TECHcitement

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Advances in Technological Education

ATE Develops Student Recruitment and Retention Strategies

Cultivating people's interest in science, technology, engineering, and math and encouraging their pursuit of advanced technology careers helps the nation compete in the global economy.

The Advanced Technological Education (ATE) projects and centers featured in this issue of *TECHcitement* adeptly use an array of new technologies and effective practices to recruit students, to develop their technical skills, and to retain incumbent technicians. The entire ATE program aims to deliver more and better qualified technicians to high-tech workplaces that are of strategic importance to the nation.

The ATE program is the National Science Foundation's (NSF) premier community college initiative. Its competitive grants support innovative technician education programs at undergraduate institutions, particularly community colleges, and secondary schools. ATE grants also support professional development for the educators who teach prospective technicians. Technicians are the highly-skilled workers who carry out the processes that either directly create products or facilitate the work of others in fields such as manufacturing, biotechnology, agriculture, engineering, information, chemical, and process technologies.

Educators from community colleges—the public associate degree–granting institutions attended by nearly half of the nation's undergraduates and the main educational resources for technicians in the United States—have leadership roles in ATE initiatives. Secondary school educators, university researchers, and industry partners serve integral roles in the ingenious efforts that enhance technical career pathways.

Since its creation by Congress in 1992, the ATE program has awarded more than 800 grants. ATE project grants generally focus on improvement of particular technical education programs, curriculum or educational materials development, professional development for educators, or preparation of new secondary school teachers. ATE centers of excellence use grant support to enhance national and regional technician preparation efforts for specific fields. In 2007, targeted research in technician education was added as a third program track.

Linda L. Slakey, director of the NSF's Division of Undergraduate Education, calls the ATE program "enormously dynamic and effective."

Slakey especially appreciates the quality of the partnerships ATE initiatives generate in their communities and among their partners in industry. "It seems to me to be a genuinely transformative agent in higher education," she said at the 14th Annual ATE Principal Investigators Conference in October 2007. All of the curricula and other educational materials developed with ATE grant support are freely available for others to implement in academic and industry settings.

Noting the push for accountability throughout education and government, Slakey told the principal investigators that she uses their innovative efforts as examples of the NSF's effectiveness. "The ATE PIs [principal investigators], I see as key elements in responding to the public loud and clear, 'Yes, we are being effective.' We point to the work that you do all the time when we're asked to demonstrate that our investment of the public's funds is truly effective."

AACC
AMERICAN ASSOCIATION OF COMMUNITY COLLEGES

Inside...

Marketer Advises Tech Educators Appeal to Teens' Emotions, Desires to Do Something Important

To increase the pool of talent for mathematics, science, and technology fields, Marketer Clif McFeely advises educators to use media messages that appeal to teens' emotions and their desires to be part of something meaningful.

"It's more than just 'I've got a job in this particular area waiting for me,'" he says, adding "there's an emotional side to go with it."

Recruiting adolescents requires an understanding of the sometimes conflicting blend of emotions that motivate teens, he said at the 14th Annual ATE Principal Investigators Conference.

"What teen is not driven to feel socially connected with a group of close-knit friends?" he asks. Yet teens also want to be free, accomplished, and express themselves as unique individuals. Teens ultimately want to feel that they are part of something bigger than themselves. In addition to these "nice" motivations McFeely lists "five naughty" teen basic instincts. They are: rebellion, risk taking, sexuality, cynicism, and tribalism.

McFeely's accurate reading of complex human behaviors has served him well during several decades of work for commercial clients. His firm, North Castle Communications, now concentrates on social marketing. One of its current efforts is Brainwave®, a marketing campaign for the Business Roundtable that seeks to raise the cultural status of math and science among teens by tapping into what interests and motivates them.

Brainwave seeks to "brand" math and science knowledge by explicitly connecting the mathematics and science of new technologies with the gadgets teens favor. A preliminary Brainwave video shows students in a focus group getting excited about technology careers as they identify all of the science and mathematics-based items in a typical workplace and home.

"Its purpose is to say to young people everywhere: Math and science knowledge is power. It powers virtually everything interesting in your life, and we're going to connect the dots for you with this branding called Brainwave," he says.

McFeely also encourages educators to use the digital media favored by teens and young adults to develop students' curiosity and interest in the many degree programs developed by ATE centers and projects. "Connect with students where they are already spending their time," he advises, referring to social networking sites on the Internet.

Several ATE initiatives already do this. The National Center for Telecommunications Technology, an ATE center at Springfield Technical Community College in Massachusetts, has promotional material on You Tube, the video sharing Web site. Camden County College in Blackwood, New Jersey, and McHenry County College in Crystal Lake, Illinois, promote their digital media programs from "islands" in Second Life, an Internet-based virtual reality. Faculty from these three colleges participated in MentorLinks. MentorLinks is an AACC initiative supported by an ATE grant that provides mentors to community college faculty who need help resolving technical education challenges. ■

> ***"The ATE PIs [principal investigators], I see as key elements in responding to the public loud and clear, 'Yes, we are being effective.' We point to the work that you do all the time when we're asked to demonstrate that our investment of the public's funds is truly effective."***
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> **—Linda Slakey, Director of the Division of Undergraduate Education National Science Foundation**

Digital Bridge Academy Gets At-Risk Students on Paths to Knowledge-Based Careers

The Digital Bridge Academy (DBA) at Cabrillo College accelerates the academic and personal management skills of underprepared, low-income minority students.

