

AC 2008-630: CONSOLIDATING TWO NSF ONLINE MATERIALS AND INFORMATION RESOURCE CENTERS FOR MANUFACTURING AND ENGINEERING TECHNOLOGY EDUCATION

Gilah Pomeranz, Sinclair Community College

Robert Mott, University of Dayton

Steve Wendel, Sinclair Community College

Shep Anderson, Sinclair Community College

Sean Falkowski, University of Dayton

Robert Wolff, University of Dayton

Jack Waintraub, Middlesex County College

Consolidating Two NSF Online Materials and Information Resource Centers for Manufacturing and Engineering Technology Education

Abstract

This presentation describes the plan for the future of the Manufacturing and Engineering Resource Center (MERC), which integrates two existing National Science Foundation electronic clearinghouses for manufacturing and engineering technology educators.

Introduction

Since 2005, engineering technology and manufacturing technology educators have been served by two online searchable databases for high quality materials to facilitate and improve classroom and lab activities. Funded primarily by the National Science Foundation (NSF), the Manufacturing Education Resource Center (MERC, based at Sinclair Community College in Dayton, Ohio) and the National Engineering Technology Education Clearinghouse (NETEC, based at Middlesex County College in Edison, New Jersey) operated cooperatively but independently until January of 2008, at which time the responsibility for both clearinghouses was assigned to the Sinclair Community College team.

In addition to integrating the two websites into a comprehensive resource for all of engineering technology education, the newly formed Manufacturing and Engineering Resource Center (MERC) will also focus on attracting students at the pre-college level into the STEM (Science, Technology, Engineering, and Mathematics) pipeline, and also will research trends and best practices in engineering technology and manufacturing education programs. The goal is to increase the national impact of engineering and manufacturing technology education reform through the dissemination of model instructional resources via the web-based clearinghouse, as well as by offering faculty professional development and related outreach services.

The merger of the two resource centers was supported by their joint National Visiting Committee (NVC), which met in August 2007. The NVC representatives present at the meeting included:

- Abi Aghayere, Rochester Institute of Technology
- Walter Buchanan, Texas A & M University
- William Clark, Bell South Corporation
- Beverly Davis, Purdue University
- Winston Erevelles, Robert Morris University
- Mark Stratton, Society of Manufacturing Engineers

The Need for MERC and Benefits for MERC Users

The need for MERC is evident and perhaps even urgent. Manufacturing accounts for two-thirds of all US research and development expenditures and 90% of all US patents (Molnar, 2005)¹. Manufacturers require significant numbers of highly skilled and broadly adept engineering technicians who are educated in numerous disciplines such as computer science, electronics, environmental, industrial, information technology, materials, mechanical, and welding.

In fact, there are numerous significant challenges to the United States' once global preeminence in STEM fields—the major obstacle being the dwindling skilled workforce, particularly for the manufacturing sector. “The shortage of skilled manufacturing workers is a severe challenge to the manufacturing industry” (Hamm, 2006)². Hamm identifies three causes:

- *Demographic challenges*: fewer available workers, skill deficiencies, and difficulty recruiting new and replacement workers.
- *Perception challenges*: manufacturing is subject to “outdated stereotypes of dark, dirty, dangerous, dead-end assembly-line jobs.”
- *The worker preparation pipeline is inadequate*: educational institutions do not have the capacity to offer advanced manufacturing and higher technology courses and educate adequate number of new workers.

The US Department of Labor Employment and Training Administration in its report *Advanced Manufacturing Industry* (2004)³, corroborates the critical need for skilled manufacturing technicians stating, “It is clear that there is a demand for new workers, recruited from new sources, trained in new skill sets, while incumbent workers need training to upgrade their skills.” Furthermore, the US Department of Commerce states in *Manufacturing in America* (2004)⁴, “Manufacturing is an engineering-based industry, and whether we’re training technicians at a very high scale or high performance production workers . . . we’re not doing it fast enough or good enough.” The reports from both federal agencies stress the need for expanding science, technology, engineering, and mathematics (STEM) programs at both the secondary and post-secondary levels. Both reports recommend high school and community college partnerships to expand the educational pipeline of skilled STEM technicians.

