Final Report
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Introduction

Oklahoma State University (OSU) created a series of seven videos as a learning resource to be integrated into existing undergraduate courses to educate students about the importance and content of documentary standards related to fire protection engineering and related fields. The video was developed in Oklahoma, but is applicable throughout the entire United States of America.

The objective of the video series is to help students to identify the different types of codes and standards that are used in industry and how all of the different types of codes and standards are interconnected. The seven videos cover an introduction to the topic; the National Fire Protection Association (NFPA) code development process; the International Code Council (ICC) code development process; design, installation, testing, and maintenance standards; product standards, the role of the American National Standards Institute (ANSI), and a concluding module.

Problem

Codes and standards are used throughout the fire protection industry. They are essential for industry professionals to understand and use properly as part of their daily assignments. Because the industry has a central requirement of keeping people safe, effective codes and standards enable buildings and systems to be used in ways that help to keep the public safe.

Many professionals in fire protection do not have a solid background in codes and standards. Professionals in the field (including instructors at institutions of higher education) comment that the standard developing organizations are making them do "X" whenever a new requirement comes out. They feel that the organizations are acting independent of the rest of society; they do not understand the consensus process and the role that they can play in changing codes and standards.

In other instances, students are not taught about codes and standards as part of their curriculum. It is not until they enter the workforce that they are even aware that codes and standards exist. Even when they do know that codes and standards exist, there is also a general lack of knowledge related to the different types of codes and standards. For example, some people are only aware of product standards while others are only aware of model codes. All types of standards are necessary.

Poor understanding of codes and standards can have a significant economic impact. Professionals not understanding all of the different standards can have projects cancelled or delayed during construction to fix problems that following the standards would solve initially. It is common for code officials to reject plans because the designer was not adhering to the applicable codes and standards.

The videos explain the different types of codes and standards and how their application impacts professionals in fields related to fire protection engineering. There is no known comparable resource available for people interested in learning about codes and standards.

However, in educating undergraduates, we have observed that many of the students are not aware of the different codes and standards that are related to fire protection engineering. The students have trouble understanding codes and standards and simply view them as rules that have to be memorized. Even when they are aware of organizations like NFPA, or are familiar with a few of the codes and standards, they do not understand two important concepts. First, they do not understand how the different types of codes and standards (model codes; design, installation, testing and maintenance standards; and product standards) interact and build upon one another. It is essential for students to understand that not all standards are the same. Second, they do not understand the process of developing, updating, and enforcing codes and standards is accomplished. Development of robust codes and standards requires that people in the field are active in the process. That only occurs if the people realize how they can be involved in the process.

There were no known resources available that can be used by educators in the fire protection and related industries to teach students about how codes and standards are interrelated as well as the code and standard development process.

Goals

The primary goal of the video series was to improve a viewer's understanding of the code and standards related to the fire protection industry. The intention is that this would be achieved by providing modules on the code development process as well as the different types of codes and standards. The videos are easily accessible for academic institutions to use as a teaching resource. The main advantage to a video over traditional lecture material is that viewers who have difficulty with the material can review the film repeatedly.

Viewers are expected to understand how codes and standards are used in combination with one another to form the requirements that are found in constructing safe buildings. Furthermore, viewers should understand how they can be involved in the code development process. All of these skills are covered within the videos.

Project Outcomes

The videos will be released on youtube, easily accessible to any student, instructor, and professional throughout the country.

The first module in the series is a module related to introducing the general role of codes and standards in the fire protection industry. The emphasis is on explaining the use and history of codes and standards in fire protection and associated fields. The module covers the differences between codes and standards as well as explaining the process used to adopt codes and standards. The intended audience for this module is students and professionals new to the field that have limited exposure to codes and standards. For example, it would be appropriate to be shown in classes like construction management or architecture.

The second module focuses on the standards making process. Specifically, it includes information about the role of the ANSI in both establishing how codes and standards in the

United States are consensus documents as well as how ANSI represents the United States for international codes and standards. The intended audience for this module are students and professionals that know that codes and standards exist, but are unsure of how the process works or believe that they do cannot have input on the development process. This module would be appropriate for fire science classes and as introductory information in a code-based course.