For the majority of students enrolled in the program at Cabrillo's center in Watsonville, California, the DBA's two-week Foundation Course and Bridge Semester is unlike any previous educational experience. It resets their learning patterns, personal habits, and career horizons. The students who complete the credit program—and most of those who start the DBA complete it—move into regular community college classes and begin on pathways toward knowledge-based careers.

The project's independent evaluator, Norena Norton Badway, reported in 2007 that "the lowest-performing cohort of DBA surpassed other Cabrillo students in successfully passing courses by 10%, and other DBA cohorts surpassed other Cabrillo students in passing courses by 30% or more." She praised the initiative, noting, "These findings alone commend the WDBA [Watsonville Digital Bridge Academy] program: underprepared, at-risk students make progress toward academic, career, and personal goals."

An ATE grant supported pilot testing and revision of the DBA's student persistence model, as well as Badway's evaluation of its implementation. A second ATE grant supports the addition of a numeracy course to the one-semester program, and the development of a two-semester, science-intensive curriculum.

Digital Bridge Academy students gather around an open computer to learn the function of its hardware components at Cabrillo College.

The DBA's results are particularly remarkable because of the academic progress made by the large number of ultra at-risk students, which the DBA defines as those not considered sheltered, protected, or innocent. Many of these people, in other educational settings, would likely spend one or more semesters in noncredit, remedial courses, then drop out.

"Remedial education doesn't really work well because it is not really designed for adults; it's not designed for the adult brain and for what its capacity is," says Diego James Navarro, the director of the DBA.

The DBA curriculum attempts to tap the capacity of its adult students' brains in two significant phases. Its two-week, three-credit Foundation Course uses an intense, multi-modal process that helps students create the conditions to learn more effectively and motivate themselves. "[When] they come out of this program, they are on fire. They know where they want to go," Navarro says, explaining that what follows not only stretches students academically; it helps them change their behaviors so they can accomplish their goals. The students move on to the Bridge Semester as a cohort that becomes a support system.

"Our community colleges—particularly in the science, technology, engineering, and math area as sources of technicians—are so critical to our academic institutions and certainly our industrial firms."

—Norman L. Augustine, Chairman, National Academy of Sciences panel that issued *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*
Retired Chairman and Chief Executive Officer, Lockheed Martin Corporation

The 13-credit Bridge Semester uses a community-based research project on a social justice issue of the students' choosing. The project feeds the students' interests and plays to the strengths of individuals whom Navarro describes as having "PhDs in social injustice." Courses covering information technology, literacy, team self-management, movement, and careers are integrated and focus on the social justice projects. DBA instructors coordinate their lessons and teach the students new skills just in time for them to be applied on the projects. In this way students learn how to identify research questions, develop survey instruments, interview people, analyze quantitative and qualitative data, create reports, and make presentations using PowerPoint and other computer software.

"There is so much learning that goes on in this environment, and the project-based learning is the right way to do it because you create degrees of freedom, because learning is messy. It's just like innovation. It's very messy," Navarro says.

The DBA curriculum draws on Navarro's personal and professional experiences, and the advice he received from the 125 experts in various fields that he interviewed while developing the DBA model with private foundation support. The DBA model is an eclectic collection of theories and successful practices. For instance, the team self-management course reflects Navarro's experiences as a team leader at Hewlett-Packard Labs. The movement classes employ kinesthetic learning techniques and aspects of the Feldenkrais method to help students deal with stress. The Bridge Semester uses some of Marcia Heiman's Learning to Learn curriculum. The entire model builds on the latest research of neuroplasticity and the physiological connections between the heart, the brain, and learning.

Navarro notes that many of the DBA students have resided in or now live in violent, socially unstable environments where hypervigilance is essential for survival. Hypervigilance affects the nervous system, making it difficult to sustain the concentration needed for success in school and work. As Navarro explains, "We use everything from ancient breathing techniques to a soon-to-be-implemented biofeedback module to give these students the best chance at success."

Toward that end Navarro continually refines the model based on student feedback. "Our goal is to create a community of practice because we are all learning together," Navarro says, likening the ongoing "tweaking" to rapid prototyping in manufacturing and innovation cycles in high-tech companies.

As he pursues the goal of helping adults rewire their brains so they can succeed in community colleges and beyond, Navarro has even more ambitious plans. He is teaching other community college faculty—15 from Cabrillo and 32 from eight other California community colleges so far—to scale up the DBA model for use in metropolitan areas with large community college populations. The University of California Santa Cruz Center for Justice's evaluation of the faculty institutes and the expansion of the DBA found the new programs work as well with inner city students as they have with the rural, mostly Latino population in Watsonville.

The UC-Santa Cruz evaluators also found that the faculty who learn the DBA model teach their regular courses differently and connect more effectively with their other students. For this reason, Navarro says, "this program could have a greater impact on the system." By the system, he means community colleges nationally. ■

Project TLC's Attentiveness Engages Students in Technical Education

Project Technology Learning Community (Project TLC) recruits students who have talent and promise but who, for one reason or another, do not have a plan for life after high school.

"That's what we are trying to provide: the social support so that they can develop the pathway," says Anthony Benoit, director of Engineering Technology at Three Rivers Community College in Norwich, Connecticut. A cohort structure encourages peer support. The project also provides mentors and tutors throughout the academic year, and internships in the summer.

