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Introducing Students to Technical Standards

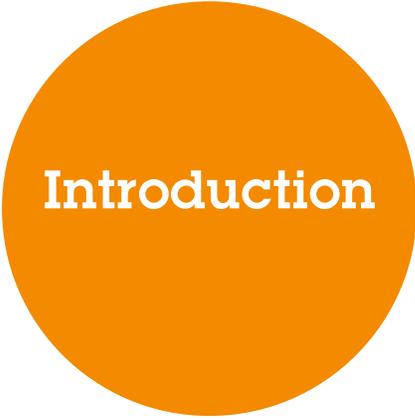
DEVELOPING THE 21ST
CENTURY WORKFORCE

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The Association of
Technology,
Management, and
Applied Engineering

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Introduction

Introduction

Despite the inability to see them, technical standards are in action all around us to assure safety, allow for interchangeability of parts, ensure proper use of materials, and to maintain consistency within company processes. From simple objects such as ink pens and paper to more complex objects such as computers, automobiles, bridges, and buildings, standards drive the design, manufacturing, and testing of each. However, many individuals do not give much thought to the impact that standards have on the world around us until there is some sort of failure. As standards impact every profession, it is extremely likely that individuals will one day find themselves having to comply with standards, thus it is vital that students are thoroughly introduced to the topic before entering into their profession.

Despite the importance of standards, and the ABET accreditation guidelines stating “Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.” (Accreditation Board for Engineering and Technology, 2015), standards are often times glazed over in classroom settings without highlighting the importance that they play in the discipline and how they can be applied to practical applications. When compared to educational programs offered in other developed countries such as Korea, Thailand, and Canada, the United States currently lacks sufficient across the board training for future practitioners about how to find and apply technical standards to real world scenarios (de Vries & Egyedi, 2007). Daniel Schultz, a standards professional with ASTM, wrote an article titled *Standards in the Classroom*, that highlighted this lack of education and several key negative impacts that failing to properly educate students about technical standards could have on their future employment (Schultz, 2005). Therefore, the purpose of this paper is to encourage educators to seek out ways in

which they can integrate the use of standards into their curriculum. This paper will introduce research that highlights how managers view the importance of standards and the need for students to be educated prior to employment, how standards are currently being implemented into an engineering technology curriculum, as well as free/low cost resources that educators can take advantage of to begin such introduction.

Standards and Industry

In 2010, researchers at a Purdue University surveyed 1,431 managers from various professions to determine how their respective industries viewed the importance of standards and to assess whether or not introducing students to standards in the classroom would be value additive for their professional careers. When asked about how standards impact the growth and success of their company, 1,050 respondents selected very important or extremely important. There were 855 respondents that answered the following question: "Is there a need for students entering the workforce to understand not only the development process but also how to find and apply standards?", of which 84% (716) agreed that such a need for education about standards existed. Of the 716 that agreed, 83% (596) also indicated that taking a course that focuses on the development and application of standards would better prepare graduates to work for this company.

With standards playing a pivotal role in almost every technical field, it is critical that practitioners from various corporations be active participants within standards development organizations (SDO's) to assure that the approved standards are in fact relevant to today's industrial capabilities but also adhered to on a daily basis. Within the United States alone, there are approximately 200 standards

As the workforce and workplace changes, companies and corporations need to make cultural and environmental adjustments in order to not only keep up with change, but also to also address millennial worker concerns.

development organizations overseeing the development, approval, and adherence to tens of thousands of technical standards, while internationally there are thousands of committees from 162 countries working to assure that some standards are genuinely agreed upon between different countries. For example, the American Society for Testing and Materials (ASTM) has over 12,000 active standards that influence an array of industries assuring product quality, consistency among competing products, interchangeability of parts, and user safety (American Society for Testing and Materials, 2015). Therefore, it is imperative that students are provided with opportunities to not only learn more about the impact of standards but also gain hands on experience working with standards in their discipline.

Curriculum Integration

With standards playing an integral role throughout our society, especially in the technical disciplines, educators need to take a more proactive role in educating students about how standards impact the discipline. While integrating standards into an existing curriculum may seem difficult, one can take an array of approaches that provide students the opportunity to learn more about how standards not only impact items they interact with on a daily basis, but also gain first-hand experience using standards that directly relate to their discipline. In the Mechanical Engineering Technology program at Purdue University, students are exposed to standards early on in the curriculum when taking the materials processes and testing courses and statics. Throughout these courses students utilize material characteristics tables extracted from standards when conducting lab experiments and compare lab results to the standards. Standards are then reiterated at a deeper level in the product design and quality courses in which students research and apply standards to practical projects.

In the production design and specification course, students are introduced to standards in three different ways. The first assignment of the term involves students researching three everyday items such as tires, toasters, or a particular household appliance and utilize the standards databases available on campus to find two standards about each item. Students then must summarize one standard about each item, discussing how the standard impacts the design, manufacturing, or testing of the product. The fundamentals of this assignment carry forward into the design projects assigned throughout the term, as with each new design challenge, commonly developing a new rendition of an existing product, students must identify areas in which standards would drive their design, whether it is through the use of standard parts such as fasteners or the material selected for the item being designed. Students must then present on each design highlighting the areas they have identified would be driven by technical standards. Requiring students to design with standards in mind has resulted in projects that are more innovative, feasible, and realistic.

