



The Society for Standards Professionals

# **Education Challenge Grant - New Standards E-Learning Course**

**NIST Grant 60NANB12D183**

Final Report  
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## 1. Introduction

In September 2012, SES – The Society for Standards Professionals (SES) was awarded a grant by the National Institute of Standards and Technology (NIST) under its Education Challenge Grant program. The grant program was a special funding opportunity offered that year by the NIST Standards Services Group (SSG) to strengthen education and learning about standards and standardization and support the integration of standards education into the undergraduate or graduate course curriculum in a meaningful way.

SES received NIST funding to develop a new standards e-learning course that could be incorporated into a STEM (Science, Technology, Engineering, and Mathematics) curriculum for undergraduate and graduate classes. The project for which SES was awarded a NIST grant supports the goals of the SSG Grant Program, “to educate students about the impact and nature of standards and standardization so that they enter the workforce and or continue their academic studies with a strong understanding and appreciation for the value and benefits of standards and standardization.” In addition, the SES project meets the secondary goal of this program “to identify new approaches, methods, and models that can be replicated or built-on by other educational programs.”

## 2. The Problem

Standards are widely used in the workplace. Graduates often are expected to use standards, but rarely are they equipped with the standards literacy (knowledge of standards, and how to work with and apply them to real-world situations) to practically apply them. The following examples illustrate this problem:

➤ The typical STEM faculty member has not received any education in standards

Because the educational background of STEM faculty likely did not include standards or standardization, they are generally ill-equipped to impart standards literacy. This problem will persist until the cycle is broken.

➤ Standards are a difficult subject to teach without access to the documents

Often, access to standards is expensive and may be cost prohibitive for schools. In “The State of the Use of Standards in Engineering and Technology Education,” a paper given at the American Society for Engineering Education annual conference in 2013, the

authors noted the following obstacles to teaching about standards:

- Lack of text books that provide the fundamentals and examples of application of technical standards
- Cost of access to technical standards documents
- Lack of faculty expertise on application of standards
- Lack of access to technical standards documents

- Other (including limited time, too many standards to teach, lack of faculty time, standards are continuously changing, standards use complex language, and lack of standards knowledge by faculty and administrators)

➤ Retirement of the baby boomer generation is reducing standards literacy in the workforce

According to the Pew Research Center, 10,000 people in the United States will reach retirement age every day between January 1, 2011 and 2030. This prediction translates to a problematic drain on the institutional and corporate knowledge base. Newly-employed STEM graduates need training in standards. As

a result, graduates who enter the workforce unfamiliar with standards and their practical application in the workplace put the burden of training on their employers, many of whom are already strapped for resources. In many cases, the task of training recent graduates in the use of standards is carried out by senior staff. With these staff retiring, industry is relying on academia to better educate undergraduates in the areas of standards and standardization.

### 3. Original Project Goals

The original goals of this project, as stated in the SES proposal to NIST, were to:

- Develop an e-learning course that engages students while conveying essential information to facilitate growth in standards literacy
- Evaluate feedback from faculty and student users on the course, and revise if necessary


### 4. Standards E-Learning Course

The course developed by SES under the NIST grant, *Using Standards in the Workplace*, illustrates how the various STEM disciplines use standards. Practical examples of standards employed in a variety of real-world applications are featured in this course. Approximately one hour long, the course comprises six lessons: an introduction, one lesson for each of the STEM disciplines, and a final review lesson. Also included in the course are links to relevant websites and related resource materials, and a glossary of terms used in the course. The course was designed and developed using a blend of proven instructional design methodologies. The new course contains teaching and knowledge checking content that uses a variety of media elements to create an engaging and effective learning experience for users.

**Course Outline and Objectives**

Upon successful completion of this course, you will be able to:

1. Describe how standards are used in the various STEM disciplines
2. Provide examples of different types of standards
3. Identify organizations that develop standards used in the STEM disciplines
4. Explain the benefits of standards for STEM disciplines



The graphic shows the letters S, T, E, M stacked vertically. S is Science, T is Technology, E is Engineering, and M is Mathematics. Each letter is accompanied by a small image: a microscope for Science, a circuit board for Technology, a gear for Engineering, and mathematical symbols for Mathematics.

