
This e-book contains descriptive narratives, videos, handouts and related resources from a subset of workshops and presentations that represent the best practices in technician education as reported by participants attending the 2016 High Impact Technology Exchange Conference (HI-TEC) held July 25-28, 2016.

HI-TEC provides secondary and postsecondary educators, counselors, industry professionals, trade organizations, and technicians across the country with the opportunity to update their knowledge and skills related to advanced technological education in the following disciplines:

- Manufacturing Technologies
- Agricultural, Energy, and Environmental Technologies
- Biotechnology and Chemical Processes
- Electronics
- Engineering Technologies
- Information Communications, Geospatial, and Security Technologies
- Learning, Evaluation, and Research
- Micro- and Nanotechnologies

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Acknowledgements

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We hope this E-Book will be shared widely with educators, industry partners, and other stakeholders from the community.

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How to Use this Multi-Touch E-book

How to Use this Multi-touch Book

Tap and swipe finger left to go forward.
Tap and swipe finger right to go back.
Tap this icon to start a touch interactive.
Tap this icon to start playing a video.

Hand icons made by Yannick in www.flaticon.com
Play icon made by Google in www.flaticon.com
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<td>P9</td>
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Chapter 1

Preconference Workshops
Experience Hands-On Virtual Laboratories in IT/Security and Learn About Free Curriculum and Labs

Ann Beheler – Collin College/National CTC
Ernie Friend – Florida State College at Jacksonville
Doug Moore – Florida State College at Jacksonville
Bill Saichek – Orange Coast College

Traditional on-site IT computer labs have serious limitations. The hardware can be prohibitively expensive and require a large amount of space, configuration and set-up can take time for faculty and staff, and student practice time is limited to the facility’s hours of operation.

Virtual computer labs, however, offer an attractive alternative. Costs are reduced since schools no longer need to set aside dedicated IT classrooms, nor do they need to image every single PC workstation; instead, one set of servers can supply multiple classrooms. Virtual labs are also simpler and easier to configure, which provides more opportunities to integrate labs into the classroom and to offer more complex lab problems. Virtual labs can also be accessed at anytime, 24 hours a day, seven days a week, which provides more practice time for students to fully understand lab problems and solutions. Finally, there is also a security benefit: the virtual lab environment serves as a “sandbox” that protects the school network from student errors.
A number of virtual, open-source labs and courses are available across a number of essential IT topics, including security, networking, Linux, and storage management, by searching for “NISGTC” at www.skillscommons.org. The National Information Security, Geospatial Technologies Consortium, or NISGTC, was a consortium of community colleges funded by a recent $20 million Department of Labor grant tasked with offering services to students seeking training and job placement assistance in four IT areas, including Networking and Data Communications. It is the curriculum developed through the NISGTC that can be obtained through SkillsCommons.

To access select free virtual labs, schools can join the Convergence College Network (CCN), a community of practice managed by the National Convergence Technology Center (CTC) (http://connectedtech.org/). The National CTC is an Advanced Technological Education center funded by a grant from the National Science Foundation. The National CTC engages IT educators, students and businesses to meet workforce needs through the promotion and implementation of up-to-date technology.

Florida State College at Jacksonville’s Ernie Friend and Doug Moore share a Windows Server 2012 virtual lab, developed using funds provided by the iNoVATE-X grant.

Orange Coast College’s Bill Saichek discusses his internet of things practice virtual labs.
convergence technology degree and certificate programs in community colleges and universities across the nation.

One way the National CTC pursues these goals is through the CCN, which connects IT educators from community colleges and universities across the country with a wealth of resources, including virtual labs, to enhance their programs. The CCN also facilitates faculty networking and group problem-solving to address common classroom challenges. CCN membership is free and applications are available at www.connectedtech.org/educators/convergence_college_network.html. To get access to these virtual labs, CCN member schools must have a DreamSpark license.

**Virtual labs that are now being implemented in the classroom include:**

- A Windows Server 2012 configuration, developed at Florida State College at Jacksonville using funds provided by the iNoVATE-X grant for installing domain controllers. iNoVATE-X, supported by an NSF grant, develops online curriculum for courses that align with Microsoft Certified Solutions Expert (MCSE) certification.

- Two “Internet of Things” practice, developed at Orange Coast College, a member school of the National CTC’s Convergence College Network, for (1) distributing shared media using virtual networking; and (2) setting up an IP-based surveillance system using virtual networking.

To learn more about setting up the virtual lab infrastructure, schools can contact the Network Development Group (NDG) at https://www.netdevgroup.com/products/
Interactive 1.2 WS1 Handout 1

Interactive 1.3 WS1 Handout 2

Interactive 1.4 WS1 Handout 3

Tap to enlarge then swipe-scroll.

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Tap to enlarge then swipe-scroll.

Additional Resources:

• National Convergence Technology Center:
  http://connectedtech.org/

• NETLAB+ Overview page, Network Development Group (NDG):
  https://www.netdevgroup.com/products/

• SkillsCommons:
  https://www.skillscommons.org/

To find open-source IT curriculum, search for “NISGTC” and then “Online Course”

• NTER (National Training and Education Resource):
  https://nter.collin.edu/

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National Convergence Technology Center,
NSF ATE award DUE #1205077

iNoVATE Expansion Project,
NSF ATE award DUE #1501359
Engaging STEM-shy Students through Artistic Context and Interactive Notebook*

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Dr. Kari C. Coffindaffer, Pierpont Community & Technical College

Faculty at Pierpont Community & Technical College in Fairmont, West Virginia embrace STREAM (Science, Technology, Reading & Writing, Engineering, Arts, and Mathematics) in their general education science course Physics of Light and Color. Linking the physics concepts to artistic content appeals to STEM-shy students, and applying scientific and mathematical concepts to general education concepts lets students see the bigger picture.

The Interactive Student Notebook Defined

In the Physics in Light and Color course, students use an interactive student notebook (ISN) to develop visual displays of summaries, applications, and practice that allow them to deepen their understanding of the concepts learned. The ISN, which generally includes a composition or sketchbook, colored pencils, glue, scissors, pencils and pens, allows students to create a personal textbook that helps them organize and synthesize their thoughts and notes. Research has shown repeatedly that different students learn differently using visual, aural, verbal, physical, logical, social, and solitary styles of learning. The ISN engages multiple learning styles and allows students to create their notes in a way that serves their dominant learning style best. The notebook’s organizational format, strictly adhered to, becomes a portfolio of their learning. When students study from their ISNs, they have all the information they need to review for classroom discussions, homework, and tests. Allowing students...
to use their ISNs when taking portions of their tests encourages them to keep their notebooks up-to-date and complete.

The most significant benefit of the ISN is that students take ownership of their own learning through an active process. The interactive notebook benefits instructors as well, since it becomes a comprehensive record of what was taught that day, that week and that semester, helping to standardize course content between multiple sections of a course.

The Interactive Notebook Structure
On the first day of class, students set up their ISNs by numbering the pages throughout the book, with even numbers on the left and odd numbers on the right. Six or eight pages are reserved for introductory material, such as the syllabus, exam dates and grades, and the Table of Contents (TOC). A two-column TOC corresponds to the way the pages are organized in the notebook. Students glue an envelope inside the cover to store the printed syllabus.

Students insert information from the instructor on the right side of the ISN. These entries are considered input and include lectures, board notes, handouts, and notes from online sources. A student’s interaction with the content in the form of practice, summaries, and visual depictions is considered output and placed on the left side of the notebook.

For example, as new vocabulary is introduced it would be listed on the right side of the interactive notebook, and on the left side students are asked to display that vocabulary visually. Students are given some ideas for how to display new concepts on the first day of class, and then allowed creative license throughout the remainder of the course.

An Interactive Notebook Example

<table>
<thead>
<tr>
<th>LEFT (Output)</th>
<th>RIGHT (Input)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is where you process and practice new skills.</td>
<td>This side will have new ideas and skills. You look on the right side pages when you need help remembering how to do something or to study.</td>
</tr>
</tbody>
</table>
In the Physics of Light and Color course, the concepts of reflection, absorption, transmission, and refraction are defined and then interpreted by students into visual displays. For example, students are asked if reflection and/or refraction has been used in a painting, and whether or not a photograph has been digitally modified, and they can identify reflection and/or refraction in printed copies of visual art that they can glue into their notebooks.

From experience we know that students in community and technical colleges greatly benefit from hands-on activities. Therefore, labs and in-class activities play a big role in our teaching of STREAM content. Lab activities for our Physics of Light and Color course include reflections in plane mirrors, multiple reflections in two hinged mirrors, refraction in lenses to verify the thin-lens equation, and color mixing. Students create lab reports using their interactive notebooks. They sketch the setup, record collected (raw) data, and make observations on the right side of their ISN, and on the left side perform the calculations, answer questions, and work on conclusions that they support with original visual displays. Their displays could include data tables, diagrams, sketches or foldable models, as well as novel applications of the course concepts.

**Interactive Notebooks in Other Courses**
Interactive notebooks can provide a platform for students in different disciplines to take ownership of the learning process and actively interact with a variety of content leading to a deeper learning experience. Although the examples presented here are for a physics course, the approach can be easily adapted to different content and for middle- and high-school levels. In particular, in classes with no traditional textbooks the ISN works very well to keep the students organized and productive.

* This work is supported by the NASA West Virginia Space Grant Consortium (NASA WV EPSCoR)
Interactive 1.7 WS2 Handout 2

Tap to enlarge then swipe/scroll.

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A Hands-On Introduction to Microcontrollers Featuring the Arduino Platform

Mandy Orzechowski, Tri-County Technical College
Chuck Paulsen, Regional Center for Next Generation Manufacturing
Dorian McIntire, Tri-County Technical College

Introduction
College students are typically taught programming using traditional techniques that have changed little with advances in technology. Unfortunately, students quickly become disengaged when programming consists merely of making things happen on a computer monitor. For students in K-12, where there is currently considerable interest in covering programming, this outdated approach presents an even greater obstacle to learning.

As an alternative, the Arduino is a sophisticated, inexpensive controller that allows the programmer to make things happen in the real world. These could include blinking LEDs, operating motors, and reading data from sensors, as well as many other possibilities.

Interactive 1.8 Workshop 3W

Tap then use lower left arrow to progress through presentation.

Although controllers have been available for many years, the Arduino platform has a considerable advantage over earlier controllers. Its features include:
• Open-source hardware
• Inexpensive components, as low as $5 per board (Uno)
• Downloadable open-source IDE software
• Extensive online programming reference
• A huge and growing support community
• A large and growing availability of interface components such as motor controllers, readouts, wireless
• Powerful programmability in C and C++

Projects and an assortment of interface devices.

• A wide array of board sizes

As a result of its versatility, the Arduino can be used to inexpensively teach:
• Simple Programming in C
• Advanced Programming in C++
• Product design
• Electronics and digital electronics
• Control and process control
• Robotics
• STEM and STEAM

The cost of the hardware required need not exceed $20 per student for a basic starter kit with inexpensive sensors and actuators that can be hand-picked by the instructor. With this minimal cost, students learn how to program in, arguably, the most powerful, popular and versatile programming languages that exist today: C and C++.

We use the Arduino in our workshops, courses, and summer camps to guide students through the process of starting with simple programs and simple interface connections. We then gradually guide them through the process of enhancing these simple systems to create more complex systems. This scaffolding
approach to teaching helps remove much of the anxiety normally associated with programming and instills a sense of confidence and gratification that comes with a working, evolving project.

Throughout the design process, alternative solutions are sought that replace expensive hardware solutions with inexpensive hardware/software substitutes. Such design ideas are favored not only for their ability to keep design costs down but for the mental challenge they offer the designer.

For example, in one of our workshops, students create a target game using the following set of steps:

1. A simple program is written to simply blink an LED to familiarize the student with the programming language and programming environment.

2. The blink program is modified to create certain variations of the simple program.

3. A sensor is added to the simple blink circuit and the program is modified to allow activation of the blinking LED by shining a flashlight or laser light source at the sensor.

4. A servo motor is added to this circuit and a program is written to control this servo by making it cycle automatically from one position to another.

5. Finally, a program is written to control the servo positions based on whether a light source is trained on the sensor or not.
Once the last program is written, the student has created a target game that causes a target to fall back when hit by a light source and return to the upright position after a few seconds have passed.

