TECHcitement

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Advances in Technological Education

ATE Changes the Way People Learn and Work

Advanced Technological Education (ATE) programs, funded by the National Science Foundation (NSF), are changing how people learn and work throughout the nation. In the 10 years since the first grants were awarded, the impact of the ATE programs has spread beyond the projects and centers directly funded by NSF to schools, colleges, universities, businesses, and industries that are changing their practices to emulate new, ATE-developed best practices. The relationships between universities and community colleges, in particular, have been enhanced by substantial content-based collaborations initiated by the grants.

This cycle of innovation continues to expand as the principal investigators of ATE programs pursue larger, more complicated proposals. As the nation's basic researchers in the development of effective technician training, ATE grant recipients generate scientific advances and influence pedagogical improvements across disciplines and academic levels. In addition, their work invigorates the economy. Examples of advances in education that are a direct result of ATE programs include the following:

• Aquaculture instructors at Hillsborough Community College in Tampa, Florida, developed methods to cultivate live rock—coral with living marine organisms on it—with their ATE grant. Their new propagation methods have revitalized an industry that ceased when the U.S. government banned the collection and sale of natural live rock because of overharvesting.

"NSF's vision is to enable the nation's future through discovery, learning, and innovation, and community colleges are helping us realize this vision."

—Joseph Bordogna, deputy director and chief operating officer of the National Science Foundation

• Pacific Gas & Electric donated $600,000 in equipment to the power and control lab at Cuesta College in San Luis Obispo, California, because of the success of the California Regional Consortium for Engineering Advances in Technological Education (CREATE), funded in part by ATE grants. Students who learn to use the equipment qualify for paid internships at the utility and acquire trouble shooting skills useful to local wineries and other industries that have their own power systems.

• The 21st Century Urban Technical Education Project—a joint venture of the Milwaukee Area Technical College, the Milwaukee Public School District, and the University of Wisconsin-Stout with support from ATE grants—will use its synthesis of standards-based education reforms at the Lynde and Harry Bradley School of Technology. Private donors contributed $50 million toward the construction of the new technical high school, which will serve as a model for innovative curriculum and creative teaching.

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AMERICAN ASSOCIATION OF COMMUNITY COLLEGES

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ATE Changes the Way People Learn and Work

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• L-SITES (Learning through Simulated Information Technology Enterprises) demystify entrepreneurship for information technology and business students. This capstone course uses realistic workplace scenarios developed with ATE grant support to give students various perspectives on how to cope with marketing, financial, and technical problems at fictitious companies. The Regional Technology Strategies network that manages the project includes 10 U.S. community colleges and colleges in Ireland, South Africa, and Finland. All the colleges act as "other firms" with whom students may interact during the simulations.

Joseph Bordogna, Deputy Director and Chief Operating Officer of NSF, places ATE principal investigators at the vanguard of the technology revolution. During his address at the 2002 National ATE Principal Investigators Conference, he had this to say:

"The National Science Foundation is all about people and that includes all of you who are part of the Advanced Technological Education program. We are all partners in an enterprise that has far-reaching consequences for the prosperity, security, and well-being of our nation: preparing the 21st century workforce. We are on a journey whose roadbed enables society's heavy traffic to flow with vigor and success. …Technology is the very [foundation] of our economy and society. It enables us to compete in a global marketplace, raises our prospects for productive and satisfying lives, and strengthens our national security. Technological innovation moves forward hand-in-glove with the fresh science and engineering knowledge that drives it."

The rapid pace and increasing complexity of technological change, he added, "has irreversibly altered how we prepare ourselves to understand, control, shape, and embrace and exploit" new knowledge. For this reason, improving teacher preparation runs in tandem with the goal of improving technician education.

Most of the 480 grants made since the first round of ATE funding in 1993 have either directly or indirectly sought to improve training for secondary school teachers and community college instructors. "What we require of our students, we need to practice ourselves. We must be as knowledgeable, as easy with risk, as proficient in innovation, as comfortable with inclusiveness, as alert to the human and social aspects of our work, as we ask our students and workers to be," Bordogna said.

The 220 grants currently funded fit into two general categories: centers and projects. The 22 National, Regional, and Resource Centers of Excellence focus on improving a discipline, such as information technology or manufacturing, in ways that can be replicated nationally. National centers typically receive $5 million over four years and may receive lower levels of funding for additional years. Regional centers receive $3 million over four years, and resource centers receive $1.5 million over four years. Grants given to projects concentrate on specific aspects of technician training, or on math and science instruction. Project grants

"This is a premier NSF program. NSF has engaged in a lot of good programs over the years. I've never known one where the relationship between the program officers and the project people was as strong and as helpful," Arlen Gullickson with the Western Michigan University Evaluation Center, said of the ATE program. "There's a sense of community here that I've never seen before with other NSF grant programs, and I've been involved with NSF projects for well over 30 years now."

average $400,000 and generally last two to three years.

NSF has awarded $260 million in ATE grants since Congress passed the Scientific and Advanced Technology Act in 1992, which designated community colleges to lead this strategic effort. The first grants were made in 1993.