The support mechanisms begin with Recruiter-Advisor Jodi Calvert. When she visits high schools, Calvert not only makes group presentations, she meets one-on-one with students that guidance counselors identify as individuals who might benefit from Project TLC's extra attention. The students are often from underrepresented minority groups or are among the first generation in their families to go to college.

Student Jacquelyn M. Avery says she was persuaded to enroll just by the way Calvert listened to her and talked with her about what the college could do for her. Other recruiters who visited her technical high school "didn't give me a reason to go the college. They just wanted me there," Avery explains. When Calvert came to Three Rivers' campus, she guided Avery as she does other Project TLC prospects through the enrollment process, which includes English and mathematics placement tests.

Project TLC focuses on students who score just above or just below the cut-off for remediation in mathematics. Benoit explains that this is "because the technology programs are difficult. And if you don't start with college level math, you're not going to make it." Students who score well on the math exam are not invited to join the project because they do not need the additional help, but many of them continue to seek Calvert's advice.

Jodi Calvert, middle, a recruiter-advisor for Project TLC, attended the 14th National ATE Principal Investigators Conference with two students she enrolled in Three Rivers Community College.

Aside from her youthful looks and energy, Calvert converses easily with teens. It is a skill she honed when she owned a retail gift shop that employed lots of teens. Calvert considers the ability to connect with adolescents an innate talent, but notes that effective recruiting begins with listening. "I try to listen to them first," she says, explaining that she does not want any of the students she is in contact with to feel like they are just a number. "I'm amazed, [that] if you give them a chance to talk, how much they'll tell you."

With a bachelor's degree in marketing and a master's degree in secondary curriculum and instruction, Calvert has the background not only to tailor information about the college's technical programs to fit students' interests, but also to make presentations, create marketing materials, and work with high school guidance counselors.

The $1,100 that Project TLC provides in fee waivers and direct compensation does catch students' attention. "Money talks to teenagers," Calvert says, adding, "I don't think they would have started without the hook." When students register for their first fall semester, they receive a $216 fee waiver and $200 for books. When they attend the summer institute, they are paid $8 per hour, up to $720.

Benoit built in the payments and paid summer internships because most of the college's students receive financial aid or must work to pay their tuition. He was concerned that students who need the program could not forgo work to participate in the all-day institute activities in the three weeks before the fall

semester. During the institute, students receive instruction in math, English, and study skills. They also visit local companies that employ technicians, and hear guest speakers talk about the various careers open to people with engineering technology degrees.

"It's awesome. I think the thing that helped us most with the summer program was we got to know each other. I have some great friends that have developed out of this," Avery says. Calvert notes that the students bond amazingly well, and acclimate quickly to the campus by taking their first five core courses with a cohort of students who have become their friends. The paid internships between the freshman and sophomore years of the program are intended to give students work experiences and skills in the fields they hope to enter.

The project also cultivates a cadre of faculty and staff who look out for the Project TLC students. As Project TLC students integrate into courses in their technical fields, awareness grows on campus of the benefits of attentive recruiting strategies and learning communities.

"We hope that the success of the project will encourage the college to think about recruiting in a broader way," Benoit says. Recruiting is one of the many tasks of admissions personnel who do not advocate for particular programs. Three Rivers Community College was created in 1992 with the merger of Mohegan Community College and Thames Valley State Technical College, which was part of Connecticut's restructuring of its higher education system.

"If we had a technology recruiter, it would be very beneficial to the college because obviously the college benefits from having strong, well-attended technology programs," Benoit says. Calvert's position as Project TLC's recruiter-advisor receives support from the college's ATE grant.

As the project progresses, its students are becoming its best advertisements. Calvert notes that whenever possible, she takes current Project TLC students with her when she goes to high schools because they attract other students and impress guidance counselors. Invariably a few hours after a recruiting visit that includes a student, Calvert gets phone calls from guidance counselors offering names of students who they say are like the Project TLC student they just met.

"When they saw a student fired up about it, that's all it took," Calvert says. ■

Women Need to See How Tech Careers Make a Difference

Educators must show people in their target markets, particularly women, how they are going to benefit from technical education programs, according to Donna Milgram, executive director of the Institute for Women in Trades, Technology and Science (IWITTS) located in Alameda, California.

Marketing that simultaneously explains what technicians do and what careers are available through technical education is an essential recruitment tool, she says.

IWITTS used an ATE grant for its WomenTech Project, which helped increase the enrollment of women in technical programs at the Community College of Rhode Island in Warwick, Rhode Island, North Harris College in Houston, Texas, and the College of Alameda in Alameda, California. Work on that project and other IWITTS research led Milgram to conclude that when choosing careers, men care about how things work, and women care about making an impact on the world.

"In testimonials have women say why they like their jobs," Milgram advises. Other strategies IWITTS has found useful for recruiting women include

- Ads that feature women and girls.
- Personal invitations to informational programs.
- Conversations that tell women they are capable of the work involved in technical careers.
- Technology career orientation programs.
- Women in Technology sections on college and program Web sites.
- Media coverage of women working in occupations that traditionally employed men.