Watch the Target Game Video to see the completed target game in action at https://www.youtube.com/watch?v=AYLWPSkZQog

This target game is one of many ways to fully engage students and allow them to see the possibilities of programming far beyond the computer screen.

Connection diagram for laser target game.

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Chapter 2

Session Presentations
How to Know for SURE What Businesses Want Your Grads to Know

Ann Beheler, Collin College/National Convergence Technology Center

Matt Glover, CTO, Le-Vel

Employers are hiring, but there’s often a disconnect between educators and business. Surveys show that colleges and universities feel confident they are giving students the technical skills they need for the workforce, but businesses don’t always agree.\(^1\) When it comes to job skills, especially in fields like IT where the technical landscape is ever-changing, regular and open communication between educators and business is essential.

The National Convergence Technology Center (NCTC) has developed a successful model for maximizing the relationship between educators and business/industry leaders. While the “BILT” (Business and Industry Leadership Team) concept was designed for IT networking programs, it can work with any discipline.

Many programs use a traditional “business advisory council” approach: business advisers meet once or twice a year, hear a program update, and offer their – sometimes “rubber stamp” – approval. There is frequently no dialogue or business feedback. Further, some business advisory boards may not have the proper experts or, if they do, the experts may be dividing their time among several schools' boards.
The BILT model upends that “business advisory council” approach and energizes the relationship between educators and business leaders. The most important element to this may be the name itself – these are not advisory groups, but rather leadership groups that co-lead the program. The expectation is that the business leaders will take an active role in guiding the program curriculum to make sure educators are preparing graduates to be “workforce ready.” To that end, BILTs meet more often than traditional boards in order to stay engaged, involve only high-level technical executives and hiring managers who know what entry-level workers need to know and, where possible, deliver feedback to regional groups of schools rather than to one school at a time.

For NCTC’s national BILT group, three 90-minute quarterly meetings are conducted by phone call/webinar. These calls focus on current and future IT trends, forecast job needs, and address any questions or topics from the faculty. The fourth quarterly meeting, which can last 4–5 hours, occurs face-to-face. It is at this meeting that the BILT collectively validates job knowledge, skills, and abilities (“KSAs”). This alignment process, started in the U.S. Air Force, is a modification of the DACUM (“Delivering a Curriculum”) format. A meeting facilitator walks the BILT through a list of specific KSA topics and asks for feedback on the question: “How important is it for an entry-level worker to know this topic?” The result is an active dialogue with no consensus required.

At the end of the discussion, the BILT votes on each topic using a scale of 1 (not important) to 4 (very important). The votes are recorded and added to the KSA list. After the meeting, the KSA list serves as a document for faculty members to use to review their course outcomes, asking if the important skills, as validated by the BILT, are being taught. If not, adjustments to the curriculum should be considered. As to be expected in a cutting-edge industry like IT, the CTC’s KSA sheet changes substantially every 12 months.

Clearly, the success of the BILT relies on committed participation from business leaders. The chair of the National BILT, Matt Glover (CTO of Le-Vel), is one such passionate advocate for the BILT process. Aside from Matt’s altruistic interest in “giving back,” he finds value in helping to give graduates the skills they need to be workforce ready. Elevating community college curricula saves businesses money by reducing on-the-job training and engaged BILT members also get an inside track to new talent. Matt hired
one student even before she had finished her degree since he was able to witness her talent early through his relationship with the school.

Because most programs already have a business advisory group, this BILT model is easy to implement. It is just a matter of adjusting meeting formats and perhaps re-evaluating the roster to sharpen the expertise. Several schools in NCTC’s network have seen the benefits of a reinvigorated BILT, whether in closer and more productive relationships with local businesses, stronger technical curricula that better aligns with workforce needs, or a more prepared pool of graduates with the skills that get them hired. For example, Polk State College in Florida completely overhauled its IT program and built an entire degree based on what its local BILT wanted in entry-level graduates. The BILT model has also been adopted by a number of other organizations: three ATE centers (SHINE, SCME, MATEC); Interlink, a non-profit workforce research group in North Texas; Maricopa County Community College’s workforce grants office; and three Maricopa County workforce sections (IT, health care, and advance manufacturing).

Additional Resources:
- National Convergence Technology Center: http://connectedtech.org/
- National Convergence Technology Center’s BILT resource page: http://www.connectedtech.org/about_us/business_and_industry_leadership_team.html

References:

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National Convergence Technology Center, NSF ATE award DUE #1205077
Biotechnology Incubators at Community Colleges: Update and the Search for New Partners

Linnea Fletcher, PI, AC2 Bio-link Regional Center
Tyler Drake, Austin Community College
Jeanne Wages, Bluegrass Community & Technical College

Biotech companies face a number of challenges, including the costs of providing adequate wet lab space and equipment for a workforce that must be highly trained. In addition, they must devote resources to protecting their technology and intellectual property. As a result, depending on location, companies may spend $400-$500 per square foot to build their own wet lab space.1 Start-up companies in particular often do not have sufficient funds to meet these high development costs.

Biotechnology educators also face challenges as they seek to find authentic work experiences for students, and overcome the misconception that community college students lack the necessary experience to work in industry. In addition, turnover in personnel makes it difficult to establish long-lasting relationships between community colleges and their corresponding industries.

To address these diverse needs, Contract Service Organizations (CSOs) support industries, universities and government organizations through outsourced research services. They provide synergistic solutions for biotech companies that need space and equipment, and for biotech students who need adequate training and education, with services that include testing products, developing assays, managing clinical trials, and assisting with commercialization of products.
Community-college based CSOs were originally established in 2004 with InnovaBio at Salt Lake Community College. InnovaBio contracts projects with local companies and oversees student workers who complete the projects. Table 1 lists the location, funding source, and services offered by community college CSO’s, including InnovaBio, around the country.

**Assessing CSO success through case studies**

Austin Community College (ACC) is one community college that has partnered with local biotech companies to provide CSO services. ACC has tracked time-to-market and cost-savings metrics that have resulted from their partnership with these companies. Two companies serving as case studies from ACC’s CSO work are presented in Table 2, below. Through CSO agreements, ACC has saved these companies months in development time and approximately $386,000 in combined costs. The companies in turn provided internships for students and developed curricula for use in ACC’s Biotech classes.

**Table 1**

<table>
<thead>
<tr>
<th>Model</th>
<th>CC CSO</th>
<th>Location</th>
<th>Funding Source</th>
<th>Services Offered</th>
<th>IP Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-house</td>
<td>InnovaBio</td>
<td>Salt Lake CC</td>
<td>Grants, State</td>
<td>Research &amp; testing</td>
<td>NO</td>
</tr>
<tr>
<td>InnovaBioMd</td>
<td>Hagerstown CC</td>
<td>Grants</td>
<td>Research</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Profile Genetics</td>
<td>Merritt College</td>
<td>Grants</td>
<td>Library &amp; array prep, robotic colony picking</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Incubator/Accelerator</td>
<td>BioBench</td>
<td>St. Louis CC</td>
<td>Grants, State, College</td>
<td>Rent-a-Bench, research, interns</td>
<td>NO</td>
</tr>
<tr>
<td>Pasadena Bioscience Collaborative</td>
<td></td>
<td>Pasadena City College</td>
<td>Grants, fees, leases</td>
<td>Full Incubator services, interns</td>
<td>NO</td>
</tr>
<tr>
<td>ACC Bioscience Incubator</td>
<td>Austin Community College</td>
<td>Grants, fees, leases</td>
<td>Leasable wet labs, internships, startup business building services</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

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**Table 2**

<table>
<thead>
<tr>
<th>Company</th>
<th>Services Provided</th>
<th>Cost Savings</th>
<th>Time Savings</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabrico Technology</td>
<td>Wet lab space, equipment, 2 student interns</td>
<td>$230,000</td>
<td>2-3 months</td>
<td>Completed Phase II research, found new applications for technology, supported 2 interns and assisted with job placement</td>
</tr>
<tr>
<td>Environmental Quality Operations</td>
<td>Supplied infrastructure to complete studies</td>
<td>$156,000</td>
<td>2 months</td>
<td>Successful proof of concept leading to technology launch, EQO led class on qPCR</td>
</tr>
</tbody>
</table>

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*Table 1: Summary of CSO models at community colleges.*

*Table 2: Example case studies of completed CSO contracts at ACC.*
Future Plans

To expand on its preliminary work, the ACC Bioscience Incubator (ABI) is under construction. The ABI is an 8,500 square foot wet lab and incubator facility that will provide skills training for students along with leasable lab space and equipment for companies. It is scheduled to open and accept its first class of companies in January 2017. Other future plans include a science building with dedicated CSO space being built by Bluegrass Community & Technical College in Lexington, KY.

In addition, the AC2 Bio-Link Regional Center is conducting a national survey to identify all CSO and CSO-like establishments in the U.S. These results will be summarized and disseminated at the next CSO summit to be held in Austin, TX in April 2017. Add your contact information to our CSO Summit 2.0 mailing list at http://www.bio-link.org/home2/event/cso-summit-20 and receive regular updates about the upcoming summit.

Additional Resources:
- AC2 Bio-Link Regional Center http://www.ac2.bio-link.org/
- Bio-Link http://www.bio-link.org/home2/
- Austin Community College http://www.austincc.edu/
- ACC Bioscience Incubator http://sites.austincc.edu/incubator
- Bluegrass Community & Technical College http://bluegrass.kctcs.edu/

References:


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AC2 Bio-link Regional Center,
NSF ATE award DUE #1501207

Bio-Link Next Generation National ATE Center for Biotechnology and Life Sciences,
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LASER-TEC and U.S. Navy Partnership Reduced the Cost of College Textbooks

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Natalia Chekhovskaya Kearney, LASER-TEC

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As fiber technology has advanced, its application in areas of telecommunications has grown rapidly and exponentially. Innovative and sophisticated tools and equipment such as fusion splicers and optical domain time reflectometers have become routinely available for the technicians’ use. To meet the needs of the qualified technician workforce in this expanding market, Indian River State College, in partnership with the Southeast Regional Center for Lasers and Fiber Optics Education (LASER-TEC), has been offering an introductory fiber optics course for several years with a curriculum that is closely aligned to the latest industry standards and trends.

As our course content has continually responded to the latest training requirements, one big challenge remained unsolved: there has been no comprehensive and affordable textbook available on the market specifically tailored to the course’s audience. The content of most fiber optics textbooks reflects a skillset and knowledge base required for engineers, not technicians. Very often, these textbooks are also poorly produced, with no or little supporting illustrations, and have extremely limited instructional support. Furthermore, they do not contain a hands-on laboratory manual, which is critical to a technician’s education.
Until recently, the solution was to heavily supplement the fiber optics course for technicians with additional resources. As a result, the content continued to be extremely fragmented. Surveys and analysis revealed that many other colleges offering fiber optics courses face the same challenge. In 2014 LASER-TEC surveyed 553 instructors nationwide and found that 95% were unsatisfied with their current textbook for the following reasons: (1) the majority of textbooks were not written for the technician studying for an associate’s degree but rather for a bachelor’s level program or for a lower level “installer” type of audience; (2) no book existed on the market in 2014 that had all of the latest updates in fiber optic technologies, instrumentation, testing, and applications; and (3) the cost of the books that could be used for teaching at the AS degree level were very expensive and needed heavy supplementation.

Our goal was to develop an affordable textbook in the field of fiber optic communications that would serve a very diverse audience at various professional levels, from entry level electronics technicians to experienced fiber optic professionals. We began with the Navy Electricity and Electronics Training Series (NEETS) Module 24, Introduction to Fiber Optics. This publication was originally developed in 1998 by the Naval Education and Training Professional Development Center (NETPDC) and was recently updated by subject matter experts at the Center for Surface Combat Systems (CSCS) of the U.S. Navy (http://www.netc.navy.mil/centers/cscs/). It is a part of a series of twenty-four modules published according to occupational and naval standards and is available in the public domain.

The content of NEETS’s Introduction to Fiber Optics is specifically tailored to fiber optic technicians serving with the U.S. Navy. It covers the use of fiber optic technology in naval applications and, to a certain limited extent, more general commercial applications of the same technology. Although missing distinctive college educational components and directed toward a very specific military audience, this manual is one of the most comprehensive and clearly written educational modules on fiber optics. We shared our goal of revising NEET’s module to conform to the needs of a broader audience with analysts from the Navy’s
Personnel Qualification Standards and the Non-Resident Training Courses at the CSCS, and received the Center’s whole-hearted support as well as the latest 2014 edition of the manual.