ATE grants constitute the largest federal commitment to community college curricula and programs, according to the Community College Resource Center at Columbia University. With about 20 percent of the nation's 1,132 community colleges receiving at least one ATE grant, the program may soon reach the critical mass necessary for the accomplishments and lessons learned through ATE projects and center activities to permeate all types of technician training. Information technology, semiconductor manufacturing, and process technology are just a few of the industries that use ATE innovations to determine how their technicians are trained.

NSF program officers and reviewers considered 200 applications for $40 million in new and continuing grants that will be announced in spring 2003.

For more information on the application process, see www.nsf.gov/ate

The stories that follow illustrate how ATE grants are changing industry practices, improving math, science, and technical instruction, and influencing individual students and the nation in substantial, important ways. ■

UC-Davis' Bioinformatics for Community College Faculty Moves Students to High Tech's Leading Edge

For several years American River College in Sacramento, California listed a bioinformatics course in its catalog but did not include it on the master schedule. "We hadn't offered it because we didn't know how to teach it," says Professor Lori Smith, whose PhD is in biochemistry.

Although she was a research scientist at a biotechnology company before joining American River's faculty and is younger than the average community college instructor nationally, bioinformatics was not a scientific field when Smith was in graduate school. The software and other research tools for bioinformatics, a fusion of computer and biological sciences, are now accessible on the Internet.

Bioinformatics, however, is still considered a field in its infancy. By deciding to fund this project, NSF is moving proactively ahead of industry and taking a calculated risk on a promising new technology similar to its backing of nanotechnology in the 1990s and its recent award of a high performance computing center grant to Maui Community College in Kahului, Hawaii.

"I did not even know they existed until I went to the summer institute," Smith says of the Internet resources she learned about during the "Tools to Teach Molecular Biology and Bioinformatics" summer institute at the University of California-Davis.

With its ATE grant, UC Davis' biotechnology program provided the institutes for free. The weeklong residential program included a microbiology foundation course on nucleic acids and proteins and a course on the fundamental concepts of genomics, proteomics, and bioinformatics needed to train students for bioinformatics. The 79 community college instructors from California, Arizona, Texas, and Wisconsin who attended the institutes in 2001 and 2002 have created

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CCSF Students Checking Medical Research Tests

Second-year biotechnology and biology students at the City College of San Francisco (CCSF) will repeat the experiments of a researcher who is investigating a rare genetic disease linked to skin cancer. It is extraordinary for community college students to be involved in basic medical research of any type and quite unusual for students in a classroom laboratory to perform tests in which the outcomes are truly unknown.

The project places students "on the cutting edge. They are going to have to be faced with real failures, just like real scientists," says NSF Program Officer David Campbell. The use of current research experiments without predetermined results is one of the aspects of the Fix-A-Gene project that appealed to NSF program officers who approved $815,000 in funding over three years, Campbell says.

Valerie Natale, who has a PhD in cell biology and virology, proposed the Fix-A-Gene project and is designing three new courses with CCSF faculty. "We're not always going to give them experiments that worked really well. And the thing about it is, because the post-doc [postdoctoral researcher] might have only done this [experiment] one or two times, we don't know how it's going to turn out when you get six groups of students repeating it six times. In a way it will further the research," she says. The project may eventually serve as a model for other community colleges to work with researchers.

Natale hopes the experience of replicating and analyzing ongoing experiments will immediately expand students' understanding of the types of work available in research and other science-related fields. "We want to help them make informed decisions when they go to get a career," she says, adding that this experience with gene therapy research may also help students get internships.

Andrea Cortez, a biotechnology student at the City College of San Francisco in San Francisco, California, performs ELISA (enzyme linked immunosorbent assay) as part of her Molecular Biotechnology class.

During the first new course, CCSF students learn the basics of cell culture and DNA repair. An early experiment requires the students, a group consisting of mid-career people updating their skills and traditional college-age people, to expose xeroderma pigmentosum (XP) cells to sunlight and another source of ultraviolet light and compare the results with what happens to normal cells under the same condition. "Most of the XP cells will be dead when they return two days later," Natale explains, noting that the experiment provides a dramatic way of introducing the students to the phenotypic effects of an XP mutation.

People who suffer from the rare genetic disease known as XP are extremely photosensitive; they should not go outside during the day, but if they do go outdoors they must wear sunscreen, sunglasses, broad brim hats, and multiple layers of clothing to avoid sun exposure. Because of the defect in their systems that would repair DNA damaged by the sun, people with XP have a risk 1,000 times higher than normal for skin cancer. "Many XP patients are diagnosed with their first skin cancers before age ten. Damage is cumulative, which is why any exposure to UV light is so dangerous," Natale explains.

In the subsequent courses the students will learn about what the postdoctoral researcher is trying to achieve with his experiments as they retest them. The researcher is working on XP cells at the University of California-San Francisco laboratory of James Cleaver, the dermatology

professor who discovered the XP gene. Cleaver has found that XP genes, DNA repair, and cancer are all related, so new XP findings are considered important for the information they potentially provide about skin cancer.

Plans for the new courses call for the students to repeat experiments, analyze the researcher's results, compare his findings with theirs, speculate on the researcher's results and hypothesize about what he should do next. "The idea behind it is that it will show them if you want to go into research science this is what you are going to spend your days doing. And if you want to do it at the PhD level you'll be designing these experiments and deciding what to do next. And if you want to do it at the master's level or below, then you'll be doing more at just the execution of the experiments rather than at the design of them," Natale says.