Female Students' Recommendations for Recruiting Women to STEM Careers

Forty-five community college students or recent graduates of community colleges showcased their involvement in ATE-supported projects at the 14th National ATE Principal Investigators Conference. Several of the female students shared their insights for recruiting women to careers in science, technology, engineering, and mathematics (STEM). ■

"Law enforcement is becoming less brawn and more brains … they are using more and more of the brain power that people have, and that has been a huge, huge factor in more women going into law enforcement."

Lisa Peterson, Investigative Science Technology Student
Century College
White Bear Lake, Minnesota

"Definitely I think it helps for other females to see females in the program, not strictly males. I think it helps to have a female representative of the program to attract more females to that program."

Holley Thomas, Robotics Student
Central Alabama Community College
Alexander City, Alabama

"Really going in to do hands-on activities with them makes a difference."

Ky'Londa Glaze, Dual Enrollment Biotechnology Student
Robeson Community College
Lumberton, North Carolina

"The best thing to do is offer them an intro class because they don't think they can do this. They think high-tech, they think PhD, they think of scientists … Get them to see that they can do this. You do the buddy system so they know they don't have to do it alone. And the third thing is get them into an internship where they get hooked on a job where they feel respected, where they are actually doing hands-on things."

Shannon Crouch, Microelectromechanical Systems Graduate
Central New Mexico Community College
Albuquerque, New Mexico

"What you can do with women is just tie in [to] their interests. If they enjoy gaming already, just bring them in or make it look good … I'm sure a lot of girls like The Sims, a PC life simulation game, which also has design and architecture elements besides the regular gameplay."

Lauren Robertson, Game Development Student
New River Community College
Dublin, Virginia

Greenville Tech Uses Virtual Reality to Improve Aircraft Maintenance Program and Its Recruitment Efforts

The virtual reality (VR) helmet Greenville Technical College instructors use to teach aircraft inspection techniques doubles as a nifty recruitment tool.

Enrollment grew 20% in the first year that the new, more portable virtual reality equipment became part of recruitment presentations by aviation maintenance faculty from the Greenville, South Carolina college. There were 89 students in the program in the fall of 2006, when the instructors began showing off the helmet designed especially for Greenville Tech by Clemson University researchers. By fall 2007 there were 109 students enrolled in the program.

"We're taking it out to the high schools for show-and-tell," Carl Washburn says of the head-mounted display unit with its binocular eye tracker as well as the other, new VR technologies that can be run from laptop computers. Washburn is head of Greenville Tech's aircraft maintenance technology department and the principal investigator of the Virtual Simulated Inspection Laboratory (ViSIns). This ATE project is the latest endeavor in Greenville Technical College's partnership with Clemson University researchers whose work on VR for aircraft maintenance applies to the nuclear energy and health care industries too.

VR is a particularly promising instructional tool for aviation technology programs because few community and technical colleges have the money or space to keep large aircraft. Instructors can also adjust VR scenarios for new aircraft and to show the effects of aging on aircraft. "As defects change we can import them to the program," Washburn says.

The "instantaneous feedback" VR provides to aircraft maintenance students and instructors adds to its value. "They [students] are learning the inspection techniques. We're actually able to watch them [do inspections]. Then they're able to review it," Washburn explains. The VR equipment Clemson University researchers developed for Greenville Tech enables instructors to monitor students' performance—what they look at during inspections—and to review with students what they actually checked and not just what they think they saw.

VR's use as a recruitment tool has been possible only in recent years as the technology has become more sophisticated, more portable, and less expensive. Washburn attributes the enrollment growth in Greenville's program to the more engaging recruitment presentations using VR and the program's new articulation agreement with Embry Riddle Aeronautical University.

"It can be a wonderful recruitment tool," says Anand Gramopadhye, an industrial engineering professor at Clemson University. He is co-principal investigator for Greenville's current ATE grant for the ViSIns project, which focuses on VR's applications for teaching nondestruction testing techniques to aviation maintenance technicians. This current ATE project extends the collaborative relationship between Greenville Tech and Clemson's industrial engineering researchers that began in 1999 with a NASA grant to Clemson. In Clemson's subsequent Federal Aviation Administration grants, Greenville Tech has served as a test site to determine whether virtual reality improves the quality of aircraft inspections.

For this and a previous ATE grant, Greenville's instructors have taken the lead, setting the specifications for software and hardware they need for simulations to match the sights, sounds, and other physical qualities of aircraft maintenance facilities. The Clemson researchers also analyze VR's effectiveness with the technical college students.

"Training has been identified as the primary intervention strategy to improve the quality and reliability of aircraft inspection," according to Clemson's industrial engineering department's Web site summary of its aviation maintenance research. Of VR's usefulness in inspections, Gramopadhye simply says, "We know that it improves performance." ■

Math and Science Skills Essential to Compete Globally

Community colleges' efforts to improve mathematics and science instruction should dovetail with other initiatives that make these subjects relevant to students and their parents, urges Norman L. Augustine, retired chairman and chief executive officer of Lockheed Martin Corporation. He chaired the National Academy of Sciences panel that wrote *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*.

"We need a populace as a whole who can understand the rudiments of technology," Augustine said during his address at the 14th National ATE Principal Investigators Conference.

The *Gathering Storm* report is really about American citizens' ability to compete for jobs. "Because in the past we had to compete for jobs with our neighbors, people down the street by and large. Today, and [with] the workforce of the future, we are going to have to compete for jobs all around the world, not just with our neighbors who happen to be physically nearby. That's the fundamental change that underlies most of what we concluded," Augustine says.

