What Teachers Can Learn from Industry Internships

ANN M. FARRELL

As our industries struggle to remain competitive in a world market and educators struggle to prepare our students for careers that may not even exist yet, it is becoming apparent to executives and teachers that education and industry must work together. The problems we face in both domains require cooperation from all.

One way teachers and industry personnel can work together for our future is through summer industry internships for teachers. Recently, the Dayton-Montgomery County Public Education Fund Mathematics Collaborative in Ohio sponsored 18 educators in a summer industry internship program. One of the nation's 15 Urban Mathematics Collaboratives, the Dayton-Montgomery group is composed of school and university mathematics educators, administrators, executives, engineers, and scientists. Its goal is to improve mathematics education in our county. The summer internship program was one of the first projects developed to meet that goal. We learned a great deal from this project, much of which has implications for all areas of the curriculum, not just mathematics and science.

During the summer of '91, eight high school math teachers, four high school science teachers, two junior high math teachers, two 6th grade math teachers, an elementary school principal, and an elementary school computer specialist spent several weeks working in local industries with engineers, materials scientists, marketing analysts, environmental consultants, physicists, and other industry personnel. As they became part of company teams working on projects, the teachers looked for mathematics and science applications they could take back to their classrooms.

All of the participants found these applications, but even more exciting (and unexpected) was the value they discovered in adapting their teaching methods to include more cooperative learning, open-ended problem solving, writing, and technology in order to better prepare students for careers in business and industry.

Learning to Work With People

Many teachers wrote at the conclusion of their summer internships about the non-scientific knowledge and skills that persons who work in industry need. Sixteen of our eighteen teachers mentioned that since working in teams is important in industry, they would incorporate more teamwork into their classroom methods. One teacher wrote:

Most impressive to me for my non-college bound students was the set-up of teams. . . . The people on these teams knew everything about every job from the computers used on the assembly line to the quality control in the loading dock. They also had been trained in how to work as a team with all other members in their group.

Three teachers mentioned the importance of "networking" or "collaborating" skills. Three other teachers mentioned the importance of "people skills" and noted that cooperative rather than competitive teaching methods could help make these skills more a part of classroom learning.

Fourteen teachers described the importance of communication skills for the workers they observed and assisted in engineering or science laboratories. The teachers found this especially interesting because, before their schools' recent efforts to incorporate more writing across the curriculum, many of their students believed they could get by with strong science skills and weak language skills. The teachers now have proof that this isn't at all the case: scientists read reports and gather pertinent information from them, communicate work to peers in both a written and verbal format, work independently to research an issue and summarize findings, present reports, listen, and gather information in a variety of ways.

Peggy O'Brien found exciting mathematics and science applications for her classroom through her internship at General Motors.
Applying Knowledge to Work

Seven teachers mentioned the importance of having students solve open-ended problems that do not have a "set answer or solution." Others said they would now adapt their lessons to be sure students had experience using such problem-solving techniques as determining how to structure a problem, solving non-routine problems, and finding the "best" solution rather than "the" solution. Some also mentioned that certain behaviors they had observed in industry personnel should become part of students' repertoires. These behaviors included planning solution strategies, discussing options before a decision is made, and designing tests and experiments.

Most of our teachers spent their first week on the job learning to use the computers and applications software necessary to work on their projects. Consequently, over half mentioned the need to integrate more technology (computers and calculators) into their school science and mathematics curricula. And since they observed that "everyone in industry uses computers," they feel that technology should be integrated across the curriculum, not limited to advanced math and science classes.

Teachers wrote many anecdotes about important employee attitudes and traits that could be addressed in the classroom. These include the ability to overcome frustration or confusion, a willingness to experiment and try new things, a positive attitude or excitement about work, a positive attitude about science, being self-directed, having confidence, remaining calm when problems arise, and keeping a professional attitude when doing a group presentation. By giving examples of how these qualities are important in industry, teachers can reinforce their efforts to instill them in students.

Preparing Teachers for Internships

The lessons that can be learned from industry internships have implications for teacher preparation programs as well. One of our mentors, who teaches a computer applications course in a local community's adult education program, has offered to design a technology course for teachers. Future participants would be able to take word processing, spreadsheets, and database applications before they begin their summer internships. Not only will they be able to use these skills during their internships, but they can use them for developing course materials and keeping records at school.