In 2005, under the auspices of the US Department of Labor and Jobs for the Future, a forum on the “Fate of the American Dream: Strengthening the Education and Skills Pipeline” produced *Education and Skills for the 21st Century: an Agenda for Action*. One of the items on the agenda is a call to “create and engage in academic environments, new school models, and support structures (Jobs for the Future, 2005)⁵.”

Expansion of pre-college and undergraduate STEM programs is a national priority as reported in *Rising above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (National Academy of Sciences, 2007)⁶. This report recommends extensive professional development for incumbent pre-college science and mathematics teachers and rigorous instructional programming for students to expand the pipeline of qualified STEM technicians. As a resource for engineering technology educators, MERC can provide both classroom materials through its online clearinghouse, as well as professional development opportunities through the resource center.

Another goal of MERC is to provide technical assistance to colleges and universities wanting to start, expand or improve technology programs, especially in manufacturing. MERC is also actively working to increase the pipeline of students choosing careers in STEM fields, with an emphasis on engineering technologies, and in particular stressing the critical workforce shortage that is facing advanced manufacturing.

Perhaps less directly impacting the STEM pipeline, but very important in identifying the most effective strategies for supporting faculty and encouraging students, MERC will conduct research into trends in engineering and manufacturing education. While the resource center will not provide direct services to students, faculty accessing products and services will reach an estimated 65,000 students annually. MERC can increase the national impact of engineering and manufacturing technology reform through the dissemination of model programs, materials, and instructional curricula via the online clearinghouse and related professional development and outreach services.

Key to the success of the new combined resource center will be the continuation and growth of the already established partnerships with organizations such as the ASEE Manufacturing Division, the Society for Manufacturing Engineers (SME) Manufacturing and Education Research Community, the SME Education Foundation (SME-EF), and the Lean Education Academic Network. The expanded scope of the center will also necessitate creating and nurturing additional partnerships. MERC will be seeking opportunities to collaborate with other major professional societies, including:

- American Society of Mechanical Engineers (ASME)
- Institute for Electrical and Electronic Engineers (IEEE)
- American Society of Civil Engineers (ASCE)
- Society of Automotive Engineers (SAE) [aka SAE International]
- Institute of Industrial Engineers (IIE)
- American Society for Quality (ASQ)
- American Society of Chemical Engineers (ASChE)
- Others of similar size and scope

Also in support of expanding and improving the pipeline of new students into STEM fields—more specifically, engineering technology careers—MERC is partnering with an established initiative in Ohio called EdVention, whose mission is to rapidly develop new schools focused on STEM education and to assist other schools to enhance their programs in STEM disciplines. MERC also seeks to build on the many other existing national and regional initiatives in STEM education and workforce development, including:

- Project Lead the Way
- Manufacturing Institute of the National Association of Manufacturers' *Dream It! Do It!* advertising campaign
- SME's *Manufacturing is Cool* website (hosted by MERC)
- ASEE's Engineering K-12 Center
- FIRST Robotics
- LEGO League
- BotsIQ (formerly BattleBOTS)
- SAE's *A World In Motion*
- Society of Women Engineers (SWE)
- National Association of Black Engineers (NSBE)
- JETS program (Junior Engineering Technology Society)
- Engineering Education Service Center (Celeste Baine, Director)

- National Institute for Women in Trades Technology & Science (National IWITTS; Donna Milgram, Executive Director),
- Time Engineers
- Next Greatest Generation web portal

Keeping informed and up-to-date on national efforts in STEM education is also important. One approach is to monitor The STEM Education Coalition that works to support STEM programs for teachers and students at the US Department of Education, the National Science Foundation (NSF), and other agencies that offer STEM-related programs. In addition, MERC will continue to be part of a national coalition of NSF's Advanced Technological Education Resource Centers (ATERC). Among the other ATE Centers participating in ATERC are:

