Industry Based Professional development for Engineering Technology

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INTRODUCTION

In an era of significant global competition fueled by burgeoning technologies, it has become ever more critical for American businesses to assure their future with a highly skilled workforce that can meet the demand. Essential understanding of math, science, and technology, then, becomes pivotal in propelling students to become fully prepared for a future in a technological world.

Ironically, in America, math and science skills have been declining. In fact, a recent survey [(1)] indicated that American eighth grade students ranked 19th in math and 18th in science among 38 countries tested. While these statistics sound grim, strides have been made to improve student performance in these areas by giving educators important linkages to business practices that can ultimately bring reality-based learning to the classroom.

In order to build a strong foundation for a qualified workforce, educators need to be made aware of emerging technologies used in business today. In 2002, CBIA and Connecticut's Community Colleges' College of Technology received a three year, Advanced Technology Education grant from the National Science Foundation. The grant focused specifically on giving high school and community college faculty exposure to technologies in three primary industries: engineering (including biomedical engineering), manufacturing, and information technology. The grant proposed work-based learning through teacher externships, technology conferences, symposiums and training workshops which highlighted emerging technologies among Connecticut companies. A second NSF funded regional ATE Center for a Next Generation Manufacturing Center was awarded to Connecticut's College of Technology. The Next Generation Manufacturing Center includes statewide partnerships with CBIA, industry, the CT Center for

Advanced Technology, the Office of Workforce Competiveness and educational institutions that include the technical high schools and four year colleges and universities in New England.

The ultimate goal of the initial NSF ATE grant was to develop educational leadership through these activities so that educators not only gained additional knowledge, but that they could affect permanent change in the classroom which reflected current workplace practices. This report will show what succeeded and what could have been done differently as the grant evolved. The lessons learned from this process can hopefully act as a guide to faculty and industry professionals who are interested in creating similar professional development programs.

(1) Trends in International Mathematics and Science Study, 2003

HISTORY BEHIND THE PROPOSAL

With nearly 10,000 members, CBIA is the largest statewide business association in Connecticut. The CBIA Education Foundation has a 20-year history of helping to prepare a skilled workforce through the development of public-private sector partnerships in education and job training. Grants from such agencies as the U.S. Department of Labor, the National Science Foundation and the U.S. and Connecticut Departments of Education have allowed the Foundation to help both students and educators keep current with changing job requirements and technologies. Program emphasis has been on improving student performance in math, science and technology, as evidenced by three previous National Science Foundation grants the Foundation received, one of which created a math curriculum program called Math Connections that is still used as a national model in schools today.

The Connecticut College of Technology is a pathway program that created a seamless 2 + 2 + 2 curriculum between secondary schools, the CT community college system and six four year universities and colleges in engineering and technology. The College of Technology has an infrastructure that allows it to be responsive to the needs of industry and implement engineering and technology programs in a credit certificate or degree program within a two month time frame. The COT and CBIA partnership has allowed both secondary teachers and two and four year higher education faculty to gain experience and develop curriculum in cutting edge technologies. As a result, the COT is the statewide vehicle for creating a technological workforce that responds to workforce needs in the region.

CBIA and the COT were also partners on a previous ATE curriculum development grant. This grant gave CBIA the opportunity to work with dedicated teachers who understood the importance of learning technology through industry collaborations. Continuing that partnership, CBIA took the lead position, collaborating with CCOT in proposing the ATE professional development grant, which was awarded in 2002. This partnership was an important factor in being awarded the grant, as the ATE program was designed to promote and advance technology education among community colleges.

(2) Survey of Connecticut Businesses, BlumShapiro & CBIA, 2004

WHAT WAS PROPOSED AND WHY

The National Science Foundation ATE professional development grant awarded to CBIA proposed to give high school and community college math, science and technology educators a series of industry-related experiences over a period of two years. Although the ATE program emphasized community college faculty development, the Foundation felt it was important to include high school teachers as well. Bringing the two faculty groups together could potentially create greater partnerships which could lead to articulation agreements, ultimately creating pathways for students who might not otherwise transition into a college program.

While the emphasis on the subjects taught was math, science and technology, the industry focus was on engineering (including biomedical engineering), manufacturing and information technology. These industry areas were chosen because of a perceived critical technology skills shortage in these areas, future positive job projections and their obvious dependence on strong math and science education.