Although much media attention is paid to jobs going overseas, the Manufacturing Institute reports that the shortage of skilled workers is what is holding back greater growth of domestic productivity and output. Eighty percent of the U.S. manufacturers who responded to the institute's survey in 2005 reported they could not find enough people with the mathematics, science, and technical skills needed to fill all their job openings.

The skills gap is one of the factors that prompted the National Association of Manufacturers (NAM) to start its "Dream It. Do It." careers campaign. Its goal is to make manufacturing a preferred career choice by 2010. The effort addresses misperceptions about manufacturing. It also offers information to young adults, their parents, and educators about the opportunities in manufacturing and the skills needed to obtain modern manufacturing jobs. "Dream It. Do It." creates community-based coalitions with community colleges and other education entities, civic organizations, government agencies, and businesses to generate interest in manufacturing and expand educational opportunities.

"It is the high performance workforce that drives product innovation and the ability to produce high quality products at low cost. So the shortage of skilled workers in manufacturing poses a triple threat unless we find ways to fill the skills gap and build a better pipeline of new, skilled workers. . . . The common perception that being the low-cost producer is the only factor that leads to business success does not match today's reality: It's the performance of the workforce that provides America's competitive edge," according to *Manufacturing: Engine of U.S. Innovation*, a Manufacturing Institute report. The institute is NAM's education and research arm.

Palau Community College students, in the Republic of Palau, measure the carapace of an Olive Ridley Turtle, a protected species, as part of a regional conservation project. The students are learning from instructors who have received professional development support from the Partnership for Advanced Marine and Environmental Science Training for Pacific Islanders, an ATE project coordinated by the University of Hawaii's Kewalo Marine Laboratory. Twelve environmental and marine science students are paid salaries or receive tuition assistance from the ATE project for their research activities. The ATE grant also provides equipment and supplies to the six Pacific Island community colleges where the project aims to develop local capacity and reduce islanders' reliance on expatriate expertise. The overall goal of the ATE project is to help indigenous people obtain the technical skills in the marine and environmental sciences that they need for careers with government agencies, nongovernment organizations, and the private sector.

Pennsylvania Project Focuses on Middle School Students

Poker chips, of all things, can attract middle school students to a career night. Or at least they did in southwestern Pennsylvania. There students flocked to the Steel Career Center's open house to use an injection molding machine to complete their sets of coin-like chips.

The traffic that Making Money demonstrations generate is a happy marketing surprise for Stanley Komacek, the principal investigator of the Advanced Manufacturing in Pennsylvania project. The ATE-supported coalition of Pennsylvania universities and community colleges promotes manufacturing and other science, technology, engineering, and mathematics (STEM) careers with middle school students and their parents.

By piggybacking on activities like the Making Money program developed by Cleveland educators, and using curriculum such as Project Lead the Way, the coalition connects and leverages initiatives.

In the case of the Steel Career Center open house, the fact that

Teacher's Enthusiasm for New Technology Spreads Changes Throughout Middle School

South Park Middle School, in suburban Pittsburgh, exemplifies what can happen when educators embrace new technologies to teach science, technology, engineering, and math (STEM) subjects and encourage STEM careers. The computer numerical control (CNC) milling machine and instruction in its use, which were provided by the ATE grant, instigated a major revision in the school's technical curriculum and led to other energizing changes at the school.

"Look, this isn't woodshop anymore," says Josh Cramer, the teacher in the department now called Applied Engineering and Technology Education. When Cramer started teaching at South Park after graduating from California University of Pennsylvania in 2005, all 750 students in grades five through eight sanded blocks of wood "to make something cute" during 22-day rotations through his classroom.

To make the most out of having the CNC machine, he now has only seventh and eighth graders who complete 90-day rotations that emphasize the science of technology. Students also have the option of taking electives in design and modeling, and automation and robotics. These new courses touch on the latest advances in digital electronics and three-dimensional modeling. An engineering and technology career unit is now a part of every class, and the eighth-grade teachers now integrate career exploration activities across all subjects for two weeks.

"We've really shifted some opinions and sparked some interest," Cramer says. He sees differences in students' attitudes and aspirations. The children of engineers seem affirmed in their plans to become engineers, while other students are gaining confidence in their potential to pursue technical careers.

South Park Middle School students use a computer numerical control milling machine and other equipment provided by the ATE Advanced Manufacturing in Pennsylvania project to build a miniature dragster for the Formula One in Schools Challenge.

There is quantitative evidence of changes at the school, too. In 2007, the South Park Middle School team won the state Formula One competition and finished fourth at the national contest. These successes and $100,000 in grants from various sources have given a boost to all of the students and teaching staff. "The NSF project prompted not only this whole curriculum change, it pretty much changed the whole outlook of the school," Cramer says.

parents had to drive their youngsters to the evening program was a bonus for recruitment activities. "We try to educate the parents because we believe they are influential in their kids' career decisions," says Komacek. He is chairman and professor of Applied Engineering & Technology at California University of Pennsylvania. The partner institutions are the Community College of Alleghany County in Pittsburgh, Pennsylvania, Harrisburg Area Community College in Harrisburg, Pennsylvania, and Millersville University in Millersville, Pennsylvania.