A mock lab will eventually be set up at the community college so that students can have the experience of performing different staff jobs. Natale is also collecting anecdotes and other information from people who work in various scientific fields for a career database.

For more information, see www.xps.org

"We want to let them know there are lots of different things that they can do with a degree in science that are not necessarily related just to research," Natale says. ■

UC-Davis' Bioinformatics

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new courses and updated or added modules to existing courses.

As informative as the institutes' lessons were, American River biology professor Ken Kubo said the attentiveness of UC-Davis faculty members afterward has perhaps been more valuable in advancing the community college's offerings. After the institutes, UC-Davis biotech faculty members continued to work with Kubo and Smith on developing the curriculum for two new courses: Introduction to Bioinformatics, and Molecular and Programming Applications in Biology. They also used their personal networks to get scientists from academia and industry to join a focus group about trends and job requirements in bioinformatics. "That was really helpful for us in developing our program," Kubo says. The ATE grant was critical in creating the new bioinformatics certificate program at American River and forging a better relationship between the community college and the research university. Prior to the grant, Kubo says he and his colleagues had very little contact with UC-Davis.

In fall 2002, 17 students took American River's new biotech course. It combines computer technology and biotechnology with 14 hours of laboratory instruction and 14 hours of lectures. Course activities did not include wet chemistry, but students analyzed the results of other researchers using the latest Internet and software tools.

Though the enrollment is small and additional grants are needed to add a course on how to create biological databases, Kubo and Smith point out that UC-Davis' ATE grant has already moved their students closer to high tech's leading edge. "It certainly looks good on your resume to have exposure to the tools of bioinformatics," Smith says. While it is uncertain how many biotech jobs will exist in the future, Smith hopes a company that produces postage-stamp-size gene sequences at a facility near American River's Sacramento campus is a harbinger of future opportunities for her students. ■

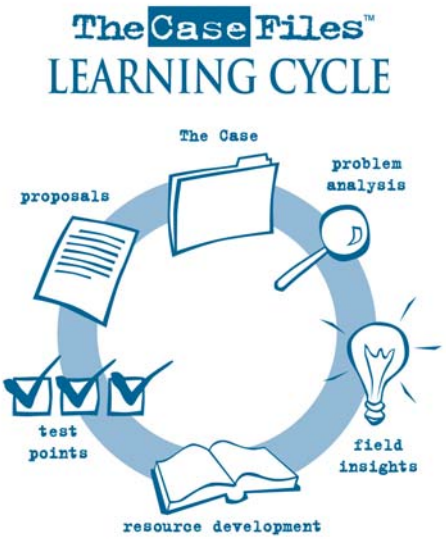
ATE Bridging Gap between Researchers and Practitioners

Cognitive scientists and community college educators are bridging the gap between educational theory and practice. The goal of their collaboration is a case study-based curriculum that melds new research on how learning happens with leading edge technology training. They want to come up with a model that transforms the way community colleges teach and develop technicians.

The result of this partnership has been The Case Files™, the first systematic use of problem-based scenarios for technology education. So far the case studies have focused on engineering technology and information technology. The educators hope to eventually develop case studies to train technicians for biotechnology, agriculture, and other fields.

Ironically, the leaders of this effort, including internationally renowned cognitive psychologist John Bransford, all worked in Nashville, Tennessee, separated by less than a five-minute drive and academe's traditional Balkanization.

Bransford is the Centennial Professor of Psychology and Education at Vanderbilt University, where he is codirector of the Learning Technology Center. Sydney Rogers and Jim Johnson, principal investigators of the Case Files ATE grant, are on the faculty of Nashville State Technical Community College, not far from Vanderbilt.



This template is based on a learning cycle that was developed and piloted at Vanderbilt University and subsequently adapted by the South East Advanced Technological Education Consortium (SEATEC) for use in technological education.

Rogers says she knew of Bransford's learning research, but that it was Gerhard Salinger of the National Science Foundation who introduced her to Bransford. "I take it as one of my accomplishments at NSF that I have sort of been midwife to the process of getting Vanderbilt and Nashville Tech working together. I am very proud of that," Salinger told the ATE principal investigators who were gathered to hear John Bransford address their conference in October 2002. As colead program director for the ATE program at NSF, Salinger shares responsibility for the ATE program with Elizabeth Teles, acting director of the Division of Undergraduate Education.

At the time she met Bransford, Rogers says she and her colleagues had completed their first ATE grant to develop a telecommunications curriculum. Part of this project involved sending faculty on internships. When many of them returned to campus brimming with stories, the team agreed they had to come up with a way to capture those experiences. "We need to somehow bring those experiences they had out there in industry to the students. We said, 'Let's just write the case studies,'" Rogers says, describing the brainstorming that resulted in 25 rudimentary case studies now posted at www.nscc.edu/casefiles.

About this same time, Bransford, along with others who served on a National Academy of Sciences committee to synthesize the latest theories on learning, reported in *How People Learn: Brain, Mind, Experience, and School* that opportunities to improve education are missed because teachers and researchers rarely work together.

