

Practical Ideas from Professors: Standards Education in Action

Introducing Engineering Technology Students to Technical Standards

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MET 102: Production Design and Specifications

MET 102 is a required CAD focused course in the MET undergraduate curricula at Purdue University, with a total enrollment of approximately 200-300 students per year. One of the learning outcomes of the course is for students to be able to identify, locate, and integrate relevant technical standards into their mechanical designs, as standards education is required for compliance with ABET ETAC accreditation criteria [1] and expected by employers [2].

Standards are integrated into MET 102 through a collaboration between the course instructor and engineering librarians. Together, the instructor and librarians, use a flipped classroom approach, where students complete a series of online, openly available, interactive tutorials (developed with funding from NIST) [3] (see Figure 1) before coming to class, and then dive more deeply into the content through in-class exercises focused on “everyday objects.” The “everyday objects” emphasis involves having students identify and locate standards in an approachable, low-stakes way by considering items that surround them nearly all the time (e.g. headphones, a credit card, a smoke detector) [4]. The instruction for this module is approached through scaffolding, where students first explore identifying and locating standards for an object in-class with a small group, and then apply these skills independently in subsequent course assignments. In completing this module, students learn the basics of how standards are created, their purpose, and gain hands-on experience searching and accessing standards in databases subscribed

to by Purdue Libraries (e.g., ASTM Compass, IEEE Xplore). We have surveyed the students to evaluate their perceptions of the interactive modules. They report positive experiences with the modules, as evidenced by statements such as, “I am now much more aware of standards and have gained skills in searching for standards as well as reading them,” and “I thought it [the anatomy module] helped me understand how to navigate a standard and gave examples of specifically what to look for. Since this helped me so much, I would recommend it to others.”

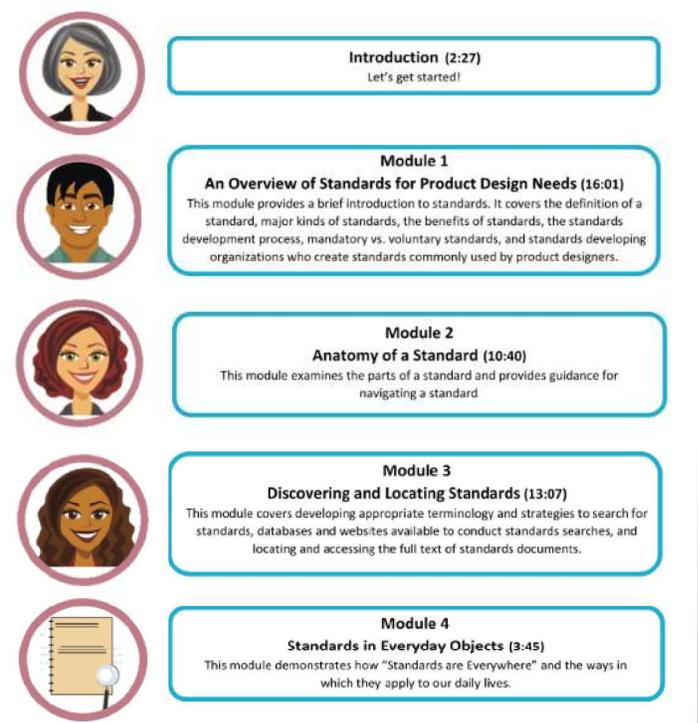


Figure 1: Standards are Everywhere tutorial modules [3].

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In addition to this focused standards project, students are introduced to a variety of specific standards that apply to active mechanical design projects in MET 102. As students design their first project, an arbor press, they must turn to ASME B94.6: Knurling to ensure that the handle is modeled appropriately, as well as ASME Y14.7.1: Gear Drawing Standards-Parts 1: For Spur, Helical, Double Helical and Rack to become familiar with gear terminology and how to perform necessary calculations to properly design the rack and pinion gears. In addition, when students find themselves needing to design or acquire fasteners for a project, they must utilize both ASME B18.3-2012: Socket Cap, Shoulder, Set Screws, and Hex Keys (Inch Series), and ASME B18.8.2-2000: Clearance Holes for Bolts, Screws, and Studs. Finally, students are required to develop fully annotated mechanical drawings while adhering to ANSI/ASME Y14.5-2009: Dimensioning and Tolerancing, thus various aspects of this standard are covered in great detail to ensure students are able to effectively communicate their design to manufacturers and inspectors.

Value added for the School of Engineering Technology and students

While this course serves as the primary course to meet the ABET criteria related to standards in the Mechanical Engineering Technology curriculum at Purdue, it also serves a pivotal role for many students both inside and outside of their academic career. Students have indicated that because of the introduction to standards in MET 102, they are able to successfully complete other course projects that require testing processes or design requirements that can be found in technical standards, such as in their senior capstone projects. In addition, we often have students comment they have not been previously

informed or trained on technical standards, despite having some industry experience. In fact, some students that have served in design roles have indicated that their companies never required them to follow a standard, such as ANSI/ASME Y14.5-2009: Dimensioning and Tolerancing, and that a prior introduction to this topic would have been extremely beneficial for their work.