"Kids at this middle school level are still reflecting their parents' attitudes about careers," Komacek says, noting that for manufacturing that has not been a good thing. Manufacturing ranks at the bottom of preferred careers in a survey of 1,200 Pennsylvania parents and teens by the Society of Manufacturing Engineers.

Carol Adukatis' disappointing experiences with recruiting high school and community college students into manufacturing programs was another impetus for the project's focus on middle school students. "Advanced manufacturing is a tough sell," says Adukatis, the Pennsylvania State System of Higher Education's coordinator of a 2+2+2 Workforce Leadership grant that recruits young adults to manufacturing. She is a co-principal investigator of the ATE grant.

Adukatis encountered two huge barriers while recruiting young adults: inaccurate perceptions of manufacturing careers and inadequate academic preparation. "Parents and guidance counselors don't know what the company down the street does," she says, explaining that this lack of information about modern manufacturing means that key adults direct students toward other careers. This lack of accurate information hampers even students who are inclined toward manufacturing. "Sometimes the students are eliminating themselves because they haven't taken the right courses," she says, noting that trigonometry and calculus are required for entrée into many advanced manufacturing careers.

So at events where teens mold poker chips or race miniature Formula One race cars, Pennsylvania educators and industry representatives talk with parents about the clean working environments, good salaries, and career opportunities available at manufacturers. The many technical career pathways that begin at the region's community colleges are the focus of these formal and informal conversations, which direct parents and students to high school courses that will lead to associate degrees in technical fields.

In its role as facilitator and information resource, the project helps staff summer STEM camps and encourages the expansion of BattleBots IQ, which are competitions by student-built and remote-controlled robots, and Formula One Technology Challenges, which are races involving student-built, carbon dioxide-powered miniature cars. The project also collaborates with the Pittsburgh Technology Council's Adventures in Technology program, which places teams of high school students with industry partners to solve real product, system, or service problems.

"We're not doing anything new in terms of curriculum or [student] competitions. Our focus has been to get teachers the resources they need," Komacek says. Adukatis sees the growth of these competitions during the grant, and the increasing enthusiasm of students and parents attending them as evidence that the project is making an impact. She hopes to replicate the success of the ATE grant at five regional STEM centers that are starting with support from a $500,000 National Governors Association grant. ■

> ***"In addition to the obvious preparation of the technical workforce that you do, the accessibility from both an affordability standpoint and geographic standpoint that community and technical colleges offer is surpassed by none."***
>
> **— Cathleen Barton**
> **U.S. Education Manager**
> **Intel Corporation**

RapidTech Readies Students, Faculty for New Manufacturing Technologies

Saddleback College Student Will Graff's work in the lab of RapidTech, the National Center for Rapid Technologies, reflects the variety of projects and quick turnaround typical of advanced manufacturing operations. Long before graduation Graff has had the satisfaction of seeing products he has worked on in use or for sale.

"Being able to build what you design is great," Graff says. He considers a Saddleback instructor's suggestion that he take a rapid prototyping course "the best thing that has ever happened to me."

Graff is one of several students who are paid, part-time employees of RapidTech's lab on the community college campus in Mission Viejo, California. The lab is equipped with $3 million in three-dimensional scanners and high-end prototyping equipment. It serves not only as a classroom for students enrolled in Saddleback's Rapid Digital Manufacturing Program, it operates a technology transfer assistance service, a training center for Materialise (a Belgium-based software company), and a beta test site for several other corporate partners.

The blend of activities is part of the center's sustainability plan and its faculty's strategy to stay at the forefront of advanced manufacturing. The field is evolving so quickly with so many different applications that it has various names, including digital manufacturing, rapid prototyping, additive manufacturing, and additive fabrication. By whatever name, rapid technologies provide a glimmer of hope for U.S. manufacturers.

"We really believe this is going to be the future of manufacturing in this country," says Ken Patton, principal investigator of the ATE center grant and Saddleback's dean of business and economic development. Patton expects the new technologies to help U.S. companies make the most of their edge in design and to expand with more customized production.

The Saddleback College program used its first ATE project grant to develop an associate degree curriculum in rapid prototyping. An industry group now advocates the standards Saddleback established with industry input as the national model. Saddleback's initial focus on small manufacturers in Southern California quickly broadened as faculty responded to requests from hundreds of companies for help applying rapid technologies in health care, art, animation, architecture, and even archaeology.

As a national ATE center, RapidTech continues to provide professional development for community college faculty while it develops a distance education curriculum for incumbent workers.

"Saddleback's focus on developing and publishing curriculum, coupled with its nationwide network of educational institutions, sets it apart," says Terry Wohlers, an international business consultant who specializes in rapid product development. Wohlers sees the challenge for Saddleback and other educational institutions as anticipating "the changes in systems and materials and how they are being used in the private sector." Wohlers points out that effectively using low-priced three-dimensional printers requires skill sets different from those needed to operate high-end systems, and that rapid manufacturing of end-use products demands skills different from those used for prototyping.

RapidTech covers the gamut of rapid technology skills thanks to the leadership, knowledge, and teaching talents of Ed Tackett, the center's director. Patton points to the 400 companies that Tackett and students worked with in just two years as evidence that RapidTech is "in essence leading the industry in this technology."

"As far as hands-on real-world experience, it's one of the few places you can go," says Steven Moore, the co-owner and operator of CPM Fastools Inc., a tool manufacturer, and Chesapeake Plastics Manufacturing, an injection molding company. Both companies are in Maryland.