Over the course of three years, two groups of teacher **ATE "Leaders**" would be chosen to participate for two years in a one to two-week summer **industry externship**. It was hoped that by extending the externship experience to two summers, the ATE leaders could develop continuity with their company sponsor, or gain even greater momentum by doing two separate externships. Complementing the externship would be a yearly **technology conference, company visits and workshops** highlighting technologies used in Connecticut industries, activities such as symposiums involving their students, and smaller workshops that would promote collaboration between the ATE leaders.

An **ATE Advisory Committee** consisting of industry and education representatives was also proposed. This committee would meet at least two to three times a year to assure that the grant's activities fell within the parameters of the proposal, and to suggest the best way to accomplish the grant's goals.

The cornerstone of the program, however, was the **summer externship**, which, in addition to the onsite industry experience, required the development of a work-based curriculum project to be explored with students the following semester. This project would be made available on a statewide Web-site dedicated to curriculum development . It was considered important to the success of the externship experience that the educators relate a classroom project to what they learned at the industry site. In this way, they could show students a direct correlation between what they might be learning in math and science and how those lessons could be applied in a work situation. It would also give educators the opportunity to think about what they learned and how that learning could change the way they teach.

Community college professors were asked to do 80 hours or two weeks at a work site, and high school teachers were required to do 40 hours or one week. College faculty would receive a stipend of $3,000, which would include the completion of the worksite externship, and the submission of a curriculum report following the externship and a summary reports following implementation of the curriculum project. High School teachers were given a stipend of $1,300, mainly because of a shorter externship requirement of 40 hours and less stringent expectations surrounding the curriculum project.

Because the grant was essentially a community college grant, it was felt that a longer period of time should be required of college educators. Although past externship programs indicated that a longer length of time would give more opportunities for project work, given the current state of the economy and educators' apparent increased summer work obligations, it was considered more practical and feasible for both the companies and educators involved to have a shorter time requirement.

Grant outcomes would be disseminated as often as possible through a dedicated Web site and through presentations at national and regional meetings.

WHAT WAS DONE AND HOW IT WAS ACCOMPLISHED

ATE Teacher Leaders

- The most important aspect of the professional development grant was to select educators who understood the value of industry-based learning and who were committed to creating sustained industry partnerships that could change the landscape of the classroom. Two groups of teacher leaders were chosen after several considerations.

In all, 13 college and 12 high school educators made up the first cohort of teacher leaders and 8 college and 12 high school educators in the second group. The break down of teacher leaders was as follows:

Community College Faculty (21 total)	**High Schools/Voc Tech Faculty (24 total)**
First Year (13)	**First Year (12)**
Technology – 9*(5 engineering,4 manufacturing engineering, 1 IT)*	Technology – 4 *(1 IT, 2 engineering, 1 general)*
Science – 4 *(2 biology, 1 physics, 1 chemistry)*	Science – 5 *(2 physics, 1 chemistry, 1 general, 1 biotech/biology)*
Math - 0	Math - 3
Community College Faculty	**High School/Voc Tech Faculty**
Second Year (8)	**Second Year (12)**
Technology = 3 (1 manufacturing, 2 engineering)	Technology = 5 (1 manufacturing, 4 engineering)
Science = 4 (3 biology, 1 physics)	Science = 6 (1 chemistry, 5 biology)

Math = 1	Math = 1

The second year saw a slight drop in participation from the first group of teacher leaders, with three college educators and 2 high school teachers withdrawing from the program.

Prior to entering the two-year program, each teacher leader was asked to sign a ***Letter of Agreement***, stating what the project's expectations were in order for the ATE leaders to receive payment for their participation, particularly in the summer externship program. **(**The overall program goals and expectations were outlined at an ***Orientation Meeting*** consisting of the grant principals, industry professionals, and education representatives. In addition to the Letter of Agreement, ATE Leaders were also asked to fill out a profile that asked specific contact information, areas of interest and what they expected to gain. This information gathering was an important part of the planning process, as it served to help grant administrators tailor activities around the educators' interests, and it also gave the educators information on what industry learning opportunities existed for them.

The focal point of the ATE Professional Development grant was the **summer externship** program. CBIA took the initiative in setting up the industry experiences, working closely with each teacher and company sponsor to assure that there was the potential for a beneficial partnership. Educators were given an opportunity to express what their interests were, and to request a particular company of interest. If an ATE leader had no company in mind, CBIA researched general areas of interest and solicited companies that would be geographically convenient as well as receptive.

