

## THE INNOVATION PORTAL – GATEWAY TO ENGINEERING DESIGN EXCELLENCE

By Mike Carr - 2012

“A problem well stated is a problem half solved.”

– Charles F. Kettering (1876-1958), engineer and inventor

This is an exciting time to be involved in STEM education, as 21st Century technology and innovation continue to accelerate. Equipping today’s students with the knowledge they’ll need to succeed is a real challenge, but educators, institutions and industry are working together to make it easier for young people to take advantage of post-secondary opportunities. In the field of engineering education, the development of the Innovation Portal (IP) and the Engineering Design Process Portfolio Scoring Rubric (EDPPSR) provide a pair of powerful new tools for use by students, teachers and post-secondary institutions, as well as outside organizations and industry.

The Innovation Portal is a multi-faceted open use online platform, designed to facilitate communication and collaboration throughout the design process, from inception to completion. As work proceeds, the EDPPSR functions as a valuable benchmark and guide for students, teachers and mentors to gauge progress and measure success. This standardization results in higher quality work and also allows university faculty and industry experts to evaluate student work much more effectively. Although created specifically for engineering applications, the Innovation Portal is relevant and adaptable for design and problem solving projects in any field, further enhancing its value.

“Many teachers around the country at all levels have been working to integrate the design process as a framework for their students to apply what they were learning in their classes,” says Mark Schroll of Project Lead The Way (PLTW), the pre-engineering curriculum for middle and high schools that emphasizes applied learning. “The problem was how to organize and showcase all of that work on a scalable level while at the same time finding a way to connect teachers and students to each other and to opportunities for recognition at the national level. The Innovation Portal -- and the wide collaboration of public and private organizations that it represents -- is proving to be a powerful model for facilitating those connections.”

The creation of the Innovation Portal and the EDPPSR are the latest in a series of efforts to effectively bridge the gap and facilitate the transition of STEM students from high school to post-secondary institutions and career opportunities.

“The impetus for developing the website and rubric came from the desire to use them in conjunction with PLTW’s capstone course, Engineering Design & Development,” Schroll explains. “However, we realized that this synergy had tremendous potential on a much larger scale. That led us to seek input from and develop partnerships with others who recognized the value of making these tools more widely accepted by a much larger audience. As a result, we have a platform and a rubric that can be used more universally.”

Design and problem solving efforts at every level -- whether curricular or extra-curricular -- all require students to use the design process to identify and justify a problem, analyze the merits of current methodologies, and then develop and test a solution of their own. That makes the design process a highly effective way to facilitate learning.

Dr. Rosemary Reshetar, an assessment specialist for the College Board, is a strong proponent of the design process. “It can be taught in segments,” she says. “It can be used effectively at different levels -- elementary, middle school, high school, college and beyond. I think that’s what people need to understand about it.”

The learning opportunities are immeasurable, but in a way, so are the outcomes. In pursuing their project, how do students know they’re on the right track and doing high quality work? In evaluating that work, how can instructors and mentors measure the success of those efforts? And at the university level, how can admission committees and STEM faculty compare an infinitely wide variation of project topics and portfolio formats as part of the admissions process or in awarding scholarships?

Developing an effective and widely accepted design rubric tied to rigorous performance standards was the ultimate solution, but seemed to be an elusive goal. Some measurement standards and methodologies had been developed by various faculty and institutions over a number of years, but those efforts lacked coordination and never reached critical mass, perpetuating the “hit and miss” approach that had existed for a long time.

Fortunately, a number of visionaries and stakeholders in the field of engineering education recognized the problem and made a strong commitment to pursue the development of a new rubric and a comprehensive online platform to facilitate its use. With support and / or funding from the Kern Family Foundation, the University of Maryland, the National Science Foundation and Project Lead The Way, their combined efforts have resulted in a pair of exciting new tools that are profoundly effective when used together.

