Introduction

In September 2012, SES – The Society for Standards Professionals, was awarded two grants from the National Institute of Standards and Technology (NIST) under a special Education Challenge Grant program. The grant program was a special funding opportunity offered by the NIST Standards Services Group (SSG) to strengthen education and learning about standards and standardization and to support the integration of standards education into the undergraduate or graduate course curriculum in a meaningful way. The goal of the Education Challenge Grant program was 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. A secondary goal of the SSG Grant Program was to identify new approaches, methods, and models that can be replicated or built-on by other educational programs.

SES received NIST funding for two projects to develop standards learning materials using multimedia technology with a focus on a STEM (Science, Technology, Engineering, and Mathematics) curriculum for undergraduate and graduate classes. One of the grants awarded to SES was for the development of four standards case studies using multimedia technology. SES developed an online e-learning course under the second NIST grant.

The Need for Standards Education Solutions

In our applications for the NIST grants, SES proposed solutions aimed at the lack of standards-related educational programs in colleges and universities, citing the fact that although graduates often are expected to use standards in the workplace, rarely are they equipped with sufficient knowledge of standards and how to work with and apply them to real-world situations. To further exacerbate the problem, the typical STEM faculty member has not received any education in standards. In addition, standards are a difficult subject to teach without access to the actual documents or excerpts from the standards. 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)

Another problem is the decline in standards knowledge in the workplace as a result of the retiring baby boomer generation. According to the Pew Research Center, some 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.

Multimedia Standards Case Studies

The aim of this NIST grant project was to connect concepts discussed in the classroom to real world scenarios with engaging and informative multimedia case studies using specific standards. SES worked with the American Society of Mechanical Engineers (ASME), ASTM International, IPC – Association Connecting Electronics Industries, Underwriters Laboratories Inc. (UL), and IHS Inc. to identify standards that would be used for the case studies and to create research questions and answers based on the scenarios.

The next phase of the project involved issuing a request for proposals (RFP) and selecting a company to develop the multimedia case studies. We chose Mudpuddle Creations to create four three-minute videos that combined whiteboard drawing and animation with a narrative voiceover. The scripts and storyboards were produced, reviewed by the project team, revised, and finalized to transform the written case studies into multimedia presentations. The scenarios we developed included determining the optimum threaded fastener to be used for nail gun housings using an ASME standard, and verifying the requirements and testing for electric-battery-powered industrial trucks with information found in a UL standard. An ASTM standard for lap joint flange pipe ends provided the basis for a storyline about plumbing on a cruise ship, and the solution for a tailhook malfunction on an aircraft carrier incorporated information from the IPC standard for electronics assembly manufacturing.

E-Learning Course

The purpose of the second NIST grant project was to develop a new online course that engaged students while conveying essential information to facilitate growth in standards knowledge. The course

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we developed, *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.

For the *Using Standards in the Workplace* course, we 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.3 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

Similar to the case studies project, the new e-learning course project was carried out in four phases. The SES project team wrote and reviewed the content for the standards course, including a quiz consisting of multiple choice, matching, and true/false questions. Course development was done by UASC, Inc., the company chosen from the proposals submitted in response to an RFP from SES. 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.

**Pilot Studies**

During the last semester of 2013, Purdue University students in the College of Technology, Department of Mechanical Engineering Technology undergraduate and graduate classes participated in pilot studies of both the multimedia standards case studies and the new e-learning course. Professor Bruce Harding incorporated the case studies and *Using Standards in the Workplace* into his course syllabi to enable us to conduct the pilot studies, an important phase of these projects.

The purpose of the pilot studies was to solicit feedback from the students about both of these projects. We were looking for information about how easily the prototypes could be adopted by teaching professionals, whether multimedia case studies engage students, and what level and depth of content and ease of use is required.

In preparation for the pilot studies, IP-Shield developed an online site for easy access to the case studies and to sign up for the new course. The four standards developers (ASME, ASTM, IPC, and UL) provided access to the documents used in the case studies through the IHS Standards Expert(tm) system at Purdue University.

After viewing the case study videos and completing the e-learning course (including the quiz), the students were required to respond to an online survey for each of the projects. Overall, the feedback from the students was very positive. For example, fifty percent of respondents chose “engaging” and eighty three percent selected “informative” to describe the case studies (other options were “boring,” “too easy,” and “too hard”). Ninety four percent of respondents “agreed” or “strongly agreed” to the statement, “After watching the videos and answering the questions, I now have a better understanding of how standards impact our everyday life.” Comments such as, “these case studies helped me relate the importance of standards to everyday life” and “I learned that standards can be used in real life situations” were typical of the feedback we received. Reinforcing a key message of the project, one student remarked, “The variety in these scenarios shows the likelihood that, no matter where an engineer goes, standards will almost certainly be a part of their everyday work experience.”

Feedback about the new e-learning course also was positive, with one hundred percent 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” one hundred percent chose “agree” or “strongly agree.” In addition, one hundred percent of respondents chose “agree” or “strongly agree” when asked if the following learning objectives for the course were met:
Standards Engineering

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.”

As noted, the purpose of the pilot studies was to determine if the prototypes developed under these projects could be adopted by teaching professionals. Analysis of the feedback from the students indicates that the multimedia case studies and the new e-learning course are effective as supplementary materials to use when teaching about standards. Furthermore, the video pilot study indicates that multimedia case studies engage students. Overall, both the multimedia case studies and the new course have proven to be suited to supporting the integration of standards education into the undergraduate or graduate course curriculum, one of the objectives of the NIST Education Challenge Grant program.

Conclusion

From its inception in 1947, SES has focused its efforts on programs and services to advance the knowledge and use of standards and conformity assessment. Today, the Society’s mission reflects its commitment to develop and support standards education initiatives. The two projects funded by the NIST education grants described in this article are perfect examples of that effort.

We thank NIST for awarding these grants to SES, without which we would not have been able to carry out these projects. Thanks also to ASME, ASTM International, IPC, and UL for working with SES from the start to create the original case studies and for allowing us to use their standards, and to IHS for facilitating access to the documents for the pilot study.

SES worked in partnership with Bruce Harding (Purdue University) and IP-Shield to develop and make available the standards case studies and the new e-learning course, and we are grateful for their involvement.

To access the multimedia standards case studies and to sign up for the online course, Using Standards in the Workplace, go to www.ip-shield.com/nist.aspx. SES encourages readers to review these educational tools and we welcome your feedback.

A Final Note

We were saddened to learn of the passing of Bruce Harding on February 23, 2014. Bruce was an integral part of the SES NIST grant project teams and we value his contributions to the projects.

Diane C. Thompson, President of Thompson Consulting, Inc. served as the Project Director for the SES NIST grant projects. Contact Ms. Thompson at dthompson@standards-consulting.com.

2 See www.pewsocialtrends.org/2010/12/20/baby-boomers-approach–65-glumly
3 For additional information about the Standards Aware™ series, go to www.ses-standards.org/displaycommon.cfm?an=1&subarticlenbr=100
4 SES Mission: To provide opportunities for professional development through programs and services, and to promote awareness, use, and value of standards and conformity assessment; www.ses-standards.org