The intent of the next module introduces product standards. While many products are tested to standards written by Underwriters Laboratories (UL) and Factory Mutual (FM), many people are not familiar or aware of what the listings actually mean. This module explains the process involved with developing these standards and what the meaning of the results are. Furthermore, how product standards are referenced in other types of standards is covered. The intended audience are students in any course that deals with product safety. Examples include apparel design courses, liability courses, and fire testing courses.

The next module covers design, inspection, testing, and maintenance standards. While there are obvious differences between each of these types of standards, they all serve a similar purpose; they are referenced by model codes about how to do a requirement of the code. The content is directly related to the material from product standards. While product standards specify the minimum requirements for each individual component, the design, installation, testing, and maintenance standards specify how those products are to be installed and maintained to ensure that the system works effectively. Even with all listed components, improper use can prevent the system from meeting its intended functions. The intended audience is students and professionals that work with building systems. Examples of these classes are heating ventilation, and air conditioning (HVAC) courses and sprinkler system design.

Model codes are the next level after the installation and maintenance standards. The model codes specify when the systems are required. For covering the model codes, the content was split into two different modules to cover how the ICC and NFPA develop codes. The ICC module explains the process used by ICC to develop the model codes, how the different ICC codes work together, where and how they are typically applied, and how the codes can work in parallel with codes developed by other organizations. The audience for this module is students that are familiar with

standards in general. This module could be used in architecture and fire protection courses that deal with building design.

The second module related to the model codes is a module covering NFPA. The model codes developed by NFPA are similar to those developed by the ICC. The module covers the NFPA standard development process. That process is also used for the development of different types of standards as well, so the content is applicable to other modules as well. The module also includes information about how different NFPA codes and standards are organized to help the audience to know how to find information that they need. The intended audience and applicable courses are the same as the ICC model codes module.

The final module discusses ties together all previous modules as well as discussing the role of NIST in relation to standards. There is a review of the different types of standards, what they do, as well as how codes and standards are adopted in the United States. The intended audience is anyone that has seen the previous modules and could be used across all courses.

Impact

In order to determine the effectiveness of the videos, one module, the NFPA module, was shown to two different sections of a freshman level class at Oklahoma State University that was learning about different codes and standards. Some of the students in this course have had previous exposure to codes and standards while others have not.

In order to ensure that the two sections had an equivalent base knowledge of codes and standards, a pre-test was administered that asked questions related to the content of the module. The scores for the two sections were both 2.7 out of 5. Thus, the two sections appeared to have a similar base knowledge on the topic.

During the instructional session, both sections were shown the video and provided with a lecture from the instructor. One section had the video first while the other section had the lecture first. After receiving the first type of instruction, the two groups were given the quiz to assess their level of understanding of the content covered. The two groups had average scores of 4.1 and 4.2

out of 5. These results are shown in Figure 1. Thus, the two different methods of instruction appear to work with equal effectiveness.
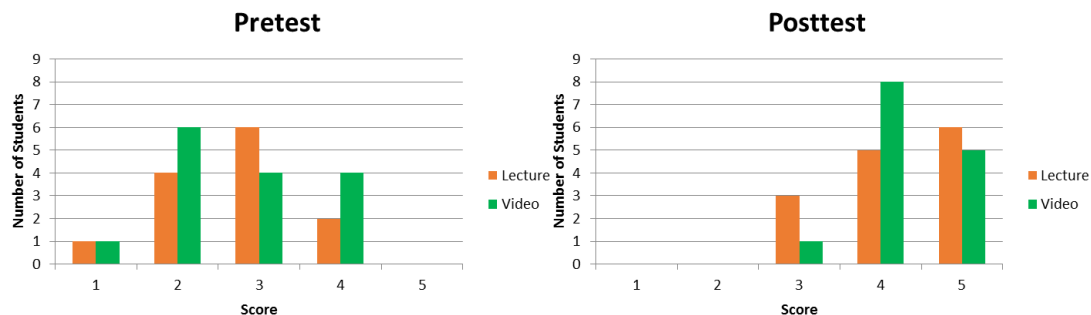