Moore and his business partner, Mark McGrath, were impressed by Tackett's teaching and RapidTech's equipment during their training sessions to learn Magics, the Materialise software that runs their

company's new desktop scanner. "He (Tackett) gets a lot more questions and figures out why it has not worked," Moore says.

They put RapidTech to the test a few weeks after they returned from California when they called Tackett about their problems scanning a cast-iron shell-shaped piece used on the base of light poles in Washington, D.C. They had an order for 15,000 plastic replicas of the piece. When the four- by three-inch piece arrived at RapidTech, Tackett directed Graff, the student lab technician, to scan it with a laser. Graff then entered the scan data into computer-aided design software from which he built a prototype of the piece using stereo lithography and fused deposition modeling equipment. For two weeks, Graff and Tackett refined the details of the piece's digital file with Moore's emailed input. When they were done, Moore downloaded the digital file in Maryland, built a prototype for his client to test, and then created the tools for the injection mold that was used to make the 15,000 shell-shaped pieces.

Graff knows that the skills he used on Moore's project are in demand; he has had job offers from other companies that have contracted with RapidTech for technology transfer assistance. But Tackett and Patton have convinced him to finish his associate degree in drafting technology in 2008, and then transfer to California State Polytechnic University, Pomona. Given the positive things that have come his way since he followed another Saddleback faculty member's advice, Graff is confident about his plans. ■

Interactive Online Program Meets Energy Technicians' Needs

Bismarck State College (BSC) uses sophisticated distance education technologies to teach technicians whose strategic work was practically invisible until 40 million Americans and 10 million Canadians lost power on August 14, 2003.

The cascade of equipment failures and human errors that contributed to the largest blackout in North American history prompted federal regulators to require educational certification for the system operators who move electricity through the grid that connects generators to consumers across the continent.

"That was really a blessing in disguise," says Daniel Schmidt, energy technology online manager at BSC, of the way the blackout revealed systemic vulnerabilities.

The blackout has also been a bit of a boon for the Bismarck, North Dakota college's Energy Transmission Systems Technology (ETST) program. It grew from 10 students in 2003 to 52 in October 2007. The 18-course, online associate degree program is the only one of 19 programs approved by the North American Reliability Corporation that is offered by a community college. It is one of only two approved programs that grant college credit along with continuing education units. ETST courses are offered one at a time in multiweek blocks that accommodate operators' shift work.

"These guys can earn a college degree and retain their credentialed status," Schmidt says. The college used an ATE grant to create the ETST courses with advanced simulations and animations.

These interactive learning tools were so successful, Schmidt explains, that they encouraged the faculty to develop WebLab©, a Web-based power laboratory for hands-on energy education with a Course, Curriculum, and Laboratory Improvement grant from the NSF. WebLab is now a part of the online curricula for BSC's ETST, power plant, nuclear power, and electric power group programs. ■

Repackaging, Recruiting, and Infusing Photonics and Robotics Revives Indian River Community College's Electronics Program

Chrys A. Panayiotou approached the enrollment decline in his electronics program like the engineer that he is: It was a problem to be solved.

Nationally, enrollments in community colleges' electronics programs have been dropping for years, so having only eight electronics engineering graduates in 2005 from Indian River Community College (IRCC), was not a unique situation. It was, however, a trend that Panayiotou, an electronics professor and chairman of the electronics engineering technology department at IRCC in Fort Pierce, Florida, was unwilling to accept.

"I had to do something drastic," he says. First, he scrutinized how popular proprietary colleges attract students to their more expensive programs. He came away favorably impressed by their marketing and recruiting. Then he partnered with the National Center for Optics and Photonics Education (OP-TEC), an ATE National Center of Excellence in Waco, Texas.

His solution, supported as a subawardee of OP-TEC's national ATE center grant, includes adding photonics and robotics to IRCC's electives, hiring a recruiter, jazzing up the program's marketing with full-color brochures and high-tech videos, and repackaging part of the electronics program into an institute with an aura of selectivity.

Enrollments have quadrupled from 40 students in 2005 to 160 in 2007.

"It is surprising," Panayiotou says, crediting much of the growth to Julie Ann Clark, program specialist for the advanced technology division, who returns from recruiting presentations not just with the number of students she spoke with but also with the names of prospective students.

"The most effective of all recruiting methods is the one-on-one contact between the recruiter and the prospective student," Panayiotou says. Clark, a parent of young children and recent recipient of a marketing degree, relates well to her target audience of high school students and young adults. She catches their attention by talking about lasers, fiber optics, photonics and robotics. "We don't use the word "electronics" until after we get their interest," Panayiotou explains. Clark starts her recruiting with group presentations, and then follows up at the high schools with personal conversations with any student who notes an interest in the institute or IRCC on the prospect cards she collects at the group presentations. From there, Clark shapes her conversations with prospective students according to what they tell her.

"It just depends on where they're coming from. I try to listen first and then work with what they want," she says, adding that she pays particular attention to students' hobbies and whether they like hands-on work. She tries to shepherd any student's interested in IRCC, regardless of their intended major, through the placement testing and enrollment process. She helps students connect with the college's tutoring services if they need help in particular subjects. "I try to treat each of these people as if they were me or one of my children," Clark explains.

