jersey. **PS**

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Ethical Statement

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