- Maricopa Advanced Technology Education Center (MATEC), Maricopa County Community College District (AZ)
- South Carolina Advanced Technological Education Center of Excellence (SCATE), Florence-Darlington Technical College (SC)
- National resource Center for Materials Technology (MatEd), Edmonds Community College (WA)
- Northwest Center for Sustainable Resources (NCSR), Chemeketa Community College (OR)
- Bio-Link, the ATE Resource Center in Biotechnology, City College of San Francisco (CA)
- National Center for telecommunications Technologies (NCTT), Springfield Technical Community College (MA)
- Advanced Technology Environmental Education Center (ATEEC), Eastern Iowa Community College District (IA)

Also involved in ATERC are the National Science Digital Library (NSDL) and Internet Scout.

MERC continues to seek input, feedback, and collaboration from other colleges and universities where increasing the STEM pipeline is a focus of their efforts. For example, Purdue University has established a novel program called *Innovations in P-12 Stem Education* involving the Colleges of Engineering Technology, Engineering, and Education. As another example, the University of Wisconsin-Stout initiated the Science, Technology, and Engineering Preview Summer (STEPS) camp for recruiting young women into STEM disciplines, and the program is now being expanded nationally through collaboration with and funding from the Society of Manufacturing Engineers Education Foundation.

Many states in addition to Ohio are placing a high level of emphasis on STEM education and on working to attract more of their "best and brightest" students into high technology career fields and high performance manufacturing. One example is Indiana's Partnerships for Advanced Manufacturing in Education. Input on other such programs is being sought.

Partners, members, and casual users alike can reap tangible benefits from MERC's comprehensive engineering technology online clearinghouse. In addition to providing ready resources for classroom instruction, MERC offers other useful services for implementing and improving programs in a variety of engineering technology fields. These services include:

- Using MERC to disseminate individually created materials
 - Example: An NSF project in California is using MERC to distribute the videos on semiconductor manufacturing they created as deliverables for their grant
- Disseminating technology-related program outlines and specific course objectives
 - Example: A large Washington state community college provides access to its Materials Science Technology program, including course listings, sequencing, and anticipated outcomes
- Hosting grant projects that have concluded
 - Example: The Society for Manufacturing Engineers (SME) is utilizing MERC to ensure that projects they fund have a way to continue to be available after the grants have ended
- Evaluating manufacturing-related programs for relevance, viability, and effectiveness
 - Example: A mid-size technical college in Illinois brought a MERC consultant in to provide guidance in streamlining their manufacturing offerings to better align with their local industry needs
- Customizing curriculum materials
 - Example: A large community college in Florida used the MERC instructional design team to edit and review their faculty's own materials and to adapt NMCE curriculum modules to reflect the manufacturing processes that are prevalent in their area
- Providing faculty development workshops
 - Example: Faculty and instructional designers from MERC's leadership team provided training in activity-based learning to community college and university faculty attending a program in collaborative design and rapid prototyping
- Assisting in grant proposal development
 - Example: The MERC leadership team provided input and direction for a joint effort between a Louisiana university and a Texas community college seeking NSF funding in process engineering technology, and site visits were exchanged as part of the consulting activity
- Providing information and advice on behalf of NSF
 - Example: The Advanced Technological Education (ATE) program officers at NSF frequently send prospective projects to "pick our brains" and absorb our expertise during informal visits to MERC in Dayton, OH
- Facilitating web seminars in emerging technologies
 - Example: Hundreds of educators have participated in various webinars with experts in such fields as RFID, teaching lean manufacturing, and micro vs. nanotechnology

Conclusion

Clearly, the growth of MERC contributes to the solution of the workforce pipeline crisis. By engaging more partners at both the institutional and individual levels, our goal is to make MERC a nationally recognized and acclaimed resource for educators and others dedicated to ensuring the future of STEM professions in the United States.

Bibliography

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