Abstract

Codes and standards are commonly used in the fire protection industry. However, many students and professionals are not aware of the different types of codes and standards, the role of each type of codes and standards, and how codes and standards are developed. To provide a learning resource for students and professionals in the fire protection and related industries, Oklahoma State University has developed seven video modules that are freely available to the public. These modules cover an introduction to codes and standards, the American National Standards Institute, product standards, design and maintenance standards, the International Code Council, the National Fire Protection Association, and a concluding module. Each module is between approximately ten to thirty minutes in length. Students who viewed the videos showed equivalent knowledge gains whether they received instruction via a traditional lecture or through the video. While the students preferred to learn from the traditional lecture, nearly all of them desired to have access to the video outside of class in order to review the concepts that were covered.

Keywords: codes; standards; fire protection; learning resource

Introduction

As a part of an eighteen-month grant funded by the National Institute of Standards and Technology, 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. They 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. The videos were developed in Oklahoma but are applicable to the entire United States of America.

The funding for the project was provided by NIST from their grant program that is specifically designed for creating educational resources for higher education related to codes and standards. For the grant program, materials have been created covering a wide range of industries. This project was focused on the fire protection industry.

It should be noted that this is not the first effort to educate students about codes and standards. The various code and standard organizations detailed above all have information publicly available on their individual websites. Additionally, NFPA, which this paper addresses through the video development and implementation, also has various case studies on the importance of Standard Development Organizations [1]. An important difference in these efforts of the codes and standards organizations and those of this project is putting the information in a user-friendly format that is also classroom ready.

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 a 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.

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 have the same purpose. Second, they do not understand how 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.

The videos explain the different types of codes and standards and how their application impacts professionals in fields related to fire protection engineering. Previous research has indicated that the number of students learning difficult subjects can be increased with the use of instructional videos to supplement classroom and text-based instruction [2]. Choi and Johnson [3] also found a significant difference in learners’ motivation when comparing video-based instruction and traditional text-based instruction. Learners in this study reported the video-based instruction to be more memorable compared to the text-based instruction [3]. There is no known comparable resource available for people interested in learning about codes and standards.

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 codes 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 of 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 for 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 during the first quarter of 2020, easily accessible to any student, instructor, and professional throughout the country. The filming was done on campus by the Institute of Teaching and Learning Excellence, which specializes in developing content to be used in online instruction. Two professors were filmed teaching about the different concepts.

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 who 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 ANSI in establishing codes and standards in the United States as consensus documents as well as how ANSI represents the United States for international codes and standards. The intended audience for this module is students and professionals who know that codes and standards exist, but are unsure of how the process works or believe that they do not 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 is. Furthermore, how product standards are referenced in other types of standards is covered. The intended audience is students in any course who 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 implement 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 who work with building systems. Examples of classes where students and professionals will benefit from the videos 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 who 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, 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 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 split into different 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
work with equal effectiveness. Different methods of instruction appear to be useful.

Results are shown in Figure 1. Thus, the two groups had similar average scores of 4.1 and 4.2 out of 5. These students had previous exposure to codes and standards, while others have not.

In order to determine the effectiveness of the videos, one module, the NFPA module, was shown to two different groups 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 groups had an equivalent base knowledge of codes and standards, a pretest was administered that asked questions related to the content of the module. In the first group, thirteen students took the pretest, and fifteen students took the pretest in the second group. The scores for the two groups were both 2.7 out of 5. Thus, the two groups appeared to have a similar base knowledge on the topic.

During the instructional session, both groups were shown the video and provided with a lecture from the instructor. One group had the video first, while the other 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. Each group had sixteen students take the posttest; for each group, students arrived after the pretest, but before the instruction. 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.