Over the last two years, LASER-TEC has enhanced the content of the latest edition of the NEET’s Module 24 and adopted it for college use, creating the Fiber Optics for Technologists textbook. The work has also involved experts from local fiber optics companies who offered their expertise, equipment, and services in making the textbook more relevant to the needs of the industry. The content has been augmented with the most recent trends in commercial fiber optic technology and applications, and learning outcomes have been modified, student assessments adjusted, illustrations and diagrams improved, and multiple practical numerical examples added to the publication. Most importantly, the new textbook contains a laboratory manual developed according to the latest industry hands-on training standards. The instructional supplements also include extensive test banks with answer keys, slides, lecture notes, and an image gallery available for a free download from www.laser-tec.org.

The textbook supports cooperative learning through lab experiments, group discussions, and case studies to enhance hands–on skills and exploration. In addition to the textbook, the course materials were also carefully created to meet the standards of a student-centered education. Inquiry-based and interactive learning through extensive use of multimedia (PowerPoint handouts, instructional videos, and computer based simulations) have been emphasized to ease the flow of information between instructor and student. Finally, non-traditional assessment techniques have been introduced throughout the textbook, such as crossword puzzles, educational games, and problem solving challenges.

The textbook has been fully embraced by the students as a cutting-edge resource for acquiring the knowledge and skills required in the fiber optics field. It has also greatly enhanced the student experience in the course. Each course participant is empowered and engaged to make a difference. The pedagogical practices by the instructor,
the proactive role of the external partners, strong support by other faculty and administration, and strong engagement by the students have all played vital roles in the success of the project. High student enrollment and retention rates in the course are a clear proof of the project’s impact. The textbook was introduced as a mandatory textbook for the course ETS 2220 Fiber Optics and Data Communication in the Fall semester of 2014. Since then, the course has been taught three times with the maximum allowable number of students in the course. No student has ever withdrawn or failed the course.

The Fiber Optics for Technologists textbook and the lab manual supplement have also been reviewed by technical colleges and fiber optics companies and has received extensive positive feedback. For example, Don Hawkins, Vice President of Precision Contracting Services, Inc. a multi-faceted firm providing design, installation, integration, maintenance and asset management services for fiber optic communication infrastructures located in Jupiter, Florida, said that the textbook "is a very valuable and up-to-date book for teaching the fundamentals of fiber optics to entry level technicians." According to Gordon Snyder, an adjunct instructor of fiber optics at Pace University in Westchester, New York, “this is the most complete book written at the technician/technologist level. It covers all the skills industry expects new hires to have." Marshall Jones, Research Scientist at GE Global Research, Niskayuna, New York, found the textbook “useful not only for technicians, but also for engineers who want to learn more about the practical aspects of fiber optic technology.”

Both the textbook and the corresponding course were developed as a balanced mix of theoretical lectures suited to the various professional levels and practical training on equipment that are most commonly used in the industry. As such, the book is intended to be used not only in the course offered at Indian River State College but can be adopted as a reference textbook for the training of fiber optics technicians at two-year colleges across the country.

The strategic goal of LASER-TEC is to establish a sustainable pipeline of highly-skilled fiber optic technicians in the Southeast United States through up-to-date and industry-relevant education and training. This textbook project was aligned with that strategic effort and fully contributed to that initiative, and its success has been determined through a collaborative effort of all the stakeholders – the instructor, the students, the external partners, and the college community at large.

The textbook can be ordered on www.laser-tec.org or by calling 772.462.7179.
Additional Resources:

• Indian River State College: http://www.irsc.edu

• LASER-TEC: http://www.laser-tec.org

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Southeast Regional Center for Laser and Fiber Optics Education (LASER-TEC), NSF ATE award DUE #1304628
For twenty-four years the NSF ATE program has provided funding to support the “education of highly qualified science and engineering technicians for the advanced-technology fields that drive the nation’s economy.” The program encourages partnerships between academic institutions and industry to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels. The program also supports curriculum development, professional development, and career pathways.

NSF expects two-year technical and community college faculty to have leadership roles in ATE projects and centers; however, the process of submitting a competitive NSF ATE proposal is challenging and not one that many of these educators have experienced. Although 1,600 grants have been awarded since the ATE Program began, the majority of two-year colleges in the United States have never received an ATE grant. A small group of two-year colleges and other institutions have received multiple grants.

The Mentor-Connect regenerative mentoring system for leadership development not only helps two-year college...
educators prepare competitive NSF ATE proposals, it also encourages their involvement in the NSF ATE program and the use of NSF ATE resources to become STEM education leaders.

Intersection between ATE and Mentor-Connect

Community colleges, while eager to pursue funding, often have little experience and support when seeking highly competitive grants. This is where Mentor-Connect makes its biggest impact on the ATE program. All Mentor-Connect activities and opportunities are focused on teaching grant-writing skills specific to the NSF ATE Program, building strong leaders in technician education, and strengthening the STEM workforce to fill needs throughout the country. As such, Mentor-Connect support is closely aligned with the ATE Program solicitation.

There are several ATE Program funding tracks designed for community college proposals, but there is one particularly inviting pathway: Small Grants for Institutions New to the ATE Program ($200K, 3-yrs). The NSF ATE overall funding rate has been between 22-34% over the last few years, and prior to 2012 lingered at 20%. In contrast, the Small Grants for Institutions New to the ATE Program track usually funds 65-70% of submissions. Mentor-Connect provides no-cost assistance to colleges to help their faculty and staff learn to write and submit proposals that have a higher potential for funding, so there is no better approach to be funded than to submit to the Small Grants category with Mentor-Connect support.

A Unique Team Mentoring Opportunity

Mentor-Connect began in 2012 at a time when two-thirds of the nation’s 1,200 two-year colleges had not received NSF ATE funding, despite the clear need for grant funding to help in adding, strengthening, or expanding technician education programs. With Mentor-Connect assistance, and that of an experienced mentor, participants are able to navigate the challenges of successful grant proposal preparation, submission, and funding processes to increase their odds of success. This faculty-driven mentorship seeks applicants who have innovative program ideas and a passion for their work.

Each year Mentor-Connect selects 20 college teams—made up of two STEM faculty members and up to two administrators—to receive the following assistance:

- Ten months of mentoring by an experienced ATE principal investigator.
- Effective, just-in-time technical grant writing help and professional development.
- Travel support for faculty team members.
- Two in-person workshops and one professional development conference for faculty team members.
Grant writers and other supportive administrators from each of the selected colleges may participate in the mentoring sessions and may attend the winter workshop on a self-pay basis. Formal mentoring continues for approximately ten months, but may continue informally thereafter. At the end of the ten-month period, the expectation of the Mentor-Connect project is that each mentored college will submit a grant proposal to NSF’s Small Grants for Institutions New to the ATE Program.

**Mentor-Connect Services for All NSF ATE Applicants**
The following Mentor-Connect services are available to all potential NSF ATE grantees:

- Live technical assistance webinars and self-guided tutorials created from these webinars that are archived on the Mentor-Connect website and YouTube Channel to assist participants with navigation through budget, evaluation, and multiple forms for their grant proposal, and financial management of funded proposals;

- An on-line, searchable database of more than 200 NSF- and ATE-specific grant writing and funding information, as well as report templates, sample proposals, grant submission checklists, NSF guides, and other helpful resources at [http://www.mentor-connect.org/](http://www.mentor-connect.org/);

- Just-in-time “Help Desk” technical assistance for answers to questions within 24-48 hours, Frequently Asked Questions relevant for NSF ATE proposal preparation, a glossary of National Science Foundation abbreviations and topic-specific connections to grantees in the ATE Program.

**Eligibility for Participation in Cohort**
Two-year technical or community colleges that have not received NSF ATE grant funding in the past 10 years and their STEM faculty members who prepare technicians for advanced technology fields are all eligible to participate in the Mentor-Connect cohort for mentoring. Especially encouraged to participate are faculty from rural colleges and faculty from populations underrepresented in STEM.

To participate in a mentorship, eligible institutions and faculty must have a clear understanding of the NSF ATE Program solicitation (call for proposals) and knowledge gained from a free Mentor-Connect Orientation Webinar, which is typically provided in September. An application, typically available July 1 of each year with a due date in early October, must be submitted online via [http://www.mentor-connect.org/get-a-mentor.aspx](http://www.mentor-connect.org/get-a-mentor.aspx) Teams selected via the application process are announced in early November. Grant writers and other supportive administrators from each of the selected colleges may fully participate with faculty teams on a self-pay basis.
**Mentorship = Successful Outcomes since 2012**

- 64% of Mentor-Connect applicants have been selected.
- 25 Mentor-Connect mentors have mentored 162 faculty and 86 administrators from 79 colleges.
- While colleges in all states have had NSF ATE grant funding, Mentor-Connect colleges are in locations across 27 states (through July 2016) that have previously not had NSF ATE grants.
- 18 of 20 college teams in each cohort have submitted proposals (90% success rate).
- 39 of the 54 Mentor-Connect participant colleges that submitted NSF ATE proposals have received funding awards (66.7% overall success rate, 72% success rate for “Small Grants for Institutions New to ATE”).

**Mentor-Connect's Value Proposition**

The primary reason to consider the Mentor-Connect’s mentorship opportunity is because faculty have innovative ideas they would like to implement to improve technician education. If their college has not yet benefited from NSF ATE funding to implement those ideas, they should apply to participate in the Mentor-Connect cohort in order to access all aspects of the mentorship opportunity. Whether a faculty member receives intensive mentoring as a cohort participant or just seeks to understand one aspect of the grant application process through the website, Mentor-Connect resources help individual educators become part of the ATE community's effort to enhance the quality of the nation's technical workforce.

**Additional Resources:**

- NSF Center link: [http://www.scate.org/](http://www.scate.org/)
- School/company affiliation: Florence Darlington Technical College; [https://www.fdtc.edu/](https://www.fdtc.edu/)
- Partner: American Association of Community Colleges; [http://www.aacc.nche.edu](http://www.aacc.nche.edu)

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Mentor-Connect: Leadership Development and Outreach for ATE, NSF ATE awards DUE #1204463 and #1501183
Incorporating the Maker Movement into Technology Program Recruitment

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The Maker Movement has become a way for hobbyists, tinkerers and students to present the technology projects they create to the rest of their community and even on a national level. In October 2015, the Connecticut College of Technology’s (COT) Regional Center for Next Generation Manufacturing held its first Greater Hartford Mini Maker Faire with the help of the Connecticut Business and Industry Association Education and Workforce Partnership. The planners of the Mini Maker Faire focused on showcasing engineering and technology programs offered throughout Connecticut.

The COT was legislatively created in 1995 to form seamless pathways between community colleges and four-year universities in engineering and technology disciplines in order to respond to workforce needs. The leadership of the COT consists of a Site Coordinator Council made up of representatives from
each CT community college and university, the CT Technical High School System, non-profits, and business and industry. The COT offers multiple entrance and exit points in a student’s journey between high school and the workforce via two separate pathways, Engineering Science and Technology Studies, which together offer eighteen certificate and associate’s degree options. These options within the community colleges transfer seamlessly to bachelor’s degrees in the eight COT partner universities.

In 2004, the COT received its first National Science Foundation (NSF) Advanced Technological Education (ATE) award to establish the Regional Center for Next Generation Manufacturing (RCNGM), an NSF Center of Excellence that is in its 12th year of operation with continued NSF funding. Within the framework of the grant’s proposal, the RCNGM has concentrated on the following major goals: 1) articulation/pathways; 2) student recruitment/retention; 3) curriculum development; 4) professional development; and 5) regional collaboration throughout New England.

The RCNGM is continuously implementing new student recruitment and retention initiatives that also strengthen and expand articulation agreements and instructional collaboration among four-year colleges, community colleges, and secondary schools. Student activities include regional career expos that allow high school students to talk to local manufacturers regarding workforce needs, tours of community college campuses, and presentations on advanced manufacturing technologies.