One teacher's praise for his industry mentor shows how some simple mentoring activities would help schools to form a more collegial environment and help to keep first- and second-year teachers from abandoning the profession:

The mentor is the most significant ingredient in making the experience a success, and I was fortunate to have someone who believed in the importance of this program. . . . He met with me as soon as I arrived and spent about an hour acquainting me with some of the routines. He gave me a list of all the people's names with whom I might be working and their roles. I was given a desk in an office, a telephone, access to computers and a copying machine. My success was obviously a high priority for him.

Perhaps the experience of one first-year teacher summarizes what teachers can learn about methods, content, and professionalism from an industry internship:

I found myself learning the ideas and concepts more quickly when I was able to actively participate. Students are the same -- they need to be able to experience math instead of sitting at a desk using a pencil and paper.

Many current reports tell us that teamwork, problem solving, technology, and communication skills are necessary for success in industry, business or the scientific fields. After their summer internships, these teachers really believe in using teamwork and technology and integrating problem solving and communication into their courses because they have seen and experienced the need for these skills firsthand. They have also widened their circle of colleagues by working with fellow teachers and local industry representatives -- professionals with whom they can exchange ideas about teaching, about mathematics, about science, and about careers in industry.

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Ann M. Farrell is Assistant Professor, Department of Mathematics and Statistics, 120 EMS Building, Wright State University, Dayton, OH 45435.
tional courses, while others are carried out through extracurricular activities.

Similarly, in a health-professions high school, the teachers incorporate health-related applications in every class. All students take seven health science courses, which are more occupationally oriented (for example, medical laboratory techniques and patient care) than conventional biology courses. In occupational high schools, integration seems natural because of the goals of the school and the ambitions of the students. For example, a social studies and an English teacher might assign reports on the history of medicine, with the math teacher checking calculations and statistics.

The magnet schools that have opened as mechanisms of racial desegregation are similar to occupational high schools. Many have a focus on electronics, computers, or business, for example. Every student is enrolled in a curriculum incorporating courses related to the magnet's focus, so that all teachers can emphasize applications in that occupational area. Unfortunately, many magnets have not yet realized their potential to develop cooperation among teachers. In some, the vocational component is trivial, and others have been labeled magnets without making any concrete changes. Still other magnets are so preoccupied with racial desegregation that they have neglected curricular issues. Nevertheless, magnet schools have substantial promise as a way of reorganizing high schools by maintaining an explicit occupational focus.

Occupational Clusters

Occupational high schools and magnets generally emphasize preparation for clusters of related occupations, rather than the highly specific occupations of traditional vocational education. There are several other ways to incorporate occupational clusters into the high school.

A few schools have replaced conventional departments with departments organized along occupational lines. For example, Dauphin County Technical School, near Harrisburg, Pennsylvania (described in Adelman 1989), organized faculty and students into four occupational clusters: communications and transportation; construction, including the building trades; a service cluster encompassing cosmetology, health, distributive education, horticulture, and food service; and a technical cluster including chemical technology, electronics, data processing, and drafting. Each student takes vocational courses within each cluster, in addition to the academic courses required for graduation. Teachers are assigned to clusters; the academic instructors then teach students from specific clusters — for example, 10th grade English to students in the service cluster — giving them greater opportunities to orient their teaching to applications within that broad occupation.

The school has also reorganized specific academic subjects with vocational coursework. For example, the English sequence emphasizes communications skills necessary for the workplace; math courses incorporate technical math; the science sequence includes Principles of Technology, an applied physics course, as well as more conventional courses; the social studies curriculum stresses the historical influences of work and technological advances, as well as employability skills.

In a different approach to occupational clusters, a few schools have retained conventional departments with occupational clusters cutting across departments. In one school, each student elects one of six "career paths" at the beginning of 10th grade. Career paths include required academic courses as well as a coherent sequence of broadly vocational courses. Extracurricular events might include visitors from industry, tours of firms, visits to postsecondary institutions with related programs of study, work experience programs, mentors, and summer internships (as in the academy model). Activities like these provide information about occupations and motivation from those outside the high school.