For the *Using Standards in the Workplace* course, SES employed the same e-learning format as Standards Aware™, a series of online e-learning courses offered by SES in partnership with Intellectual Property Shield (IP-Shield). The series, which covers the fundamentals of standards and conformity assessment, is designed for anyone who develops, uses, references, or distributes standards. The original eight courses in the Standards Aware series are:

1. What Are Standards?
2. Why Are Standards Used?
3. Standards Developing Organizations
4. Standards Development Process
5. Standards and Trade
6. Conformity Assessment
7. Strategic Standardization
8. Finding Standards

Additional information about the Standards Aware courses is provided in Appendix A.

To carry out this project, SES established the following team:

- Craig Ceniglia (Chair, SES Education Training Subteam)
- Ashley DeGiacomo (Director, SES Education Council)
- Bruce Harding (Professor, Purdue University)
- Mike Morrell (SES Executive Director)
- Diane Thompson (Director, SES NIST Grants Project)

Development of the new e-learning course, *Using Standards in the Workplace*, was carried out in four phases. In the first phase, the SES project team wrote and reviewed the content for the course, including a glossary and a quiz consisting of multiple choice, matching, and true/false questions. An outline of the new course as developed in the planning stage is shown in Appendix B.

The next phase of the project included issuing a request for proposals (RFP) and selecting a company to develop the e-learning course. SES obtained bids from three vendors for the development of *Using Standards in the Workplace*. UASC, Inc., a small firm in Illinois, was chosen to produce a storyboard from the script written by the SES project team and incorporate all the elements into the final course. A narrator was selected to record the script and graphics and photographs for use in the course were obtained. The project team reviewed and tested the course in the development phase, changes were made as required, and the course was finalized.

The resulting e-learning course, *Using Standards in the Workplace*, incorporates a variety of media components, including graphics, photographs, animations, and audio, to include the following features:

- Adobe Flash programming compatible with the Sensa LMS
- voice-over narration using professional voice talent

- bookmarking capability
- audio on/off capability
- progress bar
- audio transcript/closed captions
- glossary
- web links

Following is a screen shot from one of the lessons in *Using Standards in the Workplace*:

The screenshot shows a software interface for an e-learning course. On the left is a navigation pane with a blue header 'Intellectual Property Shield' and a list of menu items: Introduction, Using Stds in Science Apps, Using Stds in Technology Apps, Using Stds in Engineering App (highlighted in green), Using Stds in Math Apps, Course Review, Exam Results, and View Course Options. Below the menu is an 'Info' section with 'Powered by SENSa', 'Status: Slide 7 of 11', and a timer showing '01:00/01:00'. The main content area has a title 'Using Standards in Engineering Applications' and a subtitle 'Benefits of Using Standards in Engineering'. It features a large 'E ENGINEERING' logo and a list of bullet points: 'Standards... contribute to cost savings, safety, and interoperability', 'save time and money throughout the production cycle', 'shorten product design and development time', and 'specify best practices'. Below this is a summary statement: 'Standardized processes reduces scrap and waste, minimizes rework, and increases productivity.' To the right are two images: a large pile of industrial scrap and a view of an industrial refinery. At the bottom, there is a 'Dialogue' box with the text 'Standards contribute to cost savings, safety, and interoperability. For example, using standards for the fundamental aspects of a product (such as safety of...' and a 'My Notes' box with the placeholder 'Type your slide notes here.'. The footer includes a search bar, the course title 'Course: 109 - Using Standards in the Workplace', and navigation icons.

Go to [www.ip-shield.com/nist.aspx](http://www.ip-shield.com/nist.aspx) to request access to the new e-learning course, *Using Standards in the Workplace*.