Figure 1: Pretest and Posttest Scores

After completing the posttest, the students were given a survey. This survey used the Student Assessment of Learning Gains instrument to allow the students to quantitatively rank how effective they found the means of instruction. Across the different elements in the SALG, there were 27 different questions where the students were asked to rank their learning gains on a scale of 1-5 with five being the best. The two sections scored issues related to the overall material and integration of issues similarly (typically around 4). For the questions related to gains from the instruction and the class activity, the section that saw the video typically scored gains at 3.5 to 4.0 while the section that received the lecture scored gains at a 4.0 to 4.5 with approximately the same difference between the two sections across all of these questions.

While the two had equal effectiveness in this instance, not all students and professionals have access to instructors with an equivalent understanding of codes and standards. Providing a free video will enable instructors that are less comfortable with the material, or individuals who need more information about a given topic, to be able to find the information.

Also, in surveys conducted after students had received both methods of instruction, the majority of students in both sections preferred having the live instruction to the video because it enabled them to be able to interact with the professor. These results are shown in Figure 2. However nearly all students responded that their preference would be to have the videos made available to them so that way they could access the information at home.
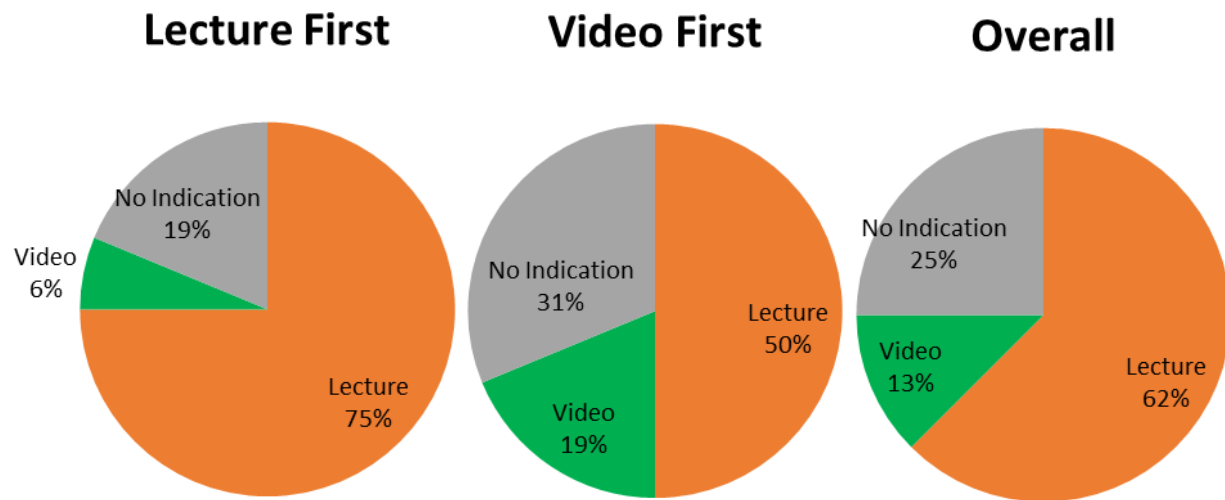
Figure 2: Student Preferences on Instructional Method

Lessons learned

The final videos turned out very similar to what we had originally envisioned. The timeline ended up being longer than had originally been anticipated due to issues that arose that were outside of our control. An important lesson was that the students preferred having a live lecture to a video, but they also wanted to have access to the video. Being able to deliver content in multiple formats is beneficial for student learning.

Potential for adoption

A youtube link will be sent to all fire protection engineering programs in the United States as well as other programs and organizations that teach related content. A paper about the video will also be submitted to *Standards Engineering*, the journal of Society for Standards Professionals.