“One of the missions of the Kern Family Foundation is to promote engineering education at both the high school and post-secondary levels,” says Karen Wilken, program director. “Through our field research into STEM, I became aware of the work being done by Dr. Leigh Abts of the University of Maryland and his team of educators who were working with the College Board and researching the possibility of an AP engineering program.”

Developing an assessment to cover engineering course work proved to be a real challenge, which was no surprise, given the nature of the field. What was surprising, however, was where the idea for a solution came from -- the world of art.

“Because engineering has so many sub-disciplines,” Wilken explains, “any one course could look very different from school to school, depending on the expertise and interest of the teacher, so developing a single assessment seemed implausible. However, when we began to talk about the potential for an engineering portfolio assessment -- something that is more common in arts disciplines and was familiar to the College Board because of its AP arts studio work -- Dr. Abts and his team were excited about the possibilities.”

Indeed, Dr. Abts and his team had recognized the merits of facilitating the design process and problem solving projects as a way to measure interest and aptitude across all levels of engineering. The Design Process is as fundamental to all of engineering education as the Scientific Method is to the foundation of all science education.

To help organize this initiative, the Foundation funded a meeting in March of 2010 at the University of Maryland, where a cadre of experts -- business leaders, university faculty and high school teachers -- formulated common goals and began to develop the assessment, which ultimately became the EDPPSR. Once the initial draft was devised, Dr. Gail Goldberg, an independent assessment specialist and consultant, was contracted to oversee its further development. Subsequently, the rubric development team applied for and received a grant from the National Science Foundation to advance their work.

While this was occurring, Mark Schroll of Project Lead The Way -- himself a former capstone design teacher -- was spearheading creation of the Innovation Portal to address the need of students and teachers to be able to document their work in a way that would make communication, collaboration, mentoring, assessment and access to recognition opportunities available in a single tool.

“From the beginning, the Innovation Portal was conceived as a free and open multi-purpose site that would incorporate a research-based rubric as a key element,” Schroll says. “Both the Innovation Portal and EDDPSR are useful tools, but the real impact results from using them together over the course of a project. Doing so puts students, teachers, mentors, researchers and outside reviewers on the same page when it comes to discussing and evaluating the work being done. The content is owned by the students and the IP platform allows them to control and offer access to mentors, subject matter experts, reviewers or representatives of post-secondary institutions and industry.”

#### **Individual students or teams use the Innovation Portal to:**

- Create an original project using a proven template and connect that work with opportunities for feedback or recognition
- Organize, document and store password-protected material within multiple project portfolios in a single online account
- Build a strong project using the embedded scored examples from other projects as a reference
- Control access to their work by inviting project partners with editing rights to score their work, provide reviews and offer feedback as work progresses
- Submit finished projects for college admissions, scholarships and prize competitions

#### **Teachers use the Innovation Portal to:**

- Manage, grade and provide feedback on student design projects
- Connect students with mentors, subject matter experts and project partners around the world
- Create scoring reviews and feedback for students
- Document individual student and project progress over time

#### **Representatives of post-secondary institutions and industry use the Innovation Portal to:**

- Evaluate student portfolios as part of the college admission, scholarship review or design competition processes
- Compare and assess a wide variety of design work in a uniform and consistent manner

Developing the EDPPSR illustrates the challenge of the collaborative process, but proves the value of engaging an array of experts to help formulate a finished version that will effectively serve and satisfy all the stakeholders. As Goldberg explains, it's not a simple task.

“The draft I was given to start with looked very much like something cooked up by many chefs, making it a challenge to distill the important concepts and remove or regroup others,” she says. With feedback and information from the NSF-supported research, Goldberg worked to align all of that input into the current version of the EDPPSR.

“Well-crafted rubrics have value because they make the target clear for each level of performance,” Goldberg explains, “and because they help to define growth by establishing the relationship between and among those levels. They are applicable whenever an assessment doesn't call for a single right answer or solution.”