**RCNGM’s Greater Hartford Mini Maker Faire**

When the RCNGM held its first Mini Maker Faire in 2015, the goal was to acquaint the entire Greater Hartford community with what it is to be a Maker, as well as to showcase educational opportunities available at COT institutions. When planning began, several locations were scouted and Tunxis Community College (TXCC) in Farmington, CT was finally chosen. TXCC’s advantages were that it met the Faire’s space requirements, and was also free to use, which helped with the overall budget. An important advantage for the college was that the Faire brought many families from the community to the campus, including many people who had never before been there.

During the Faire, it was of particular importance to present COT academic pathways, programs and extracurricular activities by showcasing students as Makers, and Makers from high school robotics teams, and community college and university projects all participated. Attendees were also able to engage with students from the Mechanical & Manufacturing Technologies for Energy and Sustainability (MET2) NSF ATE Program. MET2 focuses on building the technical and professional skills of CT community college and university students while they are developing real-world technology prototypes for industry. Finally, major companies in the manufacturing industry, including Trumpf, Lego,
Legrand, and Stanley Black and Decker, served as sponsors of the Faire. Having these companies available to talk to families completed the cycle of students moving from an interest in technology at home, to an educational pathway, and ultimately to a career in manufacturing.

Licensing through Maker Media, the global platform that publishes Make: Magazine and produces the Maker Faire, was also important. Licensing gave Faire organizers permission to use the Maker Faire official logo, allowing attendees, exhibitors, and sponsors to see the connection to the official Maker Faire brand. Licensing also provided access to official Maker Faire registration forms, a website template, a post-survey, and participation in national Maker Faire producer events and groups, making the planning of the RCNGM Maker Faire easier.

RCNGM’s Mini Maker Faire was advertised in both the local community and statewide at high school technology events. The Faire brought over 1500 attendees of all ages to visit the 48 different Makers. Conversations occurred both between the attendees and the exhibitors and among the exhibitors as well. Feedback from the post-survey demonstrated that many families wanted to see more Maker activities at their children’s schools and that COT institutions were now on their list of colleges and universities to consider when it is time for their children to apply to college.

**Additional Resources:**
- Regional Center for Next Generation Manufacturing (NSF ATE Center): [www.nextgenmfg.org](http://www.nextgenmfg.org)
- Mechanical and Manufacturing Technologies for Energy and Sustainability (NSF ATE Project): [www.met2program.org](http://www.met2program.org)
- Greater Hartford Mini Maker Faire: [https://greaterhartfordmakerfaire.com/](https://greaterhartfordmakerfaire.com/)
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Regional Center for Next Generation Manufacturing,
NSF ATE award DUE #1419783

Mechanical and Manufacturing Technologies
for Energy and Sustainability,
NSF ATE award DUE #1400610
SCME's Hands-online Academy: A Remote Approach to Hands-on Instruction

Barbara C. Lopez, University of New Mexico
Matthias Pleil, University of New Mexico

The Southwest Center for Microsystems Education (SCME) has developed over 50 Learning Modules to help instructors bring microtechnology to their STEM classrooms. The modules incorporate eleven classroom kits to be used as activities that enhance the module topics. All eleven modules are available to download for free from the SCME website (scme-nm.org) and the kits can be purchased on the site’s online kit store. In addition, the SCME YouTube channel has instructional videos, lectures, and presentations on microtechnology topics.

SCME has conducted numerous face-to-face professional development workshops to train instructors on our modules and kits. We also conduct a five-day pressure sensor workshop allowing instructors to come to our cleanroom at the University of New Mexico and manufacture a micro pressure sensor. With the help of our community partners we have transferred this process to cleanrooms at the University of South Florida, University of Michigan, North Dakota State College of Science, Chippewa Valley Technical College, and Salt Lake Community College, in cooperation with the University of Utah.

Over the past 12 years, SCME has grown a microtechnology community with participants from 33 states and 10 countries. Our active participants are instructors from four-year colleges and universities, two-year community colleges, high schools, and some middle schools.
Most of the face-to-face professional development we have conducted has been training on our eleven kits, meant to bring hands-on microtechnology topics into the classroom.

Over the years of providing this professional development to instructors we noticed that we were seeing many of the same faces in our workshops, and we realized that we had saturated our local training. After conducting a series of webinars in 2013, we saw there was a strong interest in sharing our materials more broadly, and had the idea of offering the hands-on instruction we were providing face-to-face through online/distance learning platforms instead.

SCME’s Hands-online Academy (HOLA) is a venue we have created to both train teachers and develop a broader microtechnology learning community. We launched our first new course, Career Pathways for Microtechnology, in February 1 of this year. The other courses in the HOLA series, which became available once each month through this July, are:

- Crystallography w/Bulk Micromachining
- Microcantilevers
- BioMEMSApplications
- Micro Pressure Sensors
- Science of Thin Films

HOLA allows participants 24/7 access to any of our online courses for asynchronous study, reference, and use in their classrooms. These courses are free of charge and participants are provided with the educational materials needed to teach all of the relevant STEM concepts using microsystems applications. All but one of these courses use our microtechnology kits, and participants are given the opportunity to receive the kits for free.

Each course is broken down into smaller units where participants read a lesson, watch a video or lecture, and participate in class discussions via online forums. Participants are also shown how to use the course-related kit. After going through the course and corresponding kit, instructors can also request an online session with an SCME coach. During the coaching session, participants receive answers to questions one-on-one to help ensure that they are ready to introduce the course or activity to their students.

192 unique individuals are registered in HOLA courses. They make up 650 total course registrations, 120 active enrollments and 530 registrations for participants who have not as yet completed course requirements. Of the 650, 483 represent registrations in two or more courses. The majority of the instructors taking the courses are from the SW and NE regions of the US, with 52% from four-year colleges, 30% from two-year colleges, and 18% from secondary schools.

It is interesting to compare our traditional face-to-face professional development participation with our HOLA
participation. As of July, 2016, we have 120 HOLA active registrants vs. 83 face-to-face participants. Currently, the majority of our face-to-face participation comes from secondary school instructors, mostly because we have saturated our local community college pool of instructors with microsystems training. With the online venue, we can now reach a wider audience of two-year, four-year, and secondary school instructors, vastly expanding our reach.

We have had very positive reactions to our Hands-online courses. 84% of participants report an increase in their knowledge of microsystems technologies, and 100% of participants report that they are at least somewhat likely to use the material taught in our courses in their classrooms. However, although we have had a high level of participation in most of our courses, our completion rate has been relatively low. This appears to be due mostly to the fact that our college-level instructors seem to be less interested in the completion certificate than they are in access to our microtechnology training and materials.

Please visit us at our website, scme-nm.org to register and learn more.

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Southwest Center for Microsystems Education (SCME), NSF ATE award DUE #1205138
Teaching Cybersecurity Across the Disciplines with a Focus on Women and Minorities

Dr. Debasis Bhattacharya, Applied Business and Information Technology Program, University of Hawaii Maui College

Cybersecurity has become a prevalent topic in many colleges, but how the topic should fit into academic programs requires further scrutiny. Capacity Building: Cybersecurity Education Across Disciplines with Focus on Minorities and Women, a project at the University of Hawaii Maui College (UHMC) funded by the NSF Scholarship for Service (SFS) program, spans multiple disciplines while it also targets women and minorities.

The goal of the project is to ensure that a broad audience of faculty, students and practitioners receive training in the fundamentals of cybersecurity.

Cybersecurity Beyond Computing

Many colleges in the United States and around the world have curriculum and educational programs that cover the core technical topics in cybersecurity. These topics are often geared toward students who have some degree of familiarity and interest in computer and networking technologies. Typically, these core topics include a combination of the following courses:

1. Introduction to Information Security
2. Introduction to Networking
3. Introduction to Computer Security
4. Ethical Hacking
5. Digital Forensics

However, as the researchers at the UHMC have discovered, these courses are most often taken by males who are aspiring toward a technical education that covers computer technologies or a related field of study. The courses do not attract women, minorities, or students who aspire to study disciplines outside the core area of computing. The project at UHMC attempts to address this problem by focusing on key disciplines that are outside the realm of core computing but are still relevant to cybersecurity. The disciplines selected for this project include the following:

1. Accounting
2. Administration of Justice
3. Business
4. Allied Health
5. Hospitality and Tourism
6. Electronics

Many community colleges and universities across the United States contain programs that are similar to these six disciplines. Women and minorities enroll in these programs, not because they wish to specialize in cybersecurity, but because they wish to pursue careers in these fields of study. As a result, these programs contain students and faculty who bring a diversity of experiences and backgrounds that are often different from the majority of students attracted to the disciplines of computing and cybersecurity.

Integrating Cybersecurity More Broadly

The project at UHMC attempts to train the faculty in these six disciplines in the core tenets of cybersecurity and empower them to integrate cybersecurity into their curriculum. Key techniques used to create curriculum and lab modules that are relevant and applicable to the above fields include the following steps:

1. Selecting a topic (such as Bitcoins for Accounting) that is engaging and informative to students who are not well versed in cybersecurity.
2. Creating curricula, lab materials and other lesson plans for a cybersecurity module that are relevant to the discipline and can be embedded within an existing course.
3. Training the instructor of the course on the cybersecurity module.
4. Assisting the instructor with including the new cybersecurity module into his or her existing curriculum.
5. Having the instructor teach the cybersecurity module and assess the student learning.
The project at UHMC also incorporates two technologies that enable the dissemination of cybersecurity topics across a broad spectrum of disciplines and students. These include the stealth penetration tool, USB Rubber Ducky, and Bluetooth Low Energy (BLE) beacons, transmitters that broadcast their location to portable devices. These technologies are simple to adopt by students with only a basic knowledge of computing and cybersecurity, but allow for custom adoption within their disciplines.

**Bluetooth Low Energy (BLE) Beacons**

A beacon is a low-cost hardware device that transmits a short burst of data over a small distance using the Bluetooth Low Energy (BLE) protocol. Any smartphone that supports the BLE protocol can pick up this data signal and present the information to the user.

Given that beacons signal users when they come within close proximity, these devices can be used as simple networking tools in various scenarios and locations to teach core concepts in cybersecurity. Locations could include, but are not limited to, hospitals, convention centers, retail stores, and office locations. Students from a variety of disciplines can use tools such as beacons to develop complex business scenarios and deployment strategies within their own disciplines.

Beacons for Radius Networks are simple and rugged in design.

A Beacon is an isolated device that signals a smartphone, which is connected to the Internet.

More information on BLE Beacons can be found from the following sites:


Beacon Vendor Radius Networks: [https://www.radiusnetworks.com/](https://www.radiusnetworks.com/)

Google Beacon: [https://developers.google.com/beacons/](https://developers.google.com/beacons/)
Apple iBeacon: https://developer.apple.com/ibeacon/

USB Rubber Ducky
The USB Rubber Ducky appears on the surface to be a simple USB thumb drive. Upon insertion into a USB drive, the USB Rubber Ducky generates keystrokes that can perform various operations on any computer, such as opening files, detecting internet connections, and checking for malware. The code that performs these operations can be written by a student with minimal training in computers and programming. This simplicity in design makes the USB Rubber Ducky an excellent teaching tool for students who are intimidated or apprehensive about engaging in a technical field like cybersecurity. Because of the ease of programming inherent to this tool, at UHMC the USB Rubber Ducky has been used by middle and high school students to generate complex code that performs constructive tasks on computer systems.

More information on the USB Rubber Ducky can be obtained at these sites:

- Main Company Site, Hak5.org: www.Hak5.org
- Purchase the USB Rubber Ducky, hakshop.myshopify.com/
- You Tube Demo, youtube.com/watch?v=sbKN8FhGnqg
- UHMC Training Web Site, uhmc.github.io/Ducky_Demo/

Conclusion
As cybersecurity issues and concerns become prevalent across a cross-section of society, it is increasingly important for students with a variety of backgrounds to become familiar with the basic tenets in cybersecurity. This project at UHMC enables faculty, students and practitioners from a variety of disciplines to be trained in cybersecurity based on practical tips, broad curriculum, technology examples and effective guidance.
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NSF ATE award DUE #1204904
NSF Scholarship for Service (SFS) award DUE #1437514 and #1516178
Build Your Own Recruitment Video—ATETV Customization Tool Now Available

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Anthony Manupelli, Pellet Productions
Emery DeWitt, Project Manager/Co-PI, SC ATE National Resource Center, Florence-Darlington Technical College

Growth in STEM career fields is expected to continue into the future, and the need for advanced technicians is predicted to follow. But what might attract students to these fields today has changed and traditional approaches are not enough. The new Build Your Own (BYO) Customization Recruitment Video tool is an innovative career awareness and recruitment online resource, designed to help educators stimulate career interest and recruit students into technician education programs. The tool gives each college the ability to create its own recruitment or career awareness story in a visible and memorable way.

