Shaping a Curriculum from Workplace Research

Lynn G. Mack, Thomas V. Mecca, Sara Cushing Smith
Piedmont Technical College
Greenwood, SC 29648

Abstract: The sixteen South Carolina Technical Colleges, through a National Science Foundation Advanced Technological Education (ATE) grant (DUE # 9553740), utilizing interdisciplinary faculty teams (communications, mathematics, science, and engineering technology), conducted workplace research as a strategy for designing a new integrated "workplace-focused," first-year core curriculum for engineering technology graduates. The SC ATE Workplace Research Model includes administrative and industry guidelines, research directions, and common reporting forms for gathering data and information on the roles and responsibilities of technicians in the workplace. Information gathered and the knowledge gained during the industry visits give interdisciplinary teams and college administrators invaluable insight as they author and adopt a new engineering technology curriculum for technicians entering the 21st century workplace.

Introduction:

In 1993, the Gaining the Competitive Edge[1] report disclosed a new picture of what "educational preparation" was required of technicians in order to succeed in today's workplace. This picture presented a challenge for educators. The undergraduate curriculum for technicians needs to reflect the workplace environment by emphasizing interdisciplinary studies, collaborative activities, and problem-solving skills. The need for faculty to stay in touch with the fast, ever changing, workplace was also brought out by the report. A major goal of the SC ATE Exemplary Faculty Project (DUE# 9553740) is to train a cadre of interdisciplinary faculty teams (mathematics, science, engineering technology, communications) to be the designers and authors of a new, integrated first-year engineering technology core curriculum for South Carolina's Technical Colleges. The SC ATE Workplace Research Model was designed to allow interdisciplinary faculty teams to conduct workplace research to gain a better understanding of the technician's role in the workplace and to investigate the demands placed on technicians by employers. As a result of the on-site industrial exploration, faculty teams are better able to focus on creating an integrated, relevant curriculum for tomorrow's technicians. The SC ATE Faculty Workplace Research Model, including summarized faculty experiences, data-gathering results, and lessons learned, follows.

Preparation, Visitation Guidelines, and Common Reporting Forms:

(All guidelines and reporting forms can be found on the SC ATE Web site: http://scate.org/scate).

Guidelines and reporting forms were researched and developed by an ad-hoc faculty team. This team customized the workplace research process to meet the needs of the SC ATE project and the SC Technical College System. The guidelines outlined project expectations, preliminary administrative steps, resources, project-proposal procedures and general guidelines for industry visits. Faculty found these guidelines very useful and stated that they helped them avoid unnecessary and time-consuming mistakes in setting up visits to industry (i.e., not following the correct administrative channels, not checking with other college personnel working with industry). The Workplace Research ad-hoc team also developed common research reporting forms with the assistance of an industry trainer. These forms were designed to allow interdisciplinary faculty teams to compile data, to verify the workplace needs/skills of the technicians, and to document a comprehensive view of the technician in industry in as easy and timely a manner as possible. Reporting forms and their uses are outlined in the table below.

Table 1: **Reporting Forms Utilized by Faculty**	
Form Title	**Information Requested**
Company Visitation Report Form	employee size, product(s) produced or other service(s) provided, types of technicians employed, and other specific project questions (i.e. employee training/skill development, willingness to assist with identifying application/problems for classroom use)
Technician Profile Sheet	basic job description, educational background, changes in job/industry requiring further training, projected role/skill level, recommendations for preparing students for workplace
Technician Skill and Task/Application Observation Sheets	
A. Mathematics, Science, and Engineering	
1. Task/Application Explanation	technician's role/responsibility level, job process descriptions
2. Skills Checklist	specific skill identification
B. Communication and Professional	
1. Frequency and Importance Skill Checklist	proficiency level needed with a skill and frequency of applying skill
2. Interview Sheet	application and identification
C. Computer and Technology Checklist	equipment/software used
Team /Individual Reaction Sheet	team observations and discoveries

Twenty-nine SC ATE project faculty utilized this formalized and well-developed workplace-research-reporting process to gather data from thirty-six industries/companies in South and North Carolina. Their findings and conclusions, as summarized in the next sections, provide invaluable insight and direction for the project and others seeking to create a curriculum for preparing technicians for the 21st Century workplace.