The other, somewhat counterintuitive change that is producing results is the creation of the Robotics and Photonics Institute. The institute has the same courses that the electronics department offers during the day and evening, but requires students to apply for admission, pass English, math, and reading placement tests, and enroll full-time. The placement test ensures that the institute's students have the fundamental knowledge to move as a cohort through classes that meet from 8:00 a.m. to 12:30 p.m., Monday through Thursday for five consecutive semesters.

The institute's entry requirements go against the conventional thinking about what community college students need and want. "Your program is dying; you are just going to kill it," Panayioutou remembers colleagues warning him about the placement test and rigid scheduling. But he thought the flexible scheduling just added to the college's problem of filling electronics classes. When sections were

cancelled due to low enrollment, it made it harder for students to graduate on time and many simply gave up. He thought scheduling the classes in a block would ensure that students could get all the classes they needed to graduate in two years. He also thought that having students progress as a cohort would create a peer group that would help students maintain their momentum.

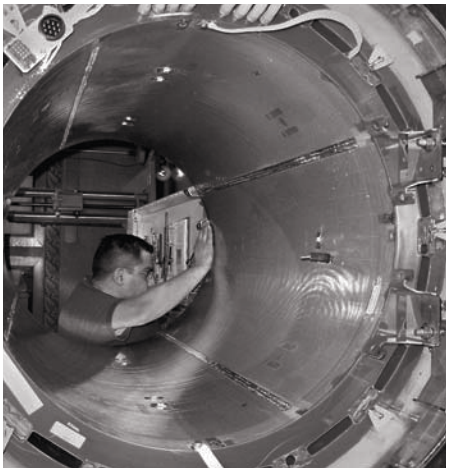
Evidence from the institute's first two years indicate he may be right. When the institute's entry requirements are combined with the efforts of the part-time recruiter and glitzier marketing, they seem to add to prospective students' interest.

"Because of the way we have the program as an institute, and the fact that they [students] have to fill out an application, they have to promise or agree that they will go to school full-time, which makes the program more desirable," Panayiotou says. It is not just that it seems special, Clark adds. For traditional college-age students the institute's schedule is a pleasant change from the all-day, every weekday requirements of high school. She has observed that the institute schedule leaves students with plenty of time for socializing and part-time jobs; and that being in a cohort creates camaraderie among students who talk together and play hackie-sack during class breaks.

When prospective students see IRCC's new classrooms and lab, it often seals their enrollment decisions. But, as Panayiotou points out, the electronics program moved into the Kight Center for Emerging Technologies in 2005 when enrollments were at their nadir. Evaluators are studying the relative importance of the various changes on enrollments, but for now Panayiotou is happy to be getting calls for the first time in his career from parents making appointments to visit IRCC's institute with their teenagers.

There were 60 applicants for the 24 places in the institute's second cohort that began in September 2007. Most of the students are right out of high school, but eight are between 30 and 45 years old; four of the older students are women, which is quite unusual in electronics. Applicants who did not score well enough on the placement tests were directed either to the identical electronics core courses and electives that the department offers at other times, or to remedial courses. Although the institute's cohort is limited to 24 because of the size of the electronics lab, the overall enrollment of IRCC's electronics program has rebounded to 1997 levels.

The number of graduates has risen, too. More than 90% of the first institute cohort, which began in fall 2006, will graduate in spring 2008. In addition to the 22 institute students on track to graduate, 10 students who attend evening classes will graduate as well. Panayiotou attributes the institute's high completion rate to the higher-caliber students agreeing at the outset to the prescribed schedule.



A graduate of Indian River Community College's electronics engineering technology program adjusts the inner drum of a magnetic resonance imaging (MRI) system. MRIs use photonics technologies.

Through OP-TEC's network of industry partners, IRCC's program has come to the attention of national manufacturers who now send recruiters to campus looking for field service technicians. "We've just started and the word is spreading," Panayiotou says, referring to the $55,000 annual salaries some of the companies offer to entry-level employees.

Panayiotou is pleased with the results, but does not consider the enrollment equation solved. It, like the field of electronics, is a constantly moving target. He is now working with OP-TEC on curricula that marries photonics with nanotechnology's evolution, and general electronics courses with alternative energy sources.

"You have to be continuously tuned to what's going on out there, and use the right words and the right approach," he advises. ■

TECHcitement

Successful Practices for Sustaining Technical Education Programs

Educators involved in the Advanced Technological Education program offer the following suggestions for sustaining technical education programs.

- Use effective communication strategies to inspire, motivate, and empower students to develop and achieve career goals.
- Inform parents about the importance of math and science education, and the value of technical education programs.
- Educate high school guidance counselors and teachers about advanced technology career opportunities for their students.
- Build relationships with employers by listening to them and responding to their workforce needs.
- Align your technical education program's goals with the college's mission.
- Take the initiative to keep your college president and other administrators informed about your program's activities.
- Supply the president and other administrators with data about your students' achievements and your program's community outreach.
- Present information about your program to the faculty senate.
- Teach other faculty about your technology in formal and informal faculty development programs.

For more information on the ATE program, please see:

National Science Foundation
www.nsf.gov/ate

ATE Centers Impact
www.atecenters.org

ATE Projects Impact
www.ateprojectimpact.org

American Association of Community Colleges
www.aacc.nche.edu/ateprogram

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