"Practitioners typically have few opportunities to shape the research agenda and contribute to the emerging knowledge base of learning and teaching," they wrote. They called for links between researchers and practitioners that would allow information to travel in both directions with "researchers shaping

practitioners' understanding and practitioners shaping the research agenda and researchers' insights."

The experimental link in Nashville has proceeded so well that The Case Files™ won an ATE regional center grant to seek case studies nationally. "John Bransford gave us a big boost," Rogers says, explaining that researchers from Vanderbilt and Auburn University's Laboratory for Innovative Technology and Engineering Education Center review the case studies drafted by community college faculty. "The Learning Cycle," the model that anchors each case study was adapted from findings reported in *How People Learn*. "If our faculty [members] use those concepts in their development, they begin to understand the rationale and the research behind the pedagogy," Rogers says.

The technical expertise of the community college faculty has informed the researchers' work, too. "I'm really a great fan of community colleges and a great fan of NSF programs. I think both are just incredibly important for our nation," Bransford said at the 2002 conference of ATE principal investigators.

The close working relationship that has developed means that the researchers and educators have new respect for each others' contributions. The change has implications for both institutions. "Vanderbilt University Hospital is the second largest employer of Nashville Tech's graduates because it is the second largest employer in the city. But we did not have a professional [relationship]. They hired our graduates and they were pleased with them, particularly our technical graduates. But as far as working together, we had never done that in terms of education. Now they are working with us on all our projects," Rogers says, adding, "It is changing. I can see it." ■

NSF Project Improves Farm's Bottom Line

For a new generation of family farmers, precision agriculture may hold the key to profitability. Brandon Karcher, an agriculture student at Jackson State Community College in Tennessee, learned this lesson with other agriculture students who gathered detailed data about his family's farm 40 miles east of Memphis. The high-tech equipment the students used was purchased with an ATE grant. Jackson State's precision agriculture curriculum was developed with assistance from the Agrowknowledge Center, an ATE Center of Excellence at Kirkwood Community College in Cedar Rapids, Iowa.

The Karchers used the information—everything from sophisticated aerial imagery to low-tech plant maps and insect counts—to determine how many seeds and how much fertilizer and growth regulator to place on every square foot of the targeted fields. Fully variable rate production, which considers each square foot of a field individually, breaks from the agricultural practice of using soil analysis and other observations to generalize about a field and use those same inputs on all the acreage. "We had one of the best crops we ever had," Karcher says. Good rainfall played a part in the successful crop, but Karcher attributes most of the improved yields to the adjustments the family made based on the student-gathered data.

The technology for precision agriculture—Geographic Information Systems (GIS) and the Global Positioning System (GPS), personal computers, and variable rate controls for seeders and fertilizers—has been around for about a decade. But the complexity and cost of this equipment overwhelms many farmers. Karcher says the Jackson State Community College students' research has "shown people that not only is it [precision agriculture] attainable, but it's a very good technique to use to increase the bottom line on the farm."

The Karchers saved $100,000, or about $100 per acre on the 1,000 acres of cotton they planted in 2002. So they spent $300, rather than $400, per acre to get an average yield of 800 pounds of

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MATE Center

When scientists and educators from two of California's leading science and oceanographic institutions began working together on a grant application for a NSF program to increase public awareness of ocean sciences, a colleague suggested they ask the Marine Advanced Technology Education (MATE) Center to join the partnership as well.

In 1996, an ATE grant created the MATE Center at Monterey Peninsula College, a public community college in Monterey, California. In the short time it has been in existence, the center has gained a national reputation for developing marine curricula based on industry standards.

Cheryl Peach, science academic coordinator at the Scripps Institution of Oceanography at the University of California-San Diego, says serendipity led the researchers from Scripps and the Lawrence Hall of Science at the University of California-Berkeley to the MATE Center. But, she says, the community college's students and the center's focus on the technical aspects of marine careers added an important dimension to the scientists' plans. For example, the MATE Center's regional and national competitions for remotely operated vehicles built by middle school, high school, and college students are igniting interest in the oceans, which many consider to be under-explored frontiers ripe with occupational opportunities for scientifically-skilled people.

"It's a wonderful step forward for Scripps to work with MATE because of the grade level and the demographic they represent. They bring another facet to the existing outreach programs that existed here at Scripps," Peach says. She adds that because many of the students taking courses at the MATE Center are preparing for second careers, Scripps now has a connection with nontraditional college-age students, with whom it previously had little contact.

Scripps is an international leader in research on the balance between the natural environment and human activity. Its Birch Aquarium serves as its primary public outreach vehicle, though most of its graduate students and scientists have little direct contact with the aquarium's programs. Prior to the grant application, which resulted in the NSF grant described below, Scripps' contacts with community college students were generally limited to aquarium field trips.

"This is a real change in the level at which you see scientists and engineers connect outside the research they do," Peach says. Now there are "absolutely no barriers to working with MATE" and, she adds, eventually other community colleges as well.

In 2002, NSF awarded a partnership, which includes the MATE Center and that is led by UC-Berkeley, $2.5 million over five years as one of seven new Centers for Ocean Science Education Excellence (COSEE). NSF wants COSEE to serve as a network for ocean scientists and educators to collaborate on an unprecedented effort to increase public understanding of the oceans' influence on the global environment. "We at NSF are encouraging the ocean science research community to become more involved in education at all levels," says James Yoder, director of NSF's Division of Ocean Sciences.