In conjunction with identifying how standards impact material selection, safety requirements and the like with each project, students are introduced to technical standards via the use of tables and charts in the Machinery's Handbook to aid in developing appropriate mechanical designs. In addition students are exposed to both ANSI and ISO drafting standards. Students are required to develop fully

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annotated mechanical drawings that conform to the ANSI/ASME Y-14.5 drafting standard. Developing mechanical drawing in accordance with this standard allows them to develop mechanical drawings such that they can be interpreted by engineers around the world as well as enter the workforce understanding how to adequately read mechanical drawings developed by other professional practitioners.

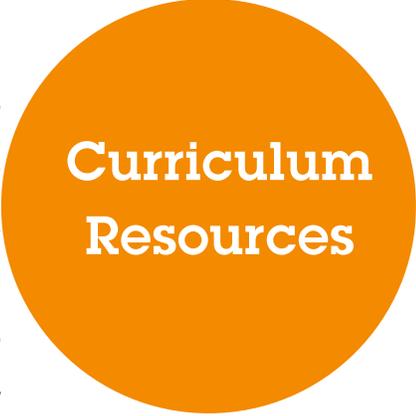
In the quality for manufacturing course, students learn about standards associated with calibration of equipment, metrology, quality management. Students must actively follow ISO standards associated with calibration of precision measurement equipment when completing a repeatability and reproducibility study on parts donated by industry partners. In addition students must complete a report that analyzes how industries actively incorporate quality management standards into everyday practices. As this project requires students to interview a manager within the company and spend time analyzing how quality is maintained throughout the organization, the students learn the pros and cons associated with integrating and assuring the adherence of such standards into a corporation.

The early introduction and reiteration of standards throughout the curriculum allow students to gain a better understanding of how to locate and apply technical standards to real world applications as well as understand their impact throughout industry. This has become apparent in their senior year when students are partnered with an industry that sponsors a real world design project and students are expected to design to and meet industry standards with their designs. As an academic advisor for these projects, students have demonstrated an understanding of being able to locate, understand and apply the guidelines/requirements within the standards that apply to their specific project.

Curriculum Resources

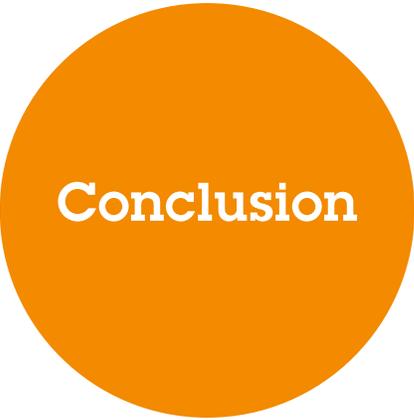
With hundreds of SDO's throughout the world, there is an abundance of free online resources available to educators to introduce students to the various ways in which standards impact the world around us. The cheapest and probably least intrusive approach for integrating technical standards into one's curriculum would be to locate case studies relevant to course projects/topics and have students critically analyze the importance that standards play in the case study and how it translates to the project/topic being discussed. One can access a multitude of case studies that provide detailed examples of technical standards in action through the American Society of Mechanical Engineers (ASME), Institute of Electrical and Electronics Engineers, International Standards Organization, StandardsLearn.org, and many other SDO websites.

Another valuable resource that educators might investigate, especially if teaching a course that is comprised of students from multiple disciplines, and the goal is to provide a broader more global sense of how standards are developed and utilized would be to have students take a series of short modular type courses offered at StandardsLearn.org. These courses which were developed in collaboration with the American National Standards Institute, are free and allow students to earn a certificate of completion. In addition, Intellectual Property Shield has several short case study videos that provide sample prompts about how standards are applied to specific applications and require students to research the technical standards that would apply to the situation presented in the video. Conducting the research to determine what standards apply to the situation introduces students to how to both research standards but also read and understand the terminology within a technical standard to apply the content.



Curriculum
Resources

Finally, a slightly more expensive route, but one that provides students with first-hand experience with utilizing the actual standard, would be to locate the full standards from which charts/tables/graphs typically found in the appendixes of a textbook are pulled and make students read and apply the content from said standards into practical lab experiments. This can be done by contacting a SDO to assure the proper standard is available and purchasing it with the rights to distribute to students for educational purposes. Faculty may even consider purchasing a membership to the American National Standards Institute to access standards from an array of SDO's on an as needed basis to provide a plethora of examples of the type of content covered by technical standards. Whether it is in a metrology lab or a design course, providing students the experience of working with the standards will better prepare them for their professional careers in which they will need to look beyond just one table and assure that they are complying with all aspects of a standard.

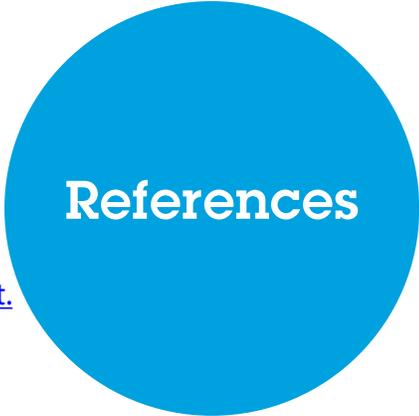


Conclusion

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Without standards, it is certain to say that the world we live in would be a much more chaotic as we would still be living in a pre-Industrial Revolutionary era without consistency of product quality, safety regulations, and interchangeable components. Research has shown that today's managers understand the key roles standards play in their daily operations and they seek out students that have had practical experience utilizing standards. Therefore, as educators, whose duties involve seeking out methods to better prepare students to become professional practitioners, we must do a better job at getting students to understand what a standard is, the importance of standards, and when they are utilizing information from a standard for a practical application within the discipline.

References and Resources



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