Created by Pellet Productions, the producers of ATETV, in partnership the ATE National Resource Center for Expanding Excellence in Technician Education (SC ATE), the BYO Video tool offers high quality videos that capture comprehensive and authentic information about technician education and career opportunities in advanced technology fields for communicating with multiple audiences. The filmmakers went to students' homes, classrooms, workplaces, and ATE industry partners' facilities to create videos in both English and Spanish, all of which are available without concern for copyright infringement or production costs. ATETV's video footage, including uncut interviews with students, employers, and educators, is accessible from a vast keyword-searchable database found at

Interactive 2.13 Session Presentation 5b

Tap to expand, then scroll.
The BYO Video tool is easy to navigate and the content is free to educators through funding from the National Science Foundation’s ATE grant. The digital archive includes music and other effects that add polished touches to the finished videos.

After registering through the Build Your Own Video tab on www.TeachingTechnicians.org, the ATETV archive can be accessed and searched by:

- Topic, such as “dual enrollment” or “internships”
- Technical field, such as biotechnology or wind energy
- Academic discipline, such as math or chemistry
- Geographic location, such as city or college

The BYO Video tool includes instructions on how to create and publish high quality videos, beginning with an instructional video on combining ATETV video snippets using YouTube Video Editor software. A Help Desk offering technical support is also available, and several tutorial videos will be added for extra help in producing highly professional recruitment or career awareness videos.
SC ATE and Pellet Productions launched the BYO video tool on July 22, 2016 at the High Impact Technology Exchange Conference in Pittsburgh, PA, following a successful workshop and beta test June 10, 2016 with 34 educators from 11 states including HI, CA, OR, NV, IL, TX, TN, WV, NC, SC, and GA.

Additional Resources:
- SC ATE Center of Excellence, https://www.scate.org
- Premier catalyst for faculty development and program improvement, http://www.teachingtechnicians.org
- Florence Darlington Technical College school affiliation, https://fdtc.edu

Contact:
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SC ATE
NSF ATE award DUE #1003733

Tap to view video.
Universal Design for Improving Student Learning...Not Just for Deaf Students

Donna Lange, PI, DeafTEC, National Technical Institute for the Deaf, Rochester Institute of Technology

Myra Pelz, Co-PI, DeafTEC, National Technical Institute for the Deaf, Rochester Institute of Technology

“Universal Design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.”

The term was coined by Ron Mace, architect and founder of the Center for Universal Design, around 1988. For most of his life Mace used a wheelchair and understood what it was to like to participate in a world that was not designed to include him. However, the power of Mace’s concept for Universal Design is that although it improves accessibility for people with disabilities, it also provides greater access for all. For example, creating curb cuts designed for wheelchairs benefits people riding bicycles or pushing shopping carts, and replacing door knobs with levers helps people with physical disabilities as well as those that just have their hands full of groceries. In the same way, captioning helps individuals who are deaf, but also those with English as a second language, and anyone watching TV on a treadmill or in a bar.

These concepts of Universal Design have also been used to provide greater access to learning, Universal Design for Instruction (UDI). The goal of Universal Design for Instruction is to maximize the learning of students with a wide range of characteristics by applying universal design principles to all aspects of instruction (delivery methods, physical spaces,
information resources, technology, personal interactions, and assessments.) The principles of UDI, and some possible applications in the classroom, are listed below:

1. **Class Climate**

Demonstrate respect for diversity and inclusiveness. Example: include a statement in your syllabus stating willingness to discuss accommodations.

2. **Interaction**

Encourage regular and effective communications between the instructor and student peers. Example: Set communication expectations/rules at the start of class.

3. **Physical Environments and Products**

Ensure that facilities, activities and materials are accessible and usable by all. Example: Check lines of sight and safety procedures for all students.

4. **Delivery Methods**

Use multiple methods to deliver content. Example: Use a combination of lectures, online exercises/problems, text, cooperative learning, group and individual and hands on activities.

5. **Information Resources and Technology**

Make course materials, assignments and notes accessible to all students. Example: Post course PowerPoints, assignments, notes etc. online so they are available to students and any support personnel.

6. **Feedback**

Provide students with specific, ongoing feedback. Example: Break larger projects into pieces and provide feedback at regular intervals.

7. **Assessment**

Regularly assess student progress with multiple methods and tools. Example: Assess both group and individual work using both written and hands on assignments.

8. **Accommodations**

Plan for accommodations for students with special needs. For example, change to a wheelchair accessible room, and plan for a deaf student to sit near the interpreter or the front of a classroom.

Based on these principles of Universal Design for Instruction, DeafTEC: Technological Education Center for Deaf and Hard of Hearing Students has developed a variety of educational resources for deaf and hard-of-hearing students that will benefit all students in the classroom.
DeafTEC, an NSF National Center of Excellence funded under NSF's Advanced Technological Education program, is the only NSF ATE center focused on a specific audience. DeafTEC’s goal is to successfully integrate more deaf and hard-of-hearing individuals into the workplace in highly skilled technician jobs in which these individuals are currently underrepresented and underutilized. Originally funded in August 2011, we received renewal funding in August 2015.

DeafTEC resides at the National Technical Institute for the Deaf (NTID), a college for deaf and hard-of-hearing students offering associate degrees on the campus of the Rochester Institute of Technology, a 4-year comprehensive university. Established in 1965 through an Act of Congress, NTID enrolls deaf and hard-of-hearing students from all 50 states and 20 countries where they live, work, and study as part of the same college community as 17,000 hearing students on the RIT campus.

To accomplish its broader goal of greater accessibility to STEM employment for deaf and hard-of-hearing individuals, DeafTEC seeks to improve the accessibility of a STEM education to deaf and hard-of-hearing students. To that end, the Center offers a variety of resources available on the DeafTEC website (www.deaftec.org) that include:

1. Examples of college faculty giving a lecture that violates the principles of UDI, and the same lecture with “popups” showing how the lecture could be improved. (www.deaftec.org/perils-lecturing)

2. Challenges and strategies for meeting those challenges in a classroom environment, including videos that provide suggestions by both faculty and students for best practices for accessibility. (www.deaftec.org/classact)

3. The “Top Ten Things” deaf and hard-of-hearing students would like teachers to know, and that will benefit all students in the classroom. (https://www.deaftec.org/classact/student-perspectives/top-ten; see Interactive 2.15 5f Handout 1 below)

Interactive 2.15 5f Handout 1
4. Math video tutorials similar to those offered by the Kahn Academy but made more accessible. ([www.deaftec.org/resources/math](http://www.deaftec.org/resources/math))

**References:**


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DeafTEC: Technological Education Center for Deaf and Hard of Hearing Students, NSF ATE award DUE #1104229 and #1501756
Recruiting and Retaining Diverse Students in Computing: The NCWIT Approach

Beth Quinn, NCWIT & University of Colorado at Boulder
Pam Silvers, Asheville-Buncombe Technical Community College

It’s not surprising that computing jobs are growing at a faster pace than most occupations. For example, the Bureau of Labor Statistics projects that information security analyst jobs will grow 36% between 2012 and 2020. But at the same time we have seen a decline in the participation of women in computing occupations. Women account for 57% of all professional occupations in the US but occupy only 26% of computing occupations.¹ Women earn only 18% of bachelor’s degrees and 20% of the associate’s degrees in computing² and hold only 6% of the Chief Information Officer positions.³ Even more troubling is that of all STEM fields, computing appears to be an anomaly, with women’s participation declining since 1990 while other fields have seen increases over the same period.²

So why should we care? There are a number of important reasons: (1) experimental research suggests that group decision-making is improved when the group is diverse, especially when there are women present⁴; (2) the rapid growth in computing jobs may mean that many of these jobs may go unfilled. Encouraging women to go into computing expands the qualified employee pool⁵; (3) when women are present in senior technology roles, technology companies show a higher return on investment. Both
racial and gender diversity are associated with increased sales revenue and greater profits\textsuperscript{6,7}; and (4) it’s clearly the right thing to do. Jobs in computing tend to garner high salaries and can be very fulfilling. Women should be encouraged and supported to pursue a computing education and to join the computing workforce.

What can your organization do? Start by having your school or organization join the National Center for Women & Information Technology (NCWIT, or “En-cee-wit”). NCWIT formed as a non-profit in 2004 with a mission to significantly increase girls’ and women’s meaningful participation in computing. NCWIT’s members form “Academic Alliances” and equips these “change leaders” with research-based techniques for taking action in recruiting, retaining, and advancing women across the “pipeline,” from K–12 to higher education, and onto workforce and entrepreneurial careers. It’s easy to join and membership is free for academic organizations.

Members have access to hundreds of research-based resources and to workshops, professional development, awards and funding programs. Professor Pamela Silvers, principal investigator for the ATE project, “Skilled Workers Get Jobs 2.0: Appalachian Impact,” makes regular use of NCWIT resources in her project where both high school and college level instructors receive materials on methods to improve retention and recruitment. In daylong summer workshops, NCWIT “10 Ways” resources are shared and discussed. This short, easy to digest format allows instructors to quickly learn about proven ideas to engage all students. Member organizations are also invited to send representatives to NCWIT’s annual Summit to learn and network with other members working across “the pipeline.” Registration for this two-day event is free for academic members. The next NCWIT Summit will be held May 22-24, 2017 in Tucson, Arizona.

What can you do if you are an instructor? One program that we would like to highlight is NCWIT’s EngageCSEdu platform and its EngageCSEdu Engagement Practices Framework. The purpose of EngageCSEdu (https://www.engage-csedu.org/) is to broaden participation in computing by providing a place for computer science instructors to find and share high quality, engaging materials for their introductory computing courses. The platform is based on the belief that we can broaden participation in computing, in part, through strategic curricular and pedagogical changes. The EngageCSEdu collection has more than 1300 curricular materials representing the work of over 200 Computer Science educators, and it continues to grow as faculty
from across the country submit their best materials for consideration. To maintain the quality of the collection, all submissions are peer reviewed by both a computer science educator and a social or learning scientist.

With its focus on broadening participation, EngageCSEdu differentiates itself from other collections in that all materials accepted to the collection must make effective use of at least one “Engagement Practice,” a pedagogical or curricular technique that research suggests helps engage and retain women in computing. All of these practices address one of three principles that we know help retain both women and underrepresented minorities in computing:

• Grow a positive student community

• Make it matter

• Build student confidence and professional identity

Explore these principles and their associated practices, and find links to related NCWIT resources and exemplar curricular materials at https://www.engage-csedu.org/engagement/make-it-matter. And if you have great, engaging CS1/CS2 materials that you would like to submit for consideration, please contact engagecsedu@ncwit.org. For more information about NCWIT, please email info@ncwit.org or check out our website: www.ncwit.org.

Interactive 2.17 6b Handout 1
Interactive 2.20 6b Handout 2

Interactive 2.18 6b Handout 3
Interactive 2.19 6b Handout 4

Additional Resources:
• NCWIT link: https://www.ncwit.org/
• EngageCSEdu link: https://www.engage-csedu.org/
References:


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Pick of the Tips: Moving Your Project from Blah to Bodacious

Marilyn Barger, Florida Advanced Technological Education Center of Excellence (FLATE) Rachael Bower, ATE Central
Elaine Craft, South Carolina Advanced Technological Education Center (SC ATE)
Mike Lesiecki, Maricopa Advanced Technology Education Center (MATEC)
Anthony Manupelli, Pellet Productions

NSF ATE grant projects typically require some work outside the “norm” for two-year technical faculty. Given a relatively short project timeframe for achieving specific outcomes and desired impacts, attention and energy needs to be focused on engaging stakeholders and getting attention from the public for your project. Several centers and projects within the ATE community provide resources and strategies that can help grantees engage partners, meet specific objectives and, ultimately, achieve their goals.