For the third phase, Purdue University students in the College of Technology, Department of Mechanical Engineering Technology undergraduate and graduate classes participated in a pilot study of *Using Standards in the Workplace* during the last semester of 2013. Professor Bruce Harding incorporated the e-learning course into his course syllabi to enable us to conduct the pilot study, an important phase of this project. IP-Shield developed an online site for the students to access *Using Standards in the Workplace*. The purpose of the pilot study was to determine if the e-learning course developed under this project could be adopted by teaching professionals.

## 5. Findings

The final phase of this project was the evaluation phase. After taking the online course and final quiz, the Purdue students were required to respond to an online survey. Overall, feedback about the new e-learning course was very positive, with 100% of respondents being satisfied or very satisfied with the course. All respondents found the course content clear and easy to understand. In response to the statement, "I now have a clear understanding of how standards are used in the various STEM disciplines" 100% chose "agree" or "strongly agree." In addition, all of the respondents chose "agree" or "strongly agree" when asked if the following learning objectives for the course were met:

1. Describe how standards are used in the various STEM disciplines
2. Provide examples of different types of standards
3. Identify organizations that develop standards used in the STEM disciplines
4. Explain the benefits of standards for STEM disciplines

Student comments about the most valuable part of the course included, "the content and flow of the material," "examples of different standards and where they are used," "definition of terms," and "learning how standards are used."

Analysis of the feedback from the students indicates that the new e-learning course is effective to use when teaching about standards. SES has developed an e-learning course that engages students while conveying essential information to facilitate growth in standards literacy, thereby meeting the original goals of this project. Additional standards e-learning courses could be created for other disciplines and applications using the same format.

## 6. Lessons Learned

With the sudden death of Professor Harding, a key member of the project team, we had to make adjustments to the Project Director's tasks to prepare the final deliverable (this report). A secondary contact at the university would have been helpful in completing this final report.

Despite these setbacks, the required deliverables were completed and overall, the project was a success.

## Standards Aware™

### **Course #1: What Are Standards?**

*Standards are part of our daily lives yet they often go unnoticed. This course explains what standards are and uses examples of the various types of standards to illustrate the many ways that we use and rely on standards.*

Objectives – Upon completion of this course, the student will be able to:

1. Explain the general concept of a standard
2. Recognize the various types of standards
3. Distinguish between design and performance standards
4. Differentiate between de facto and de jure standards
5. Describe the relationship between voluntary and mandatory standards

### **Course #2: Why Are Standards Used?**

*Standards are used for a variety of reasons. This course examines the benefits of standards for consumers, explains why industry uses standards, and explores the regulatory use of standards by government authorities.*

Objectives – Upon completion of this course, the student will be able to:

1. Explain the benefits of standards for consumers
2. Illustrate why industry uses standards
3. Explain the regulatory use of standards
4. Describe the benefits of standards for society in general

### **Course #3: Standards Developing Organizations**

*Who develops standards? Hundreds of organizations around the world produce standards. This course identifies the various industry groups and government agencies that are involved in the development of standards.*

Objectives – Upon completion of this course, the student will be able to:

1. Identify the types of organizations that develop standards
2. Explain why companies use internal standards
3. Differentiate between the various categories of standards developing industry groups
4. Provide examples of government agencies that develop standards
5. Describe national, regional, and international standards organizations

### **Course #4: Standards Development Process**

*Standards are developed by a variety of organizations worldwide. Despite their diversity, most standards organizations follow similar processes to develop standards. This course describes the most common processes used to develop industry, national, and international standards.*

Objectives – Upon completion of this course, the student will be able to:

1. Explain the process for developing standards using examples of industry, national, and international procedures
2. Describe the globally recognized principles for standards development
3. Consider options for financing the standards development process
4. Identify resources for assistance in developing standards

#### **Course #5: Standards and Trade**

*What is the role of standards in the global marketplace? The link between standards and international trade is examined in this course.*

Objectives – Upon completion of this course, the student will be able to:

1. Demonstrate the importance of standards to global trade
2. Describe standards harmonization and illustrate the concept using examples
3. Detail the benefits of using international standards to facilitate global trade
4. Explain the relationship between standards and trade agreements