Teachers also belong to career paths as well as disciplinary departments, and meet regularly in career path groups to discuss possible activities and courses. By providing teachers natural connections to other academic and vocational teachers and a focus on a broad occupational area, career paths facilitate cooperation across courses and the incorporation of vocationally relevant material in academic courses.

In a variant of this approach, students elect "majors" during their junior and senior years, organized around broad occupational clusters. Like career paths, majors include related academic and vocational courses. In one school that has adopted occupational majors, English teachers and occupational instructors have collaborated in developing technical writing modules. More generally, the fact that all students have elected a major provides academic instructors with an obvious way to contextualize their instruction and clarify its relevance.

Both of these schools have taken special pains to prepare students to make rational choices of occupational clusters. In the school with career paths, the counseling staff was expanded and freed from disciplinary and personal counseling; a 10th grade research and writing project combining...
English teachers, librarians, and counselors prepares students to select a major. In the school offering majors, students take a series of nine-week modules in each of the occupational clusters during 9th and 10th grades, in addition to conventional guidance and counseling activities, to prepare them to select a major.

Schools with occupational clusters have much in common with the first two approaches. These schools look like academies or schools-within-a-school. And, as in a single-occupation high school, each cluster has its own focus and can develop its own culture. The differences are that every student is in one occupational cluster or another, and students can choose among clusters within a school, rather than choosing among schools, as might happen within a district with numerous magnet schools.

Powerful Consequences

The three approaches to restructuring the high school can be interpreted as ways of reforming vocational education, but their greatest promise lies in redressing some of the most persistent failures of the high school:

- Eliminating the “shopping mall high school.” In place of the tendency for students to mill around and accumulate unrelated courses (Powell et al. 1985), these approaches provide a focus and coherence in the curriculum.

- Improving the teaching of all subjects. In schools that have integrated academic and vocational content, teaching has begun to change as academic teachers absorb instructional methods that have been more common in vocational classes — a greater reliance on project-driven approaches, on student-directed activities and student participation rather than teacher-dominated classrooms, on cooperative learning, on learning in the specific context, and on generic skills (Stasz et al. 1990).

- Enhancing the engagement of students. In many schools we’ve visited, the most attentive students have been in programs integrating academic and vocational education. In part, the student-centered and activity-based methods of teaching help hold students’ attention. In addition, the effort to clarify the relationship between future occupations and present schoolwork promises to enhance students’ motivation, as they come to understand how high school affects their future options.

- Reducing the isolation of teachers. Within academies, focus schools, and occupational clusters, teachers from different disciplines have reasons to meet regularly around curriculum, providing opportunities for collaboration and for the alignment of academic and vocational courses.

- Reducing tracking and segregation of students. As long as occupational clusters are broadly defined, they bring together students from very different backgrounds and with varied ambitions. The extracurricular activities — field trips, talks from business representatives, internships — provide opportunities outside the usual course structure for mixing students. For example, the health area might include both would-be doctors and practical nurses; an industrial technologies career path might include both future engineers, welders, and auto mechanics.

- Preserving options for all students. The schools discussed here have all adopted a broader conception of occupational preparation than traditional vocational education. Rather than preparing students only for entry-level employment immediately after high school, they also prepare students for postsecondary education or for the increasingly common combination of further schooling and work. Many of them have established 2+2 (2 years of high school combined with 2 years of school after high school) or tech prep programs to link their clusters with related postsecondary offerings.

- Improving guidance and counseling. Schools that have adopted an occupational focus have all improved their career guidance and counseling. Some have hired more counselors, but they have also experimented with novel approaches, including introductory modules and student projects related to career alternatives. Where students have to choose among occupational clusters or schools, they must confront early in their high school careers the options they face and the relationship between schooling and employment.

- Providing a vision for business participation. Academies, occupationally focused high schools, and occupational clusters all provide natural rationales for systematic contact with firms. In addition to providing extrinsic rewards like summer jobs and future employment, business can play an important role in motivation through testimony — testimony that most teachers cannot provide — that what young people learn in school is useful in other settings.

Reforming the High School

Creating an occupational focus for high schools is not necessarily an end in itself. Instead, it provides a vision of education and a way of overcoming some deficiencies of the high school, including those that developed from the original division between academic and vocational subjects and between college-bound students and those bound for work. Some crucial elements of these three approaches don’t have much to do with integrating