Overall, we believe the in-depth exposure MET 102 gives students to technical standards better prepares them to enter the global workforce, where over 93 percent of product exports are impacted by standards and technical regulations [5]. Current students often inform us that the ability to discuss their understanding of technical standards during job interviews has been invaluable, often being one of the pivotal decision makers in their hiring. Additionally, graduates have shared with us that having an understanding of technical standards prior to entering the workforce has assisted greatly in their ability to be successful in their careers, reducing the learning curve and allowing them to stand out among their peers.

About the School of Engineering Technology, Purdue University

The School of Engineering Technology, which consists of both Mechanical Engineering Technology and Electrical and Computer Engineering Technology programs, has been actively involved in education about standards for several decades. Faculty have worked to integrate standards into both undergraduate and graduate level courses, providing students with the knowledge and skills to be successful in their professional careers. An integral part of making this successful has been to

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collaborate with faculty in the Purdue University Libraries to ensure proper access and training is available for students.

About the Purdue University Libraries

The Purdue University Libraries system on the West Lafayette campus includes six subject-oriented libraries, the Hicks Undergraduate Library, and the Virginia Kelly Karnes Archives and Special Collections. Staff total more than 220, including 90 faculty members and professionals. Purdue Libraries faculty provide expertise about access to information resources, and they instruct students on how to identify, locate, critique, and retrieve information. Libraries faculty also collaborate with faculty colleagues across campus to teach specialized data and information courses and/or participate as members on faculty teaching teams.



Photograph of the new Wilmeth Active Learning Center (WALC) on the Purdue University, West Lafayette campus. The WALC is located in the heart of campus and houses the Library of Engineering and Science (LOES), 27 active learning classrooms, and a variety of study and collaborative spaces. (Photo courtesy of Purdue University Marketing / Alex Kumar)

Faculty bios and experience with standards



Prof. Paul McPherson is an Assistant Professor of Practice, School of Engineering Technology, Purdue University. Paul teaches a design production and specification course focused on the development of detailed mechanical drawings, rapid prototyping, and conformance to specifications, and a quality-in-manufacturing course, focused on the development and utilization of statistical process control, lean manufacturing, Kaizen, and value stream mapping in the mechanical engineering technology program. Paul has been integrating technical standards into undergraduate curricula for seven years as a faculty member at Purdue University and Berea College. He is a member of the Society of Standards Professionals (SES) and presented a session titled “Educating Future Practitioners on the Importance of Technical Standards” at the 2016 SES Conference in Denver, Co. Having worked for Tri C Company as an application engineer, Paul gained industry experience utilizing standards for manufacturing and design purposes. He is a member of ISO TC/10-Technical Product Documentation through the American Society of Mechanical Engineers (ASME) committee Y14, which is the US Technical Advisory Group (TAG) for ISO/TC 10. Paul is a co-Principal Investigator on a NIST funded project focused on integrating standards into undergraduate engineering and technology curricula, titled “Standards are Everywhere: An Information Literacy Approach to Standards Education.”

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Prof. Margaret Phillips is an Assistant Professor of Library Science in the Physical Science, Engineering, and Technology (PSET) Division of the Purdue University Libraries. Margaret has provided instruction in standards and technical information as an academic engineering librarian for eight years. Additionally, she

is responsible for developing and managing the Purdue Libraries technical standards collections. Margaret is the Principal Investigator on a National Institute of Standards and Technology (NIST) funded project focused on integrating standards into undergraduate engineering and technology curricula, titled “Standards are Everywhere: An Information Literacy Approach to Standards Education.”



Prof. Michael Fosmire is a Professor of Library Science and Head, Physical Sciences, Engineering and Technology Division of the Purdue University Libraries. Michael has over fifteen years of experience researching the use of scientific and technical information and educational best practices,

including the development of online tutorials and a badge-based general information literacy program to support first year technology students. Michael is a co-Principal Investigator on a NIST funded project focused on integrating standards into undergraduate engineering and technology curricula, titled “Standards are Everywhere: An Information Literacy Approach to Standards Education.”

References

- [1] ABET, “Criteria for Accrediting Engineering Technology Programs, 2018 – 2019,” 2017. [Online]. Available: <http://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-technology-programs-2018-2019/>. [Accessed: 30-Apr-2018].
- [2] B. Harding and P. McPherson, “What do employers want in terms of employee knowledge of technical standards and the process of standardization?,” in 2010 ASEE Annual Conference & Exposition Proceedings, 2010.
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