After completing the posttest, the students were given a survey. This survey used the Student Assessment of Learning Gains (SALG) instrument to allow the students to quantitatively rank how effective they found the means of instruction. The SALG instrument was developed in 1997 for chemistry courses. In 2007, Stephen Carroll, Elaine Seymour, and Tim Weston refined the instrument to broaden it beyond chemistry courses [4]. The SALG has respondents self-report their own learning [4]. The instrument includes five overarching questions and subquestions or items that are customized. The five SALG questions are as follows:

1. How much did the following aspects of the course help you in your learning? (Examples might include class and lab activities, assessments, particular learning methods, and resources.)
2. As a result of your work in this class, what gains did you make in your understanding of each of the following? (Instructors insert those concepts that they consider most important.)
3. As a result of your work in this class, what gains did you make in the following skills? (A sample of skills includes the ability to make quantitative estimates, finding trends in data, or writing technical texts.)
4. As a result of your work in this class, what gains did you make in integrating the following? (The items address how the students integrated information.) [4]
5. As a result of your work in this class, what gains did you make in your understanding of each of the following? (The items address how the students integrated information.) [4]

These overarching questions within the SALG provide a basis for determining how well a student who received the information as a video as compared to a student who received the information within a traditional lecture within the class.

Across the different elements in the SALG, there were twenty-seven different questions where the students were asked to rank their learning gains on a scale of 1–5 with 5 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 4.0–4.5 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 who 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

![Figure 1: Pretest and Posttest Scores](Image)
Acknowledgment

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References


Conflicts of Interest

Authors declare that there are no conflicts of interest. The work was based on a grant from NIST for developing educational material based on codes and standards, but that is not typically considered an inappropriate influence and is declared in the acknowledgment section.
Bryan L. Hoskins
Dr. Hoskins is an Associate Professor of Fire Protection & Safety at Oklahoma State University. He earned his BS and MS degrees in Fire Protection Engineering from the University of Maryland. He received his PhD degree in Mechanical Engineering also from the University of Maryland in 2011 with an emphasis on building egress. Dr. Hoskins spent one year working for Arup on projects primarily dealing with life safety design and people movement. He then spent two years working for the National Institute of Standards and Technology on projects dealing with building evacuations and emergency messaging. Professor Hoskins is a licensed Fire Protection Engineer and an active member of the SFPE and NFPA. Among other professional activities, he is on eight technical committees for codes and standards.

Virginia R. Charter
Virginia Charter is a faculty member and the Program Coordinator for the Fire Protection and Safety Engineering Technology (FPSET) program at Oklahoma State University (OSU). She obtained her BS in FPSET from OSU, her MS in Fire Protection Engineering from Worcester Polytechnic Institute (WPI), and her PhD in Educational Leadership and Policy Studies from OSU. Prior to returning to OSU in 2014, she worked in Las Vegas as a Fire Protection Engineer. She has worked on many of the infamous Strip properties evaluating fire protection, life safety, and loss control systems. While at OSU, she has focused her research on areas that impact fire protection system effectiveness, the fire problem in informal settlements, and on engineering education. She is a licensed Fire Protection Engineer and very active in her community and profession.

SES Treasurer’s Report
Presented to the SES Board of Directors and Membership
Pursuant to the requirements set forth in the SES Constitution, the following report is submitted:

Budget Performance 2019
Through December 2019, total revenue was $204,847.87 versus an annual budget of $211,117.21. Revenue from the Annual Conference, including education courses at the conference, was $139,402.50 compared to the budgeted revenue of $147,500.00.
Expenditures through December 2019 were $196,519.70 versus an annual budgeted amount of $206,390.25.
Revenues fell short of projections primarily due to overestimating conference attendance, although the 2019 Annual Conference was considered a complete success. Expenditures were less than projected primarily due to lower-than-expected attendance at the annual conference.

At the end of the fiscal year December 31, 2019, total revenues less total expenditures were 8,328.17 compared to a projected net of $4,726.96.

Bank Balances
As of December 31, 2019, the Society’s cash and short-term account balances stood at:
- Checking: $132,697.35
- Savings: $54,346.74
- Wire Account: $5,773.00

Total Assets
As of December 31, 2019, the Society’s total assets equaled $192,817.09.

Respectfully submitted,

Craig Cerniglia
SES Treasurer
February 2020