White Rock South Surrey (British Columbia, Canada) teammates Lydia Burnett and Aubrey Senyard make some minor modifications to the electronics can of their ROV GIGO (Group Inspired Girl Operated), which took 3rd place in the 1st annual MATE Center/ Marine Technology Society ROV Committee student ROV competition.

MATE's initial COSEE role is to develop an interactive Web site for a whole array of marine careers. The information MATE Center staffers gathered from employers and the Department of Labor about skills and pay with its ATE grant has already made for an exceptionally strong prototype. "It's a wonderful resource

that will potentially serve graduate students at Scripps, though they are not the primary target," Peach says.

Deidre Sullivan, the curriculum and industry manager at the MATE Center, considers COSEE an extension of the center's original ATE goal to increase interdisciplinary knowledge and technology information. But as Jim Hall, a MATE Center team member points out, without the initial NSF funding to improve marine technology training, the community college faculty would not be working with the nation's top researchers on this national scientific priority.

"Scripps contacted the MATE Center because we can fill a gap in what they want to do. If we didn't have the MATE Center I don't think they would have called us," Hall says, adding, "If not for the [ATE] grant, there would be no MATE Center." ■

ATE Grant Improves Training for Nondestructive Testing

When Bruce Crouse signed up for a summer institute at the Center for Nondestructive Evaluation (CNDE), he was not sure what "looking over the shoulder of a research scientist" would entail. Crouse, the chairman of the Department of Industrial Technology at Cowley County Community College in Arkansas City, Kansas, quickly found that he was not only watching but was also gathering mathematical data for a radiography simulation program now used at numerous community colleges.

Other scientists at the Iowa State University center, which was created in 1985 as a National Science Foundation Industry/University Cooperative Research Center, helped him explore probability-of-detection issues and other aspects of the field he had worked in as an inspector and community college instructor. "That gave us a chance to really apply our side, the technical side. In the process I was able to pick up some of the research techniques they were using," he says. "Before that I was strictly looking at application."

Since finishing the ATE-funded institute in the summer of 2001, Crouse has beefed up his college's math and physics courses to improve students' training for jobs with aerospace manufacturers in Wichita, Kansas, and pipeline companies in Tulsa, Oklahoma. He has also updated a radiography course that uses the software he helped the CNDE researchers develop. Students can now manipulate variables on a computer model, saving the 45 minutes usually needed to develop each x-ray as well as a lot of film.

His new emphasis on math and physics improves students' understanding of various tests and the circumstances under which several techniques should be used to pick up minuscule defects that one method alone might miss. "I think they [the community college students] have a deeper understanding of what that defect is and how to locate it," Crouse says.

Crouse likens nondestructive testing (NDT) to medical diagnostic techniques. "We do what doctors do but we do it on materials," he says. X-ray, ultrasound, magnetic particle, penetrant, electromagnetic, leak, and acoustic emission tests augment low-tech sight and sound evaluations.

Despite the life-and-death importance of the materials NDT technicians check, things like jet engines, bridges, and nuclear power plant cores, the field is not well-known

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Nanotechnology

The Nanofabrication Manufacturing Technology (NMT) Partnership enables Pennsylvania's community college students to complete their associate degrees at a world-class research facility. An ATE grant supports this unique statewide opportunity. As a clever model for making expensive equipment available to community college students, the NMT Partnership assists students and a new industry that needs highly-skilled technicians. It also provides a platform for greater cooperation between a flagship university and community colleges.

"We are not only proud and privileged to be able to support your work, we hope to learn from you the kinds of things that will enable us to shift our own thinking, that make our portfolio more effective over time and to demonstrate to the nation that we are capable together of solving problems that no one even envisioned a decade ago, and which you are working on as we speak."

—Judith A. Ramaley, assistant director of the education and human resources directorate at NSF

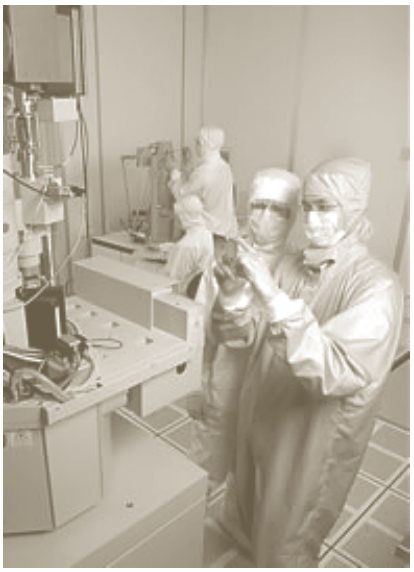
The NMT Partnership brings students from Pennsylvania's 14 community colleges, and more recently the commonwealth's public four-year colleges and universities, to Penn State's main campus for a semester of rigorous hands-on course work at its Nanofabrication facility. The partnership has used its ATE grant to help community colleges revise their courses so that students understand the engineering principles and gain familiarity with the biology, physics, and chemistry necessary for the capstone semester. "Creating a properly prepared nanotechnology technician workforce, which is essential for manufacturing, is probably the most demanding educational task of all," wrote facility director Stephen J. Fonash in the *Journal of Nanoparticle Research*.