#### **Course #6: Conformity Assessment**

*What is conformity assessment and how does it relate to standards? This course provides an overview of testing, certification, and other related elements of conformity assessment.*

Objectives – Upon completion of this course, the student will be able to:

1. Define conformity assessment and related terms
2. Distinguish between the various methods for determining conformity
3. Explain the principles of conformity assessment
4. Describe your national conformity assessment system and its relationship to regional and international programs
5. Illustrate how harmonization of procedures and mutual recognition agreements facilitate global trade

#### **Course #7: Strategic Standardization**

*Standards are as much of a business issue as a technical one. This course examines the benefits of adopting a strategic approach to standardization by companies and government agencies.*

Objectives – Upon completion of this course, the student will be able to:

1. Explain the importance of having a standards strategy
2. Identify the reasons for using standards
3. Demonstrate why it is beneficial to participate in standards development
4. Determine how to implement strategic standardization in your organization
5. Apply recent research about the economic benefits of standardization



### **Course #8: Finding Standards**

*Standards users frequently require assistance in finding the standards appropriate for their needs. This course addresses the problems that standards users have in identifying the standards they need and in obtaining the required documents.*

Objectives – Upon completion of this course, the student will be able to:

1. Make use of a variety of sources to identify standards
2. Locate suppliers for purchasing standards
3. Find services to help you keep your standards collection up-to-date
4. Choose the appropriate format for obtaining standards

***Using Standards in the Workplace Outline***

<b>Course</b>	<i>Using Standards in the Workplace</i>
<b>Course Description</b>	This course describes how the various STEM (Science, Technology, Engineering, and Mathematics) disciplines use standards in the workplace. Lessons include examples of a variety of real-world applications.
<b>Target Audience</b>	<ul style="list-style-type: none"> <li>- University faculty and students (STEM, business, public policy, law)</li> <li>- Corporate engineering, manufacturing, and design staff</li> <li>- Government and public administration staff</li> </ul>
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. Describe how standards are used in the various STEM disciplines</li> <li>2. Provide examples of different types of standards</li> <li>3. Identify organizations that develop standards used in the STEM disciplines</li> <li>4. Explain the benefits of standards for STEM disciplines</li> </ol>

<b>Lesson</b>	<b>Slide</b>	<b>Course Objective</b>
1. Introduction	1: Welcome	
	2: Course Objectives	
	3: Course Interface	
	4: About the Glossary	
	5: Glossary	
	6: Search Links	
2. Using Standards in Science Applications	1: Introduction	1
	2: Types of Standards Used in Science	2
	3: Standards Developers	3
	4: Benefits of Standards Used in Science	4
	5: Example 1	1, 2, 3
	6: Example 2	1, 2, 3
	7: Example 3	1, 2, 3
3. Using Standards in Technology Applications	1: Introduction	1

	2: Types of Standards Used in Technology	2
	3: Standards Developers	3
	4: Benefits of Standards Used in Technology	4
	5: Example 1	1, 2, 3
	6: Example 2	1, 2, 3
	7: Example 3	1, 2, 3
4. Using Standards in Engineering Applications	1: Introduction	1
	2: Types of Standards Used in Engineering	2
	3: Standards Developers	3
	4: Benefits of Standards Used in Engineering	4
	5: Example 1	1, 2, 3
	6: Example 2	1, 2, 3
	7: Example 3	1, 2, 3
5. Using Standards in Mathematics Applications	1: Introduction	1
	2: Types of Standards Used in Mathematics	2
	3: Standards Developers	3
	4: Benefits of Standards Used in Mathematics	4
	5: Example 1	1, 2, 3
	6: Example 2	1, 2, 3
	7: Example 3	1, 2, 3
6. Review and Resources	1: Introduction	1, 2, 3, 4
	2: Review of Lesson 2	1, 2, 3, 4
	3: Review of Lesson 3	1, 2, 3, 4
	4: Review of Lesson 4	1, 2, 3, 4
	5: Review of Lesson 5	1, 2, 3, 4
	6: Resources	1, 2, 3, 4
Quiz		1, 2, 3, 4