Workplace Research Findings:

Faculty visited companies with a workforce ranging from ten employees to forty-five thousand employees nation-wide. On the average, the companies visited employed five hundred employees locally. The types of companies visited are listed in the table below.

Table 2: Types of Companies Visited

Type of Company	Number Visited
Manufacturing (products included paper, tires, batteries, drugs, adhesives, brakes)	18
Steel Fabrication	4
Packaging	3
Utility	3
Fiber	2
Design	2
Testing Lab	1
Recycling	1
Banking	1
Engineering Consulting	1

The wide variety of companies visited allowed faculty to interview and observe different types of technicians. More than sixty technicians were interviewed, and these technicians had worked an average of 8.3 years with the company. The different types of technicians included Electrical/Electronics (27%), Mechanical (20%), EGT (9%), CET (9%), Chemical (6%), Computer (6%), and other (23%). Compiled data from the technicians' interview and observation skills checklists produced the following findings:

Table 3: Skill Identification Findings

Content Area	Skills
Communication (top 7 in frequency and importance)	1. interpret written material correctly 2. read critically 3. use standard American grammar and usage 4. give oral directions on procedures 5. use effective telephone skills 6. be able to use word processing software 7. plan and prepare short reports
Computers and Technology (This was a check list, top 7, 50% checked)	1. e-mail 2. word-processing 3. programming 4. fax 5. equipment control 6. pneumatics 7. internet

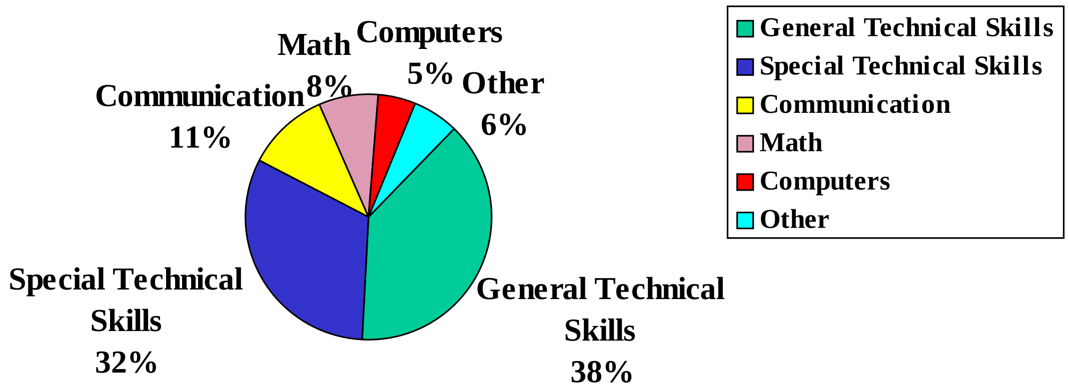
Table 3: Skill Identification Findings (continued)	
Content Area	**Skills**
Math (top 9)	1. use percentage 2. use measurements (including metrics) 3. use measuring equipment 4. use a calculator 5. use decimal number operations 6. use fraction operations 7. use ratio and proportions 8. use graphs and charts 9. use algebra (items 7-9 tied.)
Science (top 8)	1. perform simple measurements 2. work in small groups 3. keep records of work in notebook 4. write procedural steps 5. use appropriate physical units and unit conversions 6. express quantities with correct precision (significant figures) 7. draw graphs and calculate slope 8. identify experimental errors (items 6-8 tied.)
Engineering Technology (top 7)	1. problem solving 2. safety 3. communications 4. decision making 5. calculations 6. task behavior 7. adaptability

These findings can be summarized into two main areas -- those that relate to technical-operations skills and those that relate to communication/interpersonal skills.