Penn State's state-of-the art facility is a charter member of the National Nanofabrication User Network, created by NSF in 1994 at six universities to encourage academic and industrial nanotechnology research. Various companies and universities use the equipment and clean room facilities, which are 10,000 times cleaner than a hospital operating room, on a fee basis or work in conjunction with Penn State's engineers and staff.

Nanotechnology is the study of things that are 1 to 10,000 nanometers in size (a nanometer is the term for one billionth of a meter). Nanoscale fabrication involves building structures with molecules and atoms. Working on such a small scale presents many challenges. For instance, operators of the instruments that enable one to view what is otherwise invisible must make sure they are not disturbing the tiny materials under construction. Although nanotechnology is already used for semi-conductor electronics and other applications, it is such a new field that its potential uses in biotechnology, the cognitive sciences, and other disciplines have yet to be discovered.

Nanotechnology is also not well known outside the scientific community. Part of the NMT Partnership's ATE grant provides information to college and secondary school students and their academic advisers about the opportunities for employment in this emerging field. Starting salaries for nanotechnicians range from $30,000 to $50,000 a year.

Because few community colleges can afford to build and operate a $25 million facility like the one at Penn State, the NMT Partnership gives the community colleges access and allows them to build on their strengths in technician training. "I think it is a beautiful idea," says Rodney S. Ridley, Sr., a staff engineer in advanced process development at Fairchild Semiconductor. Ridley completed his doctorate in



Students working as part of the Pennsylvania Nanofabrication Manufacturing Technology (NMT) Partnership, a National Science Foundation Regional Center for Nanofabrication Manufacturing Education.

engineering sciences at the Nanofabrication facility and serves on the engineering advisory boards for several of the community colleges in the NMT Partnership. The two associate degree graduates that Fairchild has hired from the program "have worked out well," he says.

Despite the intense course work—four hours of lectures and four hours of laboratory exercises daily—the community college students like the capstone semester. For several years special funding from the state provided free tuition and room and board.

"Our students who have gone through the program come back so enthused about the technology they want to go on," says William Mack, an electronics professor at Harrisburg Area Community College. After they complete their capstone experience, the students return to their home colleges for graduation.

The program has also had an effect on Penn State and its relationship with community colleges, according to Doug Fenwick, who worked at the Community College of Philadelphia before he became director of commonwealth education programs for the NMT Partnership. "It has changed Penn State. Penn State never worked with the community colleges," he says. Fenwick credits Fonash with coming up with the idea and leading the collaboration. ■

NSF Project Improves Farm's Bottom Line

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cotton per acre. In addition to the college's equipment the students used at the farm, the family bought $15,000 in computer and farm equipment. The $85,000 net increase in profits has convinced the Karchers to use the technology for their cornfields, too.

The experience has not only changed the family's farming practices, it has also changed how Brandon Karcher views his prospects. The steep price of land and slender profits from cotton made the idea of farming anywhere other than on the land his great-grandfather purchased and passed on to his father seem unrealistic. But after seeing the results of fully variable rate production on his father's farm, the 24-year-old Karcher is thinking about buying a farm after he completes his bachelor's degree in agronomy at Texas A&M. He will finish his associate degree at Jackson State Community College in spring 2003. "If we keep seeing cost reductions, I'll probably buy a farm," he says. ■

Agriculture students Zawacki Ryan Thomas (foreground) and Carter Samuel Bass (background) from Jackson State Community College in Jackson, Tennessee, work on a Variable Rate Planter at Karcher Farms' Shop, Sommerville, Tennessee.

College-Industry Partnerships Change Process Technology

The educational qualifications needed to operate oil and chemical processing equipment have changed in the past 15 years, and in ways that benefit students, colleges, and companies. "They're working safer, smarter, and they're more environmentally aware," British Petroleum (BP) executive Dennis Link says, referring to new operators who have associate degrees in process technology.

The curriculum for these two-year degrees—now the requirement for entry-level positions at petroleum and chemical processing facilities along the U.S. Gulf Coast—was developed by a partnership that includes community colleges, industry, government, and labor unions. This meeting of the minds began in the late 1980s, several years before Congress created the ATE program.

Local efforts grew into a regional partnership known as the Gulf Coast Process Technology Alliance. The alliance helped foster the development of industry-college partnerships in Alaska, New Jersey, Louisiana, Oklahoma, and southern California. Together these six partner alliances helped to create the Center for the Advancement of Process Technology (CAPT).

It is the "close collaborative efforts between education and industry in these six partner alliances" that NSF has supported with ATE project and center grants. The grants have helped expand course offerings and facilitated the development of standards by other process technology industries. The competency-based courses cover instrumentation, equipment, systems, quality control, troubleshooting, safety, health, and protection of the environment.

The ATE resource center grant that CAPT received in 2002 supports the cost of revising the process technology curriculum for oil and gas exploration. It will also help create new courses for technicians in the food and pharmaceutical industries. An earlier project grant helped the center, located at the College of the Mainland in Texas City, Texas, develop texts and courses, including some for the Internet.