Critical to sustaining the externship experience was the implementation of a work-based learning **curriculum project.** Consideration was given as to whether ATE leaders should present case studies that would relate a work project to a teaching concept. However, given the short length of the externship and the probability that project work at the company site would be limited, ATE leaders were given latitude with the kind of project they developed.

Dissemination included posting the curriculum projects on a Web-site dedicated to curriculum development. An agreement was made with a Connecticut regional education center, the Area Cooperative Educational Services (ACES). An existing curriculum-based Web-site called www.ctcurriculum.org, provided an ideal basic curriculum template that would help guide the ATE leaders in their project development.

The final stage of the externship consisted of submitting a summary report once the curriculum project had been implemented. This consisted of a two-page questionnaire that gave information about what had been learned from the ATE leader's point of view, and what could be done to further develop and sustain partnerships with business and industry. The questionnaire was designed to keep the ATE leaders engaged in keeping the business connection current and of value to their students**.**

Following the summer externship experiences, educators and their corporate sponsors were invited to an ***Appreciation Reception***. The event served two purposes – to garner valuable information about what was beneficial and what could have been done better, to encourage ongoing partnerships between the two groups, and in particular, to extend an appreciation to the company sponsors for donating their time and expertise to the ATE leaders. This kind of recognition can serve as a motivator in keeping companies involved in school partnerships.

Statewide Technology Conference, Technology Expo, and Symposium

To complement the ATE leaders industry experiences and to introduce emerging technologies on a larger, more inclusive scale to both teachers outside of the grant and to their students, CBIA implemented two major statewide technology events. The first event was a technology conference held in the fall of the first year of the grant. Capitalizing on the current interest in forensics, the half-day conference was called "From CSI to Cyber Security" and included a keynote address from the state's top forensic expert as well as breakout sessions on drug research, cyber security and technologies used in stormwater systems. More than 100 teachers attended the conference. The conference was designed around the keynote forensics speaker and thought was put into the theme and how investigative technologies are used in a variety of ways in diverse industries.

The second event was much broader in scope. A day-long technology expo called "Technology: Here and Now" brought 300 teachers and students together at a community college's new technology center. Participants viewed technology demonstrations from 28 companies, and chose from 12 breakout sessions highlighting such technologies as fuel cells, space equipment, and nanotechnology used in biomedical engineering.

Having ATE leaders with connections to the local community college proved beneficial, and through their connections, CBIA was able to hold the expo at the new technology center of the state's premiere community college. The speaker topics were designed to be representative of new and different technologies that would be of interest to both students and teachers. In some instances, company representatives were solicited to speak on a subject, regardless of whether the company had a booth demonstration.

The COT and CBIA became a major sponsor of a third statewide event, highlighting the emerging field of Bionanotechnology. Leaders in this fast-growing technology spoke on the "world of the small in medicine" and how it will change our lives. The afternoon session allowed students and professionals to display research projects during juried poster sessions. Over 300 teachers, students, medical and business professionals and scientists attended the day-long symposium, which was presented by the Biomedical Engineering Alliance and Consortium (BEACON).

Students and teachers were made aware of these events through mailings, Web-site articles and emails. ATE leaders also promoted the events among their colleagues and students.

Company Visits

Another way in which ATE leaders as a group were introduced to industry technologies was visiting a company on-site where they could hear from professionals and view the technology

being used in the company's environment. Company visits were made to Electric Boat, one of the largest nuclear submarine builders in the world, Pfizer, Inc., the world's largest pharmaceutical supply company, UTC Fuel Cells, where talks were given on this formidable, alternate source of energy, and Gerber Scientific, leaders in digital sign-making.

Training Workshop
ATE teacher leaders were given the opportunity to not only learn a Computer Aided Design (CAD) technology program they could pass on to their students, but they were given free software along with the free training. Partnerships for Innovative Learning (PTC), a leading provider of product development software offered two-day workshops which would train educators to use their Pro/Desktop software used in industry today. Once the teachers completed the workshop and submitted a project, they would then be qualified to be a PTC trainer and would receive enough software for 300 students. 85 teachers took advantage of the free software training

ATE Advisory Committee
To assure that the grant's goals were on track, an advisory committee consisting of representatives from educational organizations and business and industry was established. These committee members were drawn from pre-existing partnerships that CBIA had established, and new partners, such as curriculum development specialists. The committee met three times during the first year of the grant, during which time valuable advice and information was shared to help formulate the grant's activities. In subsequent years, the need for formal meetings was reduced and input was solicited on an ongoing basis through direct contact with industry/educator representatives.