Communications
Staying in touch with your stakeholders is integral to all grant-funded projects. PIs and grant personnel must stay connected to their project funders, partners and stakeholders, recruit new partners, and generally bring visibility of the project to the wider community. Here are some quick tips for staying connected:

- Be professional and organized.
- Be regular with your communications.
- Use a format that works for your project size and scope.
• Celebrate your successes and those of your partners.

• Make news part of your daily work, keeping a log of story ideas.

• Plan to re-use your news for reports and evaluation.

• Use social media to share your news more broadly.

FLATE publishes an award-winning monthly newsletter. It has become well known and widely read within the ATE community and serves as a dissemination platform for centers and projects. Contact us at news@fl-ate.org and read the FLATE FOCUS newsletter at: http://flate-mif.blogspot.com/

**Webinars**

Webinars are interactive web-based seminars that participants and presenters can attend from virtually anywhere. They are a convenient and cost-effective way of providing training, disseminating information, and collaborating on projects. Each session can be custom tailored to meet your needs and can include an array of multimedia features to engage your audience. There are several key success factors for webinar production:

• A full “dress” rehearsal confirms audio and system compatibility and helps to smooth transitions between speakers.

• Webinar quality is often associated with audio quality – ensuring a good audio through a strong, hardwired VoIP connection is ideal.

• Less is more on slides; focus on images to tell the story with fewer words.

• Include interactivities such as polling, chat responses, and Q & A sessions to engage your audience.

• Begin on time, end on time.

When it is time to market your webinar, use a short, two- or three-week window before the event. In your marketing message describe audience take-aways and feature pictures of the presenters with short bios. Expect, as an industry norm, that 60% of registrants will attend; non-attending registrants will anticipate receiving links to recordings. Contact Michael.lesiecki@domain.maricopa.edu to discuss hosting your own webinar with MATEC’s help.

**Event and Research Repositories**

The SC ATE Center’s website ([www.TeachingTechnicians.org](http://www.TeachingTechnicians.org)) provides all fields of advanced technological education with a central, web-based resource that makes it easy to announce faculty development opportunities to a specific target audience of educators. This “matchmaker” service sends email prompts to proactively connect faculty with professional development in their
disciplines or to training on topics such as teaching methodologies or student recruitment. Both online and on-site events are posted and distributed to the website’s 3,075 registered users, and events are searchable by multiple criteria such as location, date, subject, or target audience. This resource can help recruit participants for your project’s events and can also be listed as a dissemination strategy in grant proposals.

The Teaching Technicians website also offers the only national repository of research related specifically to technician education. The site’s Compendium of Research on Technician Education houses hundreds of publications in a searchable database on technician education and related topics of interest to the ATE community, its stakeholders, and other educators. This compendium of publications makes research findings more broadly accessible and useful, allowing educators to learn, benefit from, and leverage what is known about proven strategies within technician education, both informing practice and also providing support for future proposals.

**Outreach**

Outreach and dissemination are critical for all ATE projects and centers. Whether you are trying to reach students and faculty on your campus, or stakeholders nationwide, it’s important to think about outreach every step of the way. Here are some tips to get started:

- Think about your audience first. Who are you trying to reach? Who are your primary and secondary audiences? How can you connect with them?

- Think about your time and staffing. Who will be doing most of the week-to-week outreach work? If the work will be divided among various staff it will be critical to coordinate. Monthly outreach meetings are a great way to stay on track.

- Get your plan in place. Start with a list of yearly outreach goals. Grow your mailing lists, get your website’s URL out there, leverage social media, and share results through a webinar. Once you know what you want to accomplish, add deadlines and assign a lead to each task. Then make sure to meet regularly to follow up.

How much detail and time you put into outreach will depend on many factors. ATE Central (atecentral.net) has resources, including an Outreach Kit, which can help.

**Videos**

Targeted recruitment videos have a proven ability to raise student awareness of the educational pathways and career possibilities for today’s technology fields, while providing a glimpse into what these workplaces look like and what people in these jobs actually do. The multimedia experience of watching a well-targeted video enables students to gain career information that will lead them to making better career decisions.
ATETV, a creation of Pellet Productions, Inc., is an award-winning web-based video series and interactive network designed to connect students and professionals with careers in advanced technology. ATETV ([www.ATETV.org](http://www.ATETV.org)) videos feature actual students and employers in real-world settings, at school, work, and home. The videos, available in English and Spanish and including closed captioning for accessibility, may be freely downloaded when used for educational, non-commercial purposes. Here are just two of the many reasons why you should make video an important part of your recruitment strategy: 52% of marketing professionals worldwide name video as the type of content with the best ROI. Using the word “video” in email subject lines boosts overall open rates 19%, click-through rates by 65%, and reduces unsubscribes by 26%.

“Webinar Checklist” is a quick checkoff list to use when preparing and delivering a webinar: [http://www.matecnetworks.org/hosting/_pdf/Webinar_Checklist_2016.pdf](http://www.matecnetworks.org/hosting/_pdf/Webinar_Checklist_2016.pdf)


“FLATE’s Communications Best Practice Guide” with tips and strategies for developing a robust communication program with stakeholders: [http://fl-ate.org/flip/BP/2016/communications/Communications%20Best%20Practice%2020101216.pdf](http://fl-ate.org/flip/BP/2016/communications/Communications%20Best%20Practice%2020101216.pdf)

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**FLATE Focus Newsletter Handout:** A short overview of best practices for developing a good online newsletter.

**Interactive 2.23 6f7f Handout 2**

Tap to enlarge then swipe/scroll.

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**FLATE,**

NSF ATE awards DUE #1204751

and #1261914

**MATEC,**

NSF ATE award DUE #1261893

**ATETV,**

NSF ATE awards DUE #0802503

and #1003657

**SC ATE**

NSF ATE award DUE #1003733
Economic Impact of High-Tech Education: Model for Motivating Recruitment, Completion, Job Placement

Sam Samanta, Ph.D. Instrumentation and Control Technologies, Finger Lakes Community College

In my presentation on “How to Increase Student Retention and Career Placement through a 21st-Century High-Tech Education” in the 2015 HI-TEC Conference Proceedings E-Book I described five challenges that face workforce education in the United States.¹ A 6th challenge is the need to estimate and communicate to a variety of influential stakeholders the economic impact that a high-tech education will have on a particular region. Having local government officials, college administrators and funding agencies, for example, aware of the economic impact that highly skilled technicians provide can help to increase resource development, program recruitment rates, technology degree completions, and job placements.

The higher the cumulative salaries of a company’s employees, the greater the economic impact the company will have on the region in which those employees work. That impact can be seen in terms of everything from the quality of schools and health care to the food on the grocery store shelves. The Instrumentation & Control Technologies (ICTech) program at Finger Lakes Community College, in collaboration with 40+ diverse high-tech businesses in the Rochester, NY region, provides training in advanced manufacturing careers. Our interest was in demonstrating the economic impact of the program through the high salaries commanded by our graduates. In the following, we show how we calculated an Estimated Cumulative Payroll of $2M
for the first 27 graduates of the ICT program over three years, with an Economic Impact of $10M.

Our economic impact model assumes:

- That maximum and minimum salaries fit a Pareto Distribution of income, also known as the “80-20 rule,” which says that 20% of the population controls 80% of the wealth. The factor for the Pareto Distribution is represented by d, assumed to be 3.17 in the model.

- Salaries increase by 2.5% per year for employed individuals, with or without job changes, and graduates are fully employed (generally true, with minimal breaks in employment).

- Revenue/Payroll, an industry’s total revenue as a ratio of payroll, can be estimated to be between 3 and 5 for most high-tech industries and is assumed to be 3.6.

- The Multiplier factor, or overall Economic Impact/Revenue, is the effect that hi-tech jobs can have on job creation in a given community, particularly in the service sector. Having well-paid employees in a hi-tech industry can create additional jobs in the food industry, real estate, health care, etc. If no additional jobs will be created for every hi-tech job, the multiplier effect is 1.0, and can range from 1.4 to 1.6. It is estimated to be 1.4 in the model.

- The first cohort, Cohort1, has three years’ accumulated income, Cohort2 has two years, and Cohort3 has one year of regular salary.

Our model does not account for:

- Differential incomes, i.e. does not subtract income of individuals who did not undertake study.

- Lost income during pursuit of study. Not a major factor since all sophomore classes are after 4 pm, and many first year students are placed in co-ops which lead to jobs.

- Outlay of expense for student & society.
The LabVIEW screenshot illustrates the same results as the Excel calculations.

If you would like to receive an Excel spreadsheet containing all of the formulas used for the model, contact Sam Samanta at Sam.Samanta@flcc.edu.

As shown in the Excel spreadsheet below, given the model’s assumptions and calculations, the Economic Impact for five cohorts (by May 2018, when current sophomores would have earned full year’s regular salary) is estimated to exceed $25M. The largest uncertainty in our model stems from variations in the actual Revenue/Payroll and Multiplier Effect among businesses. The overall uncertainty in our estimated/projected economic impact is about 30%.

**Conclusions & National Implications**

Nationwide, about 500k jobs can be filled through advanced technology education, amounting to an additional $75 billion in revenue, and resulting in an estimated $100 billion in economic impact. It should also be noted that an important contributing factor behind the $1.3 trillion of student loan debt is the 45% underemployment of recent graduates with baccalaureates and higher degrees. An adaptable technology education program dynamically tuned to evolving regional high-tech ecosystems will lead to a reduction in unemployed and underemployed individuals and a commensurate reduction in student loan debt.
We must estimate and communicate the economic impact of educating a high-tech workforce to all stakeholders: students, teachers, administrators, businesses, economic developers, and workforce developers. This will support the argument that the higher resource allocation for technology programs is strongly justified within the broader societal context – a realistic quantitative model of economic impact helps! Such a model also motivates us as educators and institutions in our collective efforts directed towards:

- **Recruitment**: Each additional student counts.
- **Completion**: Important for individual career and institutional goals.
- **Job Placement**: Crucial for individuals, especially in businesses that support further education.

**Additional Resources:**
- Instrumentation and Control Technologies program
  [www.flcc.edu/ICTech](http://www.flcc.edu/ICTech)
- Pareto Distribution of Income
  [http://economics.mit.edu/files/10517](http://economics.mit.edu/files/10517)

**References:**

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Sam Samanta, [Sam.Samanta@flcc.edu](mailto:Sam.Samanta@flcc.edu)
How Does the Participation in an Online Multiplayer Video Gaming Environment Influence an Adult Learner’s Perception of Collaborative Leadership in an Online and Digital Setting?

Adam Beatty, West Virginia Northern Community College

Collaborative leadership is vital to the future of our organizations. However, with the millennial generation approaching the workforce, we could be faced with a generation of Computer Information Technology students more comfortable collaborating via digital and online technologies than with their colleagues face-to-face. Therefore, we should be attempting to measure, understand, and enhance the collaborative leadership behaviors of individuals in an online setting. My research focuses on how we can prepare our future Computer Information Technology graduates for online collaborative leadership via games such as Minecraft where participants have only online communication.

Currently, there is ample research available that looks at face-to-face collaborative leadership. Archer and Cameron (2013) identified three levels: symbiotic, mutual, and transactional. The symbiotic level of collaborative leadership requires the highest level of collaboration from all members of a group, such as a sports team, where differences need to be put aside, and full collaboration is required to achieve a goal. Mutual collaborative leadership requires a medium level of collaboration, more like middle management personnel, where collaboration is required to achieve a goal but does not require the same amount of active collaboration that would be needed to win in a team sport. Transactional collaboration is the lowest level of collaboration
and can be compared to working together to purchase a piece of furniture, for example.

In contrast to the research on face-to-face collaborative leadership, the amount of research that has looked at online collaborative leadership as it relates to video gameplay is minimal. However, Erhel and Jamet (2013) have shown that digital game-based learning provides an opportunity for players to set goals and to work toward those goals.

Since collaboration can be perceived as a relationship between two or more parties that work toward the achievement of goals, I propose that using an online multiplayer video game could provide the evidence, and the acquisition, of online collaborative leadership. Using Archer and Cameron’s paradigm, those that are familiar with the game of Minecraft and have played the game with others may demonstrate a form of symbiotic collaborative leadership since they know how the game works and how it is played. Those that have only played on a casual level may demonstrate mutual collaborative leadership and become a form of middle management throughout the gameplay. Finally, those that are not familiar with the game or are not collaborative leaders in most settings will wait to be told what to do and will collaborate in the quickest fashion possible to fulfill their assigned task.