TABLE 4: SUMMARIZED FINDINGS	
1. COMMUNICATION/INTERPERSONAL	**2. TECHNICAL OPERATIONS**
a. Critical reading	a. Measurements, measuring equipment, data taking
b. Oral directions	b. Record keeping and procedural steps
c. Electronic communication (computer/software, phone, fax, email, etc.)	c. Fundamental math operations, units and unit conversion
d. Planning and short reports	d. Problem solving/decision making
e. Teaming/small group activities	e. Graphical analysis of data
	f. Precision and experimental errors

Two questions asked on the **Technician Profile Sheet** provided faculty with further verification of essential educational preparation that technicians need:

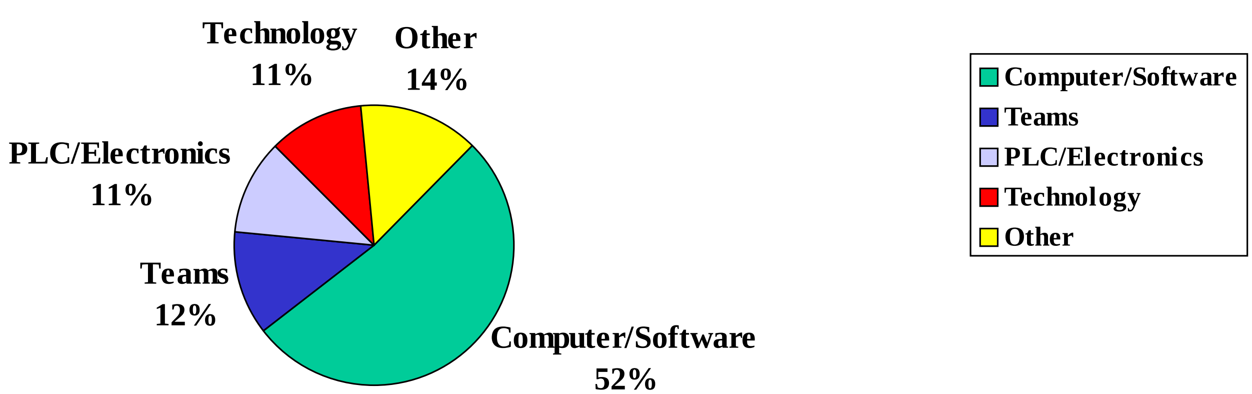
What do you wish you had learned in school before you came to this job?



General technical skills included hands-on, applications, trouble shooting, problem solving, and working with processes. **Special technical skills** included working with PLCs and computers, and applying academic topics. **Communication** included technical report writing, oral communication, and technical material/manuals.

The second question was on change in the workplace.

What changes have taken place in the last five years that have changed your job?



The 1993 SCANS Report stated that programs for technical students should place increased attention on interpersonal skills, on using information, on using technology, and on working with systems/processes.[2] Because the faculties' research findings very closely match the skills identified in this report, faculty now have a better appreciation of this report and the direction curriculum reform must follow to address workplace needs.

Faculty Reactions and Observations

"The level of responsibility of our graduates is beyond our expectations; many of them hold jobs that require maturity, assertiveness, major responsibility, and authority." This quote made by the Florence-Darlington Technical College SC ATE team is representative of what other faculty teams concluded after their visits. Many faculty were overwhelmed by the strong involvement of technicians in solving major industry problems and the level of responsibility technicians were expected to assume in fulfilling their job duties.

Many teams also observed the need for strong communication skills. The Orangeburg-Calhoun ATE team noted the need for technicians to understand how to write safety reports and to be able to produce documents with an appropriate audience in mind. "*Without fail, the importance of writing for the intended audience is an issue that was stressed throughout my observations*" (Warren Yarbrough, Communication Faculty, OCTC).

Another commonly observed skill area for all technicians focused on applying and attending to professional skills such as being on time, meeting deadlines, and following assigned procedures. "*A majority of the technician's job centers around professional skills rather than technical skills"*(Piedmont Technical College ATE Team). Many faculty stressed the need to include more professional skill building in the new curriculum. One final major observation made by a majority of the faculty researchers concerned how technicians must be able to cope with change and to continually be learning new technology and processes. *"They agree that keeping up with change in technology is not easy, but that it is a necessary, continual process"* (York Technical College ATE Team).