A portfolio is an assessment instrument particularly well suited to capturing the engineering design process, Goldberg notes. “Portfolios allow their creators to build a ‘biography’ of their learning as they add, remove or change the artifacts that help tell the story. Used well, they document process as well as related products and capture ongoing thinking and learning -- not just serving as a narrative to recount what was done and why, after the fact.”

The integrated online format is proving to be of great value to students and teachers alike, Abts says. “The electronic portfolio and the rubric are the framework for students to document and submit their work in an organized fashion for others to review. But more importantly, it’s not just a snapshot of the students’ work, it’s a longitudinal record of how they’ve applied the design process to develop and tune their 21st century skills in the areas of problem solving, creativity, innovation, modeling and team collaboration. Those are all the attributes that educators and employers are looking for.”

Abts uses the EDPPSR himself at the university level. “I’ve found it to be a very important and useful tool in my ‘Designing a Sustainable World’ course,” he says. “It gives me a structured way to teach design, which keeps the students motivated and engaged. It provides students with a process to learn design, which is especially valuable for those who’ve never been exposed to that methodology.”

Student Michael McKay and his team used the Innovation Portal and the EDPPSR in their capstone class at Colonie High School in Albany, New York. “We pursued a new method for the recycling of CRT monitors and we relied heavily on the Portal as a valuable tool to portray our ideas,” he says.

The ability to look at the rubric for each aspect was extremely valuable, McKay adds. “Using the rubric for reference allowed us to gauge the quality of work that we needed to present. The examples accompanying the elements also served as a valuable resource. I believe that the Innovation Portal did guide us in developing our ultimate solution and enhanced the overall quality of our presentation.”

McKay’s teacher, Barry Witte -- a former U.S. Navy nuclear engineer who has taught engineering at the high school for 17 years -- is a strong proponent of the Innovation Portal. “These tools have multifaceted value to me and my students,” he declares. “First of all, it is not enough that I say something is required -- the IP and EDPPSR carry stronger authority than I do and those expectations are communicated fully from the beginning. Secondly, the IP contains previous graded examples that the students and my partnership team can use to gauge against the current class’ work. Thirdly, the IP provides a repository for students’ work that is less likely to result in its loss. Lastly, the IP is available 24 / 7 from any internet-connected computer, so accessing the portfolios and communicating is easy for everyone involved.”

Universities, companies and organizations interested in utilizing the Innovation Portal and its embedded scoring process can request an “Opportunity Account” for the purposes of admission consideration, scholarship opportunities, internship applications, competitions or any other form of student recognition. This allows them to post their opportunity for all students to see and consider, receive qualified entries and manage the evaluation of portfolios by multiple reviewers, all through the Innovation Portal.

Witte cites a telling example of how valuable that kind of access can be. “I have a former student who, as a freshman in college, went to a job fair. College job fairs are normally for seniors, but he just went to see what it was about. He started talking with one company and right there on the spot -- with permission, of course -- he jumped onto the company rep’s laptop and showed him the work he had preserved on the Portal from his senior year in high school. This company official was so impressed that he offered my former student an internship for the coming summer. You can’t script stuff like that, but you can offer it as an example of the power of the Innovation Portal.”

As of the writing of this article over 18,000 teachers, students, faculty, organizations and mentors have created Innovation Portal accounts to document, process, and evaluate thousands of project portfolios. You can learn more about the Innovation Portal online at <https://innovationportal.org/>

## SIDEBAR

### ELEMENTS OF THE RUBRIC

The Engineering Design Process Portfolio Scoring Rubric (EDPPSR) is comprised of the following elements and is suitable for use with many types of design projects:

- Presentation and justification of the problem
- Documentation and analysis of prior solution attempts
- Presentation and justification of solution design requirements
- Design concept generation, analysis and selection
- Application of STEM principles and practices
- Consideration of design viability
- Construction of a testable prototype
- Prototype testing and data collection plan
- Testing, data collection and analysis
- Documentation of external evaluation
- Reflection on the design project
- Presentation of designer's recommendation