It is possible to test this hypothesis by conducting a pretest and posttest of the Robert Wood Johnson Foundation (RWJF) Collaborative Leadership Self-Assessment (CLSA) questionnaire. The CLSA consists of six collaborative leadership behaviors:

- Assessing the Environment
- Creating Clarity: Visioning and Mobilizing
- Building Trust
- Sharing Power and Influence
- Developing People
- Self-Reflection

Each of the six sections has Likert-scale questions that help determine a participant’s collaborative leadership behavioral style. Participants would complete the CLSA before and after playing the online game of Minecraft. During the game, they would be asked to build an item, such as a college campus or a city, with online communication among the players only. We could then compare the participants’ CLSA scores before and after playing the game to see if there is a difference in collaborative leadership behaviors.

Although not all individuals from the millennial generation are online gamers, many are, and we may soon have a generation of Computer Science professionals entering the workforce more comfortable with collaboration or communication that takes place online rather than face-to-face. Using online gaming to measure
and enhance collaborative leadership via online video gameplay for this new generation may prove to be a valuable approach.

**Contact:**
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Authentic MEMS Education through Distance Learning and Industry Partnerships

Rick Vaughn, STEM Initiatives, Rio Salado College

Jeanne Ratliff, Corporate and Government Programs, Rio Salado College

The Southwest Center for Microsystems Education (SCME), Rio Salado College, and Arizona State University have come together in a unique partnership to give students hands-on clean room opportunities while earning their hybrid (distance and in-class) Nanotechnology degree and/or certificate. The partnership allows for cost-effective delivery of essential skills for micro and nanotechnology at the community college level, with SCME providing support with curriculum, professional development, and educational modules and kits.

Rio Salado College, one of the ten independently accredited Maricopa Community Colleges based in Tempe, Arizona, is primarily a distance-education institution offering over 40 degree and certificate programs in 43 states. Founded in 1978 to challenge the limits of traditional education through customized, high-quality learning design, the College’s current mission is to reinvent the learning experience to change lives. Hybrid technician training is one way to achieve this mission.

Rio’s involvement in micro and nanotechnology began with the appointment of Dr. Rick Vaughn as the Faculty Chair for STEM Initiatives in 2011. In 2012, the College envisioned five arenas for STEM impact: community outreach, teacher professional development, K-12 pathways, community college programs in STEM and emerging technology, and workforce connections. Early interest was in engineering technology. Following the Micro and Nano Technology (MNT) Conference in 2012, the college
narrowed its interest to nanotechnology as the first major new program to develop in STEM.

Between 2013 and 2016, the College wrote curriculum and received approval from all of its regulatory agencies, including internal vetting, the Higher Learning Commission, Instructional Councils, the US Department of Education, and the College’s Governing Board. The program is now live as of fall semester 2016.

Work is underway to add a Micro-Electro-Mechanical Systems (MEMS) program during the 2016-17 academic year.

A new prefix was created to house the MEMS program: MNT for micro and nanotechnologies. Following the Penn State/NACK model, the program features general science preparation and survey courses culminating in an intensive six-course Certificate of Completion. Key courses include:

- MNT110 General Principles of Nanotechnology
- MNT120 Introduction to Micro Electro-Mechanical Systems
- MNT201 Materials, Safety and Equipment for Nanotechnology
- MNT210 Basic Nanotechnology Processes
- MNT220 Materials in Nanotechnology MNT230 Patterning for Nanotechnology
- MNT240 Materials Fabrication with Nanotechnology
- MNT250 Characterization of Nanotechnology Structures and Materials

A complete copy of the curriculum is available on the College’s website at [http://www.riosalado.edu/programs/nanotechnology/Pages/AAS-in-Nanotechnology.aspx](http://www.riosalado.edu/programs/nanotechnology/Pages/AAS-in-Nanotechnology.aspx)

The hybrid model for most courses utilizes our unique learning management system for online lectures, videos, activities, and assessments. 3-4 labs per course are split between online preparation and in-person experience with tools in the cleanroom at Arizona State University. Students schedule their labs with the instructor at the start of the course.
For the MEMS MNT120 course, students purchase a kit containing materials for lab that can be completed at home. Rio Salado had already been using student kits for many of its science classes. Typically, materials are packed into a single box, which is cost neutral. Students may have to supplement the materials with perishable or other over-the-counter items such as spinach leaves or acetone. In hybrid settings, students may also be provided with certain hazardous materials.

Support for the MEMS course will consist of repackaging materials from the SCME kits into a single kit that can be similarly used.

The latest technology to be used in the MEMS program at Rio Salado College and ASU is a fully-immersive 3D-rendered cleanroom environment. For the short term, students can use the virtual field trip (VFT) to experience the features, tools, and protocols in an authentic, working nanofab center. Longer-term plans are to integrate the software so that students can access tools remotely and to embed videos and labs.

The links to the current versions of the 3D cleanroom are included here in two versions. One version (iVFT) can be accessed from a PC, tablet or smart phone with internet access, and a second (VR) version can be used with a 3D virtual reality headset, commonly available through Ebay or Amazon.

iVFT computer version: [http://vft.asu.edu/VFTNanofab/panos/nanofab/cleanroom.html](http://vft.asu.edu/VFTNanofab/panos/nanofab/cleanroom.html)

VR headset version: [http://vft.asu.edu/vftvr/nanofab/](http://vft.asu.edu/vftvr/nanofab/)

One of the newest ways to provide authentic experiences for students in a hybrid course is with Arduino microcontroller boards and accessories. At low cost, an Arduino can be included in a student kit and can be used to support multiple activities in a variety of courses. For example, MEMS students can use Arduino to analyze results, while programming students can use it to practice their coding. Rio is just beginning to explore the possibilities with this versatile technology.

Interactive 2.27 8e Handout 1

Tap to enlarge then swipe/scroll.
Through the design, piloting, implementation, and now delivery of its nanotechnology program, Rio Salado College has received overwhelming support from both ATE centers and industry partners. Although it has been a long journey, the College is now poised to provide authentic experiences to train technicians via its unique hybrid delivery platforms.

**Additional Resources:**

- Rio Nano Program Curriculum: [http://www.riosalado.edu/programs/nanotechnology/Pages/AAS-in-Nanotechnology.aspx](http://www.riosalado.edu/programs/nanotechnology/Pages/AAS-in-Nanotechnology.aspx)


- 3D Virtual Cleanroom for VR headsets: [http://vft.asu.edu/vftvr/nanofab](http://vft.asu.edu/vftvr/nanofab)

- Other Virtual Field Trips at ASU: [http://vft.asu.edu/](http://vft.asu.edu/)


- School Affiliation: [http://www.riosalado.edu](http://www.riosalado.edu)

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Southwest Center for Microsystems Education (SCME), NSF ATE award DUE #1205138

Nanotechnology Collaborative Infrastructure Southwest at ASU (NCI-SW), NSF ATE award DUE #1542160
A Pathway from High School to a Manufacturing Career

Sharon Gusky, Professor of Biology, Northwestern Connecticut Community College

Tara Jo Holmberg, Department Chair – STEAM/Professor of Environmental Science and Biology, Northwestern Connecticut Community College

The overall purpose of the NSF-funded project Manufacturing Associate Degree Education in Northwest Connecticut is to provide students with both the theoretical and technical education needed to enter our region’s advanced-technology manufacturing workforce. One of the project’s major initiatives is to develop a Manufacturing Technology Pathway under the Northwestern Connecticut Community College’s (NCCC) existing Industrial Technology Associates Degree program. This new degree pathway has several goals:

1. To provide students with multiple points of entry so they can build their skills and academic knowledge in a step-wise fashion while being, or becoming, gainfully employed in the manufacturing sector.

2. To develop clearly articulated pathways from high school to an associate’s degree and then to a bachelor’s degree in advanced manufacturing.

NCCC student investigating appropriate soldering technique.
3. To advance the careers of individuals currently working in manufacturing.

4. To increase and strengthen the partnerships between higher education and industry.

The manufacturing pathway is articulated with Central Connecticut State University (CCSU) through the Connecticut College of Technology (COT). The COT provides students with a clear pathway from a two-year college to a four-year university, without loss of credits or repeated coursework, and direct admission into CCSU’s School of Engineering and Technology. Students completing their associate’s degree in Technology Studies: Manufacturing Technology transfer seamlessly into CCSU’s B.S. in Industrial Technology-Technology Management program. In addition to the 67 credits in the program, CCSU allows students to complete and transfer an additional 8 credits from the community college.

A unique aspect to this project is the partnership NCCC has developed with one company, Altek Electronics, which approached the college with a technical course idea based on their hiring and skill needs. Under a Memorandum of Understanding with the Board of Regents through the Spring 2017 semester, this course has been fully funded for four semesters as part of the “Jobs Bill” Public Act 10-75, and serves as a model for other community colleges looking to partner with industry. The course combines two different skills sets necessary...
for work in electronics manufacturing: soldering and circuits. Altek employees and NCCC professors together designed the curriculum to meet accreditation, credentialing, and industry standards. Altek then recruited seven students from local high schools who showed interest in the field and were looking for a position after graduation. To qualify, students had to meet minimum requirements and complete a series of interviews. After passing the course and the credentialing exams, the company hired six of the seven students in the Spring of 2016.

As a result of the new manufacturing pathway, a greater number of local employers are recruiting our students for job openings. Part of this is due to the relationships NCCC has built within the Northwest Connecticut Manufacturer’s Coalition and the press and outreach generated by the number of NCCC students achieving their national certifications through the college’s courses. Students in the program are already working in eight local manufacturing companies. We have also had a few requests from companies to develop collaborations like the one we have developed with Altek.

The manufacturing pathway has also positively impacted enrollments in all of our COT programs, which have all seen enrollments increased since the project began. In the fall of 2013, 43 students were enrolled in College of Technology programs, and in the fall of 2015, 88 students were enrolled. The program has also had a positive impact on math, chemistry and physics enrollments, which have all increased since the start of the program. NCCC’s manufacturing program has also become an entry point into other COT programs. Students often start in the manufacturing program and once they begin to do well, especially in their math and science courses, switch to Engineering or Engineering Tech programs.
We have found that our manufacturing pathway can have a momentous effect on the careers, and lives, of students. One NCCC student enrolled in the program can serve as an example. After graduating from high school, the student took a job in a manufacturing firm as a drafter. He then began taking courses at NCCC, and completed all of the technical courses in the pathway along with a number of other required courses. He excelled in the program and found that he enjoyed the math, so after doing well in his pre-calculus course he continued on to calculus.

The student was then selected by his math professor to participate in two programs sponsored by the NASA Connecticut Space Grant: a quadcopter build and competition, and a week-long Aircraft Readiness workshop at the US Navy Fleet Readiness Center-East Facility in North Carolina. These experiences introduced him to engineering. He has now decided to switch to the engineering technology program and plans on transferring to Central Connecticut State University to earn his Bachelor’s and Master’s degrees. When this student graduated from high school and took a job as a drafter, he had never envisioned himself as an engineer or being on the path to a graduate degree. However, thanks to the manufacturing pathway, which opened the door to higher education and all it has to offer to him, he has a clear vision for his future.
Interactive 2.30 8f Handout 2

Tap to enlarge then swipe/scroll.

Interactive 2.31 8f Handout 3

Tap to enlarge then swipe/scroll.

Additional Resources:

• Northwestern Connecticut Community College:
  http://www.nwcc.edu

• Regional Center for Next Generation Manufacturing:
  http://www.nextgenmfg.org/

• Technical High School Program: Oliver Wolcott Technical High School:
  https://wolcott.cttech.org/

• Internship Program: Mechanical & Manufacturing Technologies for Energy & Sustainability (MET2):
  http://www.met2program.org/about

• Industry Partner: Altek Electronics:
  http://www.altekcompany.com/

• Connecticut State Colleges and Universities:
  http://www.ct.edu

• Northwest Connecticut Chamber of Commerce:
  http://nwctchamberofcommerce.org/

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Manufacturing Associate Degree Education in Northwestern Connecticut, NSF ATE award DUE #1400570
Is Teaching the Internet of Things In Your Future?