LESSONS LEARNED: SUCCESSES AND CHALLENGES

The following conclusions could be drawn as to how the activities of the grant faired in terms of value added and lessons learned.

Activity	Successes	Challenges
ATE Teacher Leader Selection	• Existing committed teachers. • Geographic proximity for HS and CC faculty = potential partnerships. • Balance of subject areas taught related to industry focus. • Administrator recommendations • Orientation meeting important for clarification of expectations.	• Two separate audiences with different needs (HS vs CC). • HS/CC partnerships not as frequent as anticipated. • Too many activities, not enough release time nor funding. • Not all committed. • Fewer schools=more systemic change?
Summer Externship	• Excitement/change.	• Not long enough.

	• Industry connections made. • Preliminary planning effective. • Curriculum projects benefiting students. • Dedicated Web-site. • Grassroots movement the best advocacy.	• Need for more hands-on projects. • Feedback needed on student work. • 2-year commitment feasibility needs further exploration.
Statewide Conferences	• Wide audience/greater exposure. • Students/Teachers together. • New technologies highlighted. • Lot of information in short period of time in one place. • Demo/showcase opportunities.	• Some speakers too technically advanced for teacher understanding, particularly at HS level.
Company Visits	• Onsite exposure to technology. • Chance for ATE Leaders of different disciplines to meet as a group	• ATE Leaders geographically spread out. • Not all ATE leaders interested in technology highlighted.
Training Workshop	• Free training on a CAD program used in industry. • Students benefited from training as well. • Some CCs received low-cost college software	• Excluded college software training.
Advisory Committee	• Initial affirmation of grant directions. • Feedback from both educators and industry reps on best practices.	• No sustainability due to establishment of grant procedures and undefined role.
Grant Dissemination	• Opportunity to advocate for industry experiences at local/national conferences	• No challenges (win/win)

ATE Teacher Leader Selection: The participating ATE teacher leaders represented a balance of math, science and technology teachers from both high school and community colleges across the state. In the second year, in particular, special attention was paid to having high school teachers on the grant who could possibly partner with a community college educator. This did happen with two biology teachers who plan on offering similar work-based projects in their

classes. There were some instances where teachers from the same school worked together at the same company. However, the majority of the teachers preferred working independently.

Bringing together high school teachers and community college faculty together to participate in the same activities proved to be a challenge in that high school teachers were more likely to have less flexibility. Scheduling events that would be beneficial to both audiences was made difficult because of differing class schedules. High school teachers were also less able to take time from their classroom and less inclined to deviate from a more structured curriculum.

A major factor in the decline in activities outside of the externship was time, and not being reimbursed for time spent away from the classroom. High school teachers, in particular, had difficulty getting excused from classes without the school being reimbursed for substitutes.

Conclusion: Teacher Selection

- **In selecting teachers to participate in a long-term professional development program, it's important to be clear about all commitments involved and to select teachers who are truly committed to all aspects of the program.**
- **An effective way to assure dedication to the program is to have prospective teachers submit a formal request for proposal, outlining their intentions for the overall professional development program, with detailed information about what they intend to do with their externships.**
- **When planning grant activities, consideration needs to be given to the different schedules and curriculum planning allowed when bringing high school and community college faculty together.**
- **Having appropriate funding to help facilitate time away from class is important to the successful outcome of attendance at all grant activities.**
- **The endorsement of the teacher's school's administration can help facilitate time away as well.**
- **Finally, selecting a greater number of teachers from fewer schools affords the opportunity for more systemic change as the teachers could support one another. The factor that could affect this goal adversely would be the inability of the school system to release too many teachers at one time.**

Summer Externships: Where the summer externships succeeded the most was in creating industry learning opportunities for teachers, which subsequently translated into more enthusiasm and excitement over the subjects taught and created innovative ways to teach concepts in the classroom. The hands-on approach to learning gave teachers a more current and greater

understanding of how technology is used in industry today and ideas as to how to help students connect the subject area with a real life work situation.

Requiring the ATE leaders to develop a work-based curriculum project provided a means for them to analyze their own experience and to come up with a different way of teaching their subject matter. These grassroots efforts are difficult to quantify, but can be seen in the enthusiasm and genuine surprise that teachers expressed in their learning once the externship was completed. A Web-site showing these curriculum projects afforded a larger audience of teachers to take advantage of these projects and the potential to monitor student results.