A new pilot plant built with $1 million contributed by industry and unions illustrates the type of broad support ATE centers attract. The process technology center, like many other ATE centers and projects, started with local industry and community assistance that attracted state grants. The high quality of these efforts helped the center win NSF grants. The prestige of these awards then attracted other grants and corporate donations.

"ATE is making a difference and industry recognizes that," says Merv Treigle, assistant director of the center and a retired chemical company manager. He estimates that 90 percent of the 3,400 students enrolled in process technology programs at 19 community colleges will obtain jobs immediately upon graduation. "We cannot fill the pipeline fast enough," he says.

John Payne, BP Gulf Coast regional manager, said BP—one of the center's major industry partners—saved $16,000 per trainee by hiring only graduates of process technology programs for entry-level operator positions. During a three-year period when his region hired 221 people, Payne estimates BP saved $3.4 million.

Requiring an associate degree in process technology enables the company to interview fewer applicants to find well-qualified employees, cut its five-week basic operation training

I want to congratulate all of you for your fine work in educating and training America's technological workforce. ... We do live in challenging times. And these are all areas of crucial national interest. You are all contributing to the long-term vitality of our country and I thank you.

—AACC President George R. Boggs in his address at the 2002 ATE Conference

course to a five-day orientation, and assign new employees to solo duties in just three months, according to Dennis Link, learning and development director at five South Houston BP sites. In the past, Link says new employees were not considered assets to the bottom line until they had worked at least six months. As an adjunct professor at the College of the Mainland since 1989, Link uses his field experiences for classroom scenarios.

BP, an international oil company, gives process technology graduates two years of credit on its pay scale. So it takes them just three years rather than five to reach the top of the pay scale. BP pays starting operators $23 per hour.

Because of their favorable impression of CAPT, BP and Dow Chemical provide scholarships to process technology students. BP has also started an internship program that pairs process technology students with experienced mentors at its South Houston facilities. The interns are paid half the starting hourly wage and receive four credit hours. BP provides weekly written evaluations of the students' work. The interns' evaluations are shared with college faculty, who also consult regularly with plant personnel to make sure CAPT's curriculum aligns with current industry practices. "It's really a great tool. It's part of the quality control loop," Link says. ■

Carl Ilks, a process technology student, monitors and adjusts vacuum pressure on the Glycol Separation Training Unit at the College of the Mainland in Texas City, Texas, home of the Center for the Advancement of Process Technology.

Training for Nondestructive Testing

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and is facing an enormous worker shortage from retirements. Bill Wiley, an NDT instructor at Southeast Community College in Lincoln, Nebraska, uses what he learned about new technologies and high-tech instructional delivery methods during his summer at the center to create informational videos for students and their potential employers.

In addition to the summer institutes, the center's first ATE grant established an ongoing network for the few, but previously isolated, community colleges with associate degree programs in nondestructive testing so they can share information and quickly receive research on new quantitative techniques. Many of the community colleges are now participating in the center's second ATE grant, which is developing a career resource center for community college students. With the grant, the center is also creating PowerPoint presentations and other materials to enhance instructors' teaching skills.

For more information, see www.ndt-ed.org

"We work together. We talk together, separate from the grant... that was the value I saw," Crouse says, adding that things have changed enormously since 1991, when he started his college's program relying on materials he collected from industry. ■

Sinclair Uses Grants to Nurture Inventiveness

The concentration of machine shops in Dayton, Ohio, 100 years ago made it the perfect place for Orville and Wilbur Wright to work out their plans for an airplane. "As they got an idea [for a part] they could take it and have it built," explains Ned J. Sifferlen. As president of Sinclair Community College, Sifferlen and the faculty have used their multiple ATE grants to create a similarly supportive environment for innovation.

Sinclair's National Center of Excellence for Advanced Integrated Manufacturing was among the nation's first ATE centers. "It enabled the community and the college to make manufacturing more effective and productive," Sifferlen says. The center has also had a national impact as a model for ATE projects at other colleges.

Among the ongoing collaborative activities initiated by the center grant is an exceptionally generous dual enrollment program with the private University of Dayton (UD). When Sinclair's manufacturing technology students are accepted into the dual enrollment program, they receive University of Dayton identification cards that give them access to the university's library and athletic facilities. When they actually transfer as juniors, not only are their Sinclair credits accepted but they receive a 33 percent discount on UD's tuition.

"The Sinclair programs are very strong," says Scott Segalewitz, UD's chairman of engineering technology. He noted that Sinclair's students generally do well in UD's engineering technology programs; 30 Sinclair graduates were enrolled in them during the winter of 2002.

Other ATE grants include a pilot program to implement science, math, and engineering technology education reforms on an institution-wide basis and marketing improvements for engineering technology education. One of the largest of the college's six active ATE grants, known as IT@Sinclair, has redesigned 90 computer information systems courses around competencies. The tech prep curriculum that prepares high school students for the associate degree program in information technology has been completely overhauled as well.

"My success as a president, relative to ATE, is not only what we've done in terms of manufacturing technologies and engineering technologies, but how that has spilled over to the rest of the institution in terms of modularization of the curriculum," Sifferlen says.

Modularization at Sinclair means that as courses are updated they are separated into components for subsequent revision as needed. Breaking courses into discrete modules allows students to take only what they do not already know. In manufacturing technology, for instance, every subject, including English and other core courses, is presented in modules.