Unanimously, faculty found that their industry research allowed them to better understand how to design an integrated curriculum that would prepare engineering technicians for the constantly changing work environment and allowed them to establish much needed networking channels with industries in their service area. These findings are on target with the project's direction and development as stated by Dr. James C. Wood, Co-PI for Curriculum Reform, SC ATE Center of Excellence: "*The role of the engineering technology program is to identify the unique characteristics of the technician and to create an educational environment to fulfill the needs of industry in this changing situation."*[3]

Institutional Implications of Workplace Research

Institutions and their administrators adopting new curriculum models based on workplace research must be ready to embrace change and to address the implications arising from it. An integrated curriculum has the potential to better prepare students for the complex workplace. Research on an integrated or interdisciplinary approach to presenting content material in a curriculum supports strategies needed to implement changes in the Engineering Technology curriculum.[4]

Faculty from various academic disciplines must be given time from their normal teaching load to restructure the content of the curriculum and to design new instructional modes necessary to promote the mastery of that content. This time may represent either reduction in the faculties' teaching loads or assignment of special projects in addition to their regular teaching assignments. Either strategy for accomplishing the necessary work will typically result in stress on the institution's existing budget. Administrators should be prepared to either reallocate funds within the budget or secure additional funds that can be targeted for curriculum revision.

Administrators also must be ready to implement a more formal, on-going process of curriculum revision. To be of long-term value, the results of an on-going program of workplace research must be incorporated into an institutional process of continuing curriculum revision. It is not uncommon, however, for institutions to revise curricula only when they have to respond to external requirements (i.e., accreditation, state board policies, etc.). Typically, a consequence of such sporadic curriculum revision is the lack of a well-designed institutional process and the application of ad-hoc designed processes that reflect academic department autonomy that examines only a limited number of factors. A more formally well-structured process which examines the curriculum systemically will improve the chance to bring about changes that lead to more effective instruction and greater learning on the part of the students.

Major revisions in the curriculum, new modes of instruction, new ways of conducting the curriculum revision process, working with interdisciplinary faculty teams, and possible changes in the organizational structure of the institution's academic departments may well represent major changes for faculty and staff. For such changes to be successfully integrated into the institution's on-going operations and organizational culture, administrators must carefully design, implement, and manage the change process. To do so requires them to understand the nature of organizational change, design effective intervention strategies to bring about the desired change, and apply the techniques of organizational change appropriate to that change. More importantly, administrators must reallocate their time to effectively manage the change process.

Conclusion

Faculty and administrators must continue to challenge the learning process to better align it with workplace needs. Workplace research is important to faculty who are authoring a new integrated first-year Engineering Technology Curriculum that models the workplace and prepares students to cope with job responsibilities and tasks in the fast pace of today's work requirements. This research activity allows faculty not only to keep up with the changing roles of the technicians (i.e. technical operations and communication/interpersonal skills), but also to establish linkages with industry partners. Systemic curriculum reform also requires that administrators develop ways of implementing workplace-driven changes related to faculty workload, the curriculum-revision process, and organizational-change management.

Bibliography

1. Collins, T. W., Gentry, D. K., & Crawley, V. O. (1994). Gaining the competitive edge: Critical issues in science and engineering technical education. Arlington, VA: National Science Foundation.

2. Martin, L., Aguirre, E., Brock, W. E., & Biggins, J.V. (1991). What work requires of schools: A SCANS report for America 2000. Washington, DC: U.S. Department of Labor.

3. Wood, J. C. (1997, September). Engineering technology curriculum integration in an associate degree program. Paper presented at the conference of ASEE, Milwaukee, WI.

4. Panitz, B. (1997, September). The integrated curriculum. ASEE Prism.

LYNN G. MACK is a mathematics instructor at Piedmont Technical College, Greenwood, SC. She is currently PI for Faculty Development for the SC Center for Advanced Technological Education. She received her BA from Winthrop University and her MS from North Texas State University, both in mathematics. She is currently pursuing a doctorate in curriculum and instruction at the University of South Carolina.

THOMAS V. MECCA is Senior Vice President and Chief Academic Officer at Piedmont Technical College, Greenwood, SC. He received his BS in Education and MS in Social Science from the State University in New York and his Ed. D. in Higher Education Administration from the University of South Carolina. He has written a number of articles and chapters of books on strategic planning and organizational change.

SARA CUSHING SMITH is an instructor of English at Piedmont Technical College, Greenwood, SC. She serves as Piedmont's ATE campus team leader and served as the team leader of the Workplace Research Ad-Hoc team. She received her BA in English from Duke University and her MS in secondary education from the State University of New York at Cortland. She is the author of You, Too, Can Write.