The major challenge to the externship program's goals was the length of time given. Many educators and corporate sponsors agreed that a longer length of time would have given the teachers more opportunities to become immersed in project-work as opposed to extended job shadowing. However, a minority of corporate sponsors preferred the shorter length of time as that was all the time they could give.

The two-year time commitment for ATE leaders was, in some cases, challenging, but in others, rewarding. No conclusive information is available at this time.

Another challenge was the importance of preliminary planning in order to assure the best match between teacher and corporate sponsor. While encouraged, a preliminary meeting did not always occur, which caused some teachers feeling as if they had not accomplished what they had planned. Feedback on the impact of the curriculum projects on students was also difficult to obtain due to the lack of adequate assessment planning and unavailability of funding to pursue a longitudinal study.

Overall, though, both teachers and company sponsors gained from the experience and were supportive of continuing partnerships that could ultimately enhance student learning as well as educators' professional development. To quote some of the participants:

> *"I learned so many ideas to take back to my classroom – ideas from how to arrange my classroom to be more conducive to thinking, to dividing my shop into groups, each responsible for certain things but dependant upon each other for results."* – Rose Givens, A.I. Prince Technical High School
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> *"It's valuable having connections with high schools. (Rose) came in and has technical eyes, and learned what our strengths are. She told us she was amazed at the strength she experienced in the teamwork at Otis."* – Steve Davis, Otis Elevator
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> *"One of the most important aspects of my learning was to develop a fuller understanding of the power and utility of plant biotechnology (at Monsanto Dekalb). This technology will play a key role in our future, and it is critical that the public come to understand this technology and not fear it."* – Jonathan Morris, Ph.D., Manchester Community College
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> *"We're working hard to create linkages with our local schools to fight manufacturing's stigma of being a sweat shop. It's easy to become disconnected. So it was fantastic*

having (Neil) with us this summer, working on a project from beginning to end. I think the educational system needs to know what's going on in our industry. We're working with a lot of advanced technology, and I think teachers and students would be amazed at what we do."– Andy Summerville, Becton Dickinson Medical Supplies

"I just wanted you to know that the staff and I truly enjoyed our interaction with (Sharon and Ingrid) through the externship program. I feel we all mutually benefited from this experience and will be using ideas generated by Sharon and Ingrid in our approach to conducting career tours for high school students." – Patricia Pisciotto, M.D., University of Connecticut Health Center.

"My externship exceeded my expectations. They were very kind and allowed me to jump right in doing research along side of them. I was very nervous, things have changed tremendously. The amounts that people work with are smaller and smaller and techniques are more advanced. The model that I studied at the Connecticut Experimental Station I'll be using in my classroom. The experience gave me more depth of understanding than if I were to lecture in my class. I actually carried out the techniques that I'll be speaking about – JoAnne Russell, Ph.D. Manchester Community College

"From our standpoint, we feel confident (Mehrdad) is better armed to prepare his students for the many challenges they will encounter in industry. He seemed impressed with how resourceful industry people have to be when confronted with schedule, manpower, and funding issues." – Stan Ciempa, Pratt and Whitney

Conclusions: Summer Externship Program

- **Externships create enthusiasm and change for both educators and students in the form of learning about new technologies in the workplace and how they apply to subjects taught in schools.**
- **Critical to the success of a hands-on, project-based externship is length of time, which ideally should require at least 3-4 weeks or 160 hours of involvement. This allows the corporate sponsor to involve a teacher more realistically in a project and gives the teacher the opportunity to see the project through from beginning to end.**
- **Requiring the implementation of a work-based project into the classroom following the externship is an effective way to help teachers understand what they learned and a way to involve students in the process.**
- **A dedicated Web-site disseminating the curriculum projects is an effective way to expose a wider audience of educators to the impact of work-based learning on students.**
- **Preliminary planning prior to the externship in the form of a meeting between the corporate sponsor and teacher is essential to clarify goals and expectations.**
- **The feasibility of requiring ATE teachers to participate for two years needs to be**

explored further.

- **A long-term study analyzing the impact of these work-based experiences on student interest in technology-related careers and higher education is indicated, but would require additional funding.**

Statewide Conferences: The conference and technology expo offered were highly successful in that they brought together a large number of both students and teachers who had the opportunity to learn about several different and emerging technologies all at one concentrated time. The short period of time allowed for a lot of information to be conveyed and the opportunity for both educators and industry-representatives to make valuable connections that could lead to potential industry-education partnerships.

The main challenge was that in some instances, the industry representatives were more technically sophisticated than the educators, which occasionally caused some lack of understanding, particularly among some of the high school educators.