Modularization fits the college's long-term mission to create a student-centered learning environment, but might not have happened without the grants. "We would have never even started it or figured out how to start it without the ATE grants," Sifferlen says. "ATE provided the impetus for the curriculum [changes] throughout the college."

Curriculum changes at the college have been linked to revisions of high school courses for tech prep students as well. "Our board is so impressed with the ATE tech prep relationship that every student that graduates from the tech prep program in our county gets a full scholarship to Sinclair Community College," Sifferlen says. Since 1998 the college has given more than $500,000 in scholarships to tech prep students who graduate from high school with at least a 2.25 grade point average. Computer information systems (CIS) students are eligible for an additional $1,000 scholarship.

The scholarships started out as an incentive for the high schools to work with Sinclair on revamping their out-dated vocational programs. "I told them [the board] we needed that because those superintendents, principals, and teachers were going to do exactly what we wanted them to do if they knew their students would get two years of tuition paid for," Sifferlen says.

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ATE Centers

ATE National/ Resource Centers	Focus	Website
American Chemical Society (DC)	Chemical Technology	http://acs.org/vis
Bellevue CC (WA)	Information Technology	http://www.nwcet.org
Brevard CC (FL)	Space Technology	http://207.157.88.184/spacetec
Chemeketa CC (OR)	Sustainable Natural Resources	http://www.ncsr.org
College of the Mainland (TX)	Chemical Process Technology	http://www.captech.org
Daytona Beach CC and Seminole CC (FL)	Information Technology	http://www.itecfl.com
Eastern Iowa CC District (IA)	Environmental Technology	http://www.ateec.org
Iowa State University (IA)	Non-Destructive Testing	http://www.cnde.iastate.edu
Kirkwood CC (IA)	Precision Agricultural	http://www.agknow.org
Maricopa CC District (AZ)	Microelectronics	http://matec.org/index.htm
Maui CC (HI)	High Performance Computing	http://www.highperformancecomputing.org
Middlesex County College (NJ)	Engineering Technology	http://www.njcate.org
Monterey Peninsula College (CA)	Marine Technology	http://www.marinetech.org
San Francisco CC District (CA)	Biotechnology	http://www.bio-link.org
Sinclair CC (OH)	Manufacturing	http://www.aimcenter.org
S.C. Technical College System (SC)	Engineering Technology	http://scate.org
Springfield Technical CC (MA)	Telecommunications	http://www.nctt.org

ATE Regional Centers	Focus	Website
AIM Institute (NE)	Information Technology	http://www.midwestcenterforIT.com
College of the Canyons (CA)	Manufacturing	http://www.create-california.org
Kentucky Community and Technical College System & Lexington CC (KY)	Information Technology	http://128.163.202.100
Nashville Tech CC (TN)	Information Technology	http://www.cite-tn.org
Penn State University (PA)	Nanofabrication Manufacturing	http://www.nanofab.psu.edu

It has worked. There are now more than 2,000 tech prep students in Dayton area high schools; 698 tech prep graduates attended Sinclair in winter 2002. More significantly, only 20 percent of tech prep students need remedial services when they begin at Sinclair, compared with 80 percent of all incoming students. The college's random comparison of tech prep students with students of the same age in the same program found that tech prep students performed significantly better and had higher overall GPAs than their classmates. Because of the ATE grants, the internal research that produces these statistics is accepted as common practice at Sinclair.

The IT@Sinclair grant has moved the college's quality control efforts to another level. CIS students do self-assessments at the beginning and end of their college careers. All of them are surveyed after they leave Sinclair, regardless of whether they get a credential, for their opinions about their college experience and its impact on their lives. The college also sends questionnaires to employers to find out how well Sinclair prepared the students for their jobs. "The accountability is with the employer in a partnership role with us [and] with the student. The students, from our vantage point, are empowered to take control over their own learning by working with us to ensure that that happens," says David Siefert, director of strategic programs at Sinclair and principal investigator of the IT@Sinclair project.

The "closed loop" created by seeking evaluations and then using this information to adjust courses immediately is an enhancement Sinclair has added to its CIS curriculum with the grant. The college experimented with this method of surveying and checking several years ago on a retraining program for 70 Lexis-Nexis employees, according to Carl Richard Wendling, senior vice president of Lexis-Nexis. Sinclair's faculty actually modified the customized training course as it went along based on the results of student surveys, tests, and progress on work projects. This experience provided the groundwork for the IT@Sinclair grant application and led to Wendling's serving with other high tech industry people on the ATE project's visiting committee.

"I was very pleasantly surprised that the foundation [NSF] was trying to make sure the money was being spent productively," says Wendling of his experience advising Siefert and others on the grant team. He liked the committee's monitoring and reporting process as well. "I thought it provided value," he says. ■

For more information on the ATE program, please see:

National Science Foundation
www.nsf.gov/ate

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

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The American Association of Community Colleges (AACC) is the primary advocacy organization for the nation's community colleges. The association represents 1,100 two-year, associate degree-granting institutions and some 10 million students. AACC provides leadership and service in five key areas: policy initiatives, advocacy, research, education services, and coordination/networking.