William Saichek, Professor, Computer Science and Information Systems, Orange Coast College

Brian Nelson, Professor, Computer Information Technologies, Lansing Community College

“Whether you are an individual, technology developer or adopter of these technologies, the Internet of Things will stretch the boundaries of today’s systems.”

-Harbor Research Study

The Internet of Things/Internet of Everything (IoT/IoE) is the network of physical objects or “things” embedded with electronics, software, sensors and connectivity. This allows for greater value and service through the exchange of data with the manufacturer, operator and/or other connected devices. Each “thing” is uniquely identifiable through its embedded computing system but is also able to interoperate within the existing Internet infrastructure.

The International Telecommunications Union (ITU) has posited that the IoT/IoE, “Any Time/Any Place/ Any Thing” is a paradigm shift that will change the way we view and use the Internet, and the predictions of the futurists bear this out:

- In 2008 it was reported that the number of “things” connected to the Internet exceeded the number of people on Earth.\(^2\)

- It is projected that by 2017 the market revenue for the Internet of Things related to the Smart-Home industry alone will generate over $180 billion.\(^1\)
• By 2020 IoT/IoE revenue will generate $9 trillion\(^3\), and 212 billion
devices will be part of IoT/IoE.\(^4\)

• 75% of companies are either actively exploring or already using
the IoE/IoT.\(^5\)

If you have an IT program it is imperative that you prepare
students to install, configure and maintain these enhanced
devices. In particular, students will need to be prepared for the
following as a result of IoT/IoE:

• Heavy investments of the technology into commercial,
residential and industrial use

• The use of IT in OT (Operations Technology)

• Replacement of many non-traditional/proprietary networks with
IoT/IoE or the bridging of the technology into Ethernet and WiFi

• The predominance of IoT material being added to networking
curricula (Cisco is a prime mover)

• Ultimately, reaching the goal of a truly converged network

Transitioning to teaching IoT/IoE should be relatively easy since
IoT/IoE products and services are easy to understand and are
very accessible. Although IoT/IoE systems require a number of
diverse components to work together, and a complete integration
solution might be the ultimate desire, much of the technology
implementations can be built and controlled as independent
modules connected to the various appliances and devices. Six
major categories of IoT/IoE technology systems that students
should be working with include networking and Internet
connectivity, audio/video signal reception and distribution,
telecommunications (including Voice Over IP), security and
surveillance, home control management (including lighting and
HVAC controls), and appliance automation and control.

An added benefit of incorporating IoT/IoE topics and courses into
the current catalog of IT/Networking/Communications/Security
classes is that students from diverse, non-IT backgrounds will be
attracted. For example, students from traditional computer
science disciplines will need to understand the protocols and
operational aspects of IoT/IoE devices in order to program for
them. Students from traditional “trade” industries such as
construction, architecture, plumbing and electrical, industrial
engineering, aerospace and manufacturing will need to have a
deep understanding of IoT/IoE protocols.

Developing and deploying meaningful and quality hands-on IoT/
IoE assignments for students can also create some challenges.
Issues such as types and costs of IoT/IoE sensors, software
licensing, space considerations, increasing student time on task,
and allowing enough access to a lab environment are just a few
of the challenges faced by instructors planning to teach IoT/IoE.
Over the last year, both Orange Coast College and Lansing Community College have been developing easily accessible hands-on labs that are directly related to IoT/IoE, and more colleges are gearing up to do the same. The types of labs include:

- Setting up a wireless (and wired as well) network on a “residential” network and implementing OpenVPN access using DD-WRT routers.

- Building a NAS (using open-source FreeNAS and XPEnology) and connecting to the “residential” network.

- Building a small VoIP environment using Asterisk and connecting it to the residential network.

- Building a Media Server (using Plexserver) and accessing content using a variety of devices from both inside the residential network and from the Internet via the VPN. Devices used include:
  - Computers (PC’s and Mac’s)
  - Raspberry PIs using RasPlex
  - Mobile devices (iPads, iPhones and Android)
  - Roku boxes

- Setting up and configuring a lighting control system onto the residential network using Hue lighting and controlling from iPads and Android devices. Lighting systems from Lutron (RadioRA) and Insteon can also be used. The wireless protocols between the controller and the dimmers are proprietary, but both systems have mobile apps that allow for remote access to the lighting systems using TCP/IP.

- Setting up and configuring “Smart” thermostats (Nest, Honeywell, Lenox, etc.) and allowing for access over the Internet.
• Setting up a surveillance system on the residential network using inexpensive IP cameras and free PVR software (such as iSpy and Camera Viewer Pro). Additionally, the cameras can be viewed over the Internet using iPads and Android devices.

http://support.dlink.com/ProductInfo.aspx?m=DCS-932L

• Setting up and configuring home control systems using iPads and Android devices.

http://support.dlink.com/ProductInfo.aspx?m=DCS-932L

As can be seen from this list above, IT educators are already teaching many of the protocols and services that are part of IoT/IoE. Only a few items will need to be added:

• Additional wireless protocols such as Zigbee and Z-Wave

• Emphasis on UDP and RTP protocols

• Programming real-time applications

• IP based sensors and actuators

• Current non-IT protocols that are being bridged

References:


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Bioscience Industrial Fellows Program

Russ Read, PI and Executive Director, National Center for the Biotechnology Workforce

Denise Schweizer, Co-PI, Rowan Cabarrus Community College

Allison Nestor, Research Assistant, Forsyth Technical Community College

The Bioscience Industry Fellows Program (BIFP) is a four-week professional development initiative to improve the quality and relevance of community college bioscience education, hosted by the National Center for the Biotechnology Workforce (NCBW) at Forsyth Technical Community College, in Winston-Salem, NC. Through relationships fostered since its creation in 2004, the NCBW, now a part of BioNetwork, creates professional collaborations among bioscience industry partners and educational professionals to ensure educators have the necessary understanding and resources to contextualize their curricula. BIFPs participants, called Fellows, experience firsthand the concepts, techniques, and skills that students will need to successfully enter the bioscience workforce.

The BIFP initiative was built on the strong local resources of the bioscience industry in the Piedmont-Triad (Central) Region of NC, a prime location for the project. The region benefits from its proximity to the RTP, an international biotech hub, and the growing Innovation Quarter, an urban life-science research park and catalyst for research and economic development in downtown Winston-Salem. The region is also home to a variety of university campuses and research facilities, all of which collaborate on regional matters relating to biosciences and economic development.
BIFP is designed to give high-impact instructors new tools to engage students and colleagues with bioscience-based techniques and instructional resources to enhance bioscience teaching. An emphasis is on providing participants with an understanding of the bioscience industry and the potential for jobs within the industry. The goals of BIFP are to provide the Bioscience Industry Fellows with:

- Guidance on incorporating real-world bioscience examples and explanations into their curricula to make it more relevant.
- Industry insight to help guide students into community college programs leading to bioscience careers.
- A greater knowledge of STEM skills as applied to the biotechnology industry.

The program also has two broader goals: (1) to develop a network of resources available to all parties who have an interest in STEM by developing effective, sustainable links among community college instructors, university faculty, and industry leaders; and (2) to create a model that is replicable at other sites across the nation.

The NCBW recently hosted the third cohort of the BIFP, selected from a pool of faculty and staff at high schools, community colleges, and universities throughout the US that have been identified by their colleagues as being high-impact educators. During the program, Fellows traveled to multiple universities, educational and research programs, and NC Bioscience industrial facility laboratories to gain a better understanding of how their curricula can better align with this expansive industry. In addition to the observational site visits, Fellows were immersed in a skills-based laboratory “boot camp” provided by three NC community colleges that covered a broad range of skills including, but not limited to, instrumentation, sample preparation, cell culture, and transfection. Specific program activities included:

- Fellows, grouped in pairs, created team presentations that covered the scope of their month-long BIFP experience and included novel ways to bring back what they had learned to their home institutions.
• Guest speakers, interviews with the Fellows, and presentations by the Fellows were videotaped by the Forsyth Tech media team and posted to Forsyth Tech’s YouTube channel.

• Fellows attended local, regional and national conferences where they shared what they had learned from their involvement in the BIFP program.

The program has already had a significant impact on the creation of innovative and contextualized learning modules. Fellows have taken the perspective provided by the BIFP and have applied valuable industry insights to enhance existing classroom learning platforms.

To date, the NCBW has hosted three multidisciplinary cohorts of the BIFP. The three cohorts have included 27 educational professionals from 11 different states, and an international observer. We are currently in the process of assembling our fourth cohort, with the program to be held June 5-29th, 2017.

The focus in 2017 will be to create standard operating procedures for planning and implementing the BIFP at other institutions. Planning will be based on which aspects of the program have been shown to be most critical to replicate in order to achieve the desired outcomes.

Interactive 2.34 12d Image Gallery

Tap numbers or arrows to view images.

Watch Russ Read, Executive Director of NCBW, along with 2014 BIFP Fellows, talk about the opportunities available to 2015 BIFP Fellows at: https://www.youtube.com/watch?v=-ufsfN915us.

Find out more about the National Center for the Biotechnology Workforce at: www.biotechworkforce.org
**Additional Resources:**

**Affiliations:**

- National Center for the Biotechnology Workforce Link: [http://biotechworkforce.org/](http://biotechworkforce.org/)
- Forsyth Tech CC Link: [http://www.forsythtech.edu/](http://www.forsythtech.edu/)

**Program Brochure Link:**
[https://simplebooklet.com/2017bifpbrochure](https://simplebooklet.com/2017bifpbrochure)

**Application Link:**
[https://www.surveymonkey.com/r/3VL2N32](https://www.surveymonkey.com/r/3VL2N32)

**YouTube Video Clip Link:**
[https://www.youtube.com/watch?v=-ufsfN915us](https://www.youtube.com/watch?v=-ufsfN915us)

**2016 Combined Presentations Link:**

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Chapter 3

Posters

BC2’s Industry-Endorsed Biomanufacturing Curriculum for Technician Training

Maggie Bryans, Ph.D. and Jennifer Imbesi, Montgomery County Community College, Blue Bell, PA
Linda Behfuss, Ph.D. and Cianna Cooper, Bucks County Community College, Newtown, PA
Section 1

**NBC2's Industry-Endorsed Biomanufacturing Curriculum for Technician Training**

*Margaret Bryans, Linda Rehfuss, Jennifer Imbesi, Cianna Cooper, The Northeast Biomanufacturing Center and Collaborative (NBC2)*

Interactive 3.1 Poster P1

*Tap then scroll/swipe to view.*
Practicing Necessary Employability Skills Through Real-World Cyber Security and Mechatronics

John Chamberlain, Dick Hinckley, CORD

Interactive 3.2 Poster P2
Tap then scroll/swipe to view.
Using Geospatial Technology to Understand Student Enrollment Patterns

Vince DiNoto, National Geospatial Technology Center of Excellence (GeoTech)
Development of Community College Cyber Security Program Integrating Energy Sustainability

Peter Maritato, Nina Leonhardt, LIGHTES2, Suffolk County Community College

Interactive 3.4 Poster P4

Tap then scroll/swipe to view.
Undergraduate Research, Outcomes, and Assessment Tool Development

Deborah Overath, Robert Hatherill, Daiyuan Zhang, Del Mar College
Expanding Geospatial Opportunities for High School and Community College Students in Western New York

Heather Pierce, Jonathon Little, Monroe Community College

Interactive 3.6 Poster P6

Tap then scroll/swipe to view.
Microsystems and Nanotechnology Industry Interactive Maps and Workforce Survey Results

Matthias Pleil, Barbara Lopez, SCME
CREATE Faculty Learning Projects: Adding an International Perspective to Renewable Energy Education

Kenneth Walz, Kathy Alfano, Mary Slowinski, California Regional Consortium for Engineering Advances in Technological Education (CREATE)

Roger Ebbage, Lane Community College
Transformative Applied Learning Internships in Semiconductor Manufacturing

Daniel White, Robert Geer, Abe Michelin, SUNY Polytechnic Institute
Accelerating Automation: Customize Your Learning Schedule With Virtualization and Open Labs

Tom Wylie, Ron Scozzari, Sarah Stubblefield, HOME4TECHs

Interactive 3.10 Poster P10

Tap then scroll/swipe to view.