Conclusions: Statewide Conferences

- **Holding large conferences that demonstrate technologies and allow a number of speakers to talk about emerging technologies is a highly effective way to expose a large number of both students and teachers to current technologies in a concentrated period of time.**

- **Consideration needs to be given to the audience and topics, to avoid potential misunderstanding of content by those educators who might not be as technically proficient as the company speaker.**

Company Visits: Gathering a group of teachers in a formalized visit to a company is an effective way to give teachers a greater understanding of what goes on in the workplace. Not just technology is viewed, but rather, the company's product, basic operations and roles that employees play become a realistic basis for greater understanding of how math, science and technology education can impact a company's bottom line. It's also an opportunity for teachers from different disciplines to interact and possibly form valuable partnerships for future work-related activities.

Conclusions: Company Visits

- **Company visits are an effective way to bring teachers together from different disciplines to view a company's infrastructure as well as technologies.**

- **In offering a company visit, consideration needs to be given to geographic location and interest of all teachers invited.**

Training Workshops: Offering a training workshop on a technology program used in industry today is an excellent way to bring work-based learning into the classroom and improve upon an educator's understanding of a work-based technology. Teachers in the grant who didn't teach Computer Aided Designed revealed that they learned a lot from the program even though they wouldn't necessarily be using it in their classroom.

While the software training was geared toward teaching at the high school level, some college faculty benefited from the training, and because of this program, select community colleges were given college-oriented software at a major discount. But overall, the one drawback was that there was no training on software geared toward teaching at the college level.

Conclusions: Training Workshops

- **Supplemental training workshops on technologies that are used in the workplace are very effective in enhancing the professional development of teachers across different disciplines.**
- **Students benefit from the added software training and classroom project work.**
- **When bringing high school and community college faculty together in one grant, ideally it would be advisable to have technology software training made available tailored to each group.**

Advisory Committees: Having representatives from all parties who have an investment in faculty professional development is important when inaugurating an industry-based learning program. These representatives can enhance existing plans, affirm goals and lend advice on how to best conduct proposed activities. Getting the perspectives of both educators and business professionals is essential to facilitating the grants goals effectively and efficiently. However, once a program has established itself, it's difficult to assign an advisory role to committee members.

Conclusions: Advisory Committees

- **Because of the invested perspectives of its members, advisory committees are essential to moving an industry-based learning program forward.**
- **Advisory committees can outlive their usefulness once an industry-based learning program has been established.**

Program Dissemination: Presenting information on the successes and challenges of work-based learning programs is an excellent opportunity to advocate for industry experiences at the local and national levels. The program manager and principal investigator of this project had

opportunities to present at national conferences, including the Tech Prep conference in Tennessee, the American Association of Engineering Educators conference in Utah, and the National Association of Work-based Learning Workshop in Virgina, in addition to yearly presentations at the annual ATE Conference in Washington D.C. Each presentation was an opportunity to persuade other educators to participate in industry-related learning.

FINAL ANALYSIS

Evidence suggests that there is a critical need to improve the basic math, science and technology skills needed by students as they look toward their place in the workforce. Industry leaders have indicated difficulties in recruiting the kind of skilled employee they need to meet the ever evolving technologies used to remain competitive.

Educators, on the other hand, have the difficult task of training students in a vacuum, because in many instances they haven't been exposed to what is really happening in the workplace. Many have spent their entire careers in academia, which in itself can hamper them from giving their students the realistic preparation they will need to meet the workplace's demands.

Providing industry-related work experiences for educators, then, becomes an important professional development component which can have a long-range impact on how a teacher connects what he or she teaches with what industry leaders are looking for to maintain a viable economy. Educators, students and industry leaders all ultimately win.

One of the biggest challenges to creating change in the classroom through industry experiences is motivating teachers. Convincing them that these lessons are invaluable and long term requires a willingness to find the time and commitment that will ultimately reward them with a more effective and exciting way of teaching.

Critical to the success of any industry-faculty program, however, is a commitment to the outcomes and a belief that change can only occur if there is a meeting of the minds of educators, administrators and industry leaders. Giving time, financial support for release time, integrated curriculum development, and options for a variety of experiences that connect students and educators with industry are essential to successful outcomes.

The long-range impact on this learning needs to continually be examined, particularly as to how it can influence student focus on technology-related careers and higher education. Regardless of any formalized analysis, these grassroots efforts have shown that they can lead to positive and sustained change in the classroom and beyond.

Bibliographic Information
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