Articles

A Study of Three Approaches for Teaching Technical Content to Pre-service Technology Education Teachers

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Policy and decision makers within technology teacher education are searching for means to revitalize weak programs, meet the needs of their clients, and adapt in ways that will help insure the continuation of their programs. Insight into the effects of different approaches to providing technical content in technology teacher education programs may aid in this quest. Based upon discussions with technology teacher educators, it is apparent that in this time of change within the technology teacher education field, there is a need for greater insight into the effects of organizational configurations and approaches to technology teacher education.

The purpose of this study was to explore faculty and administrator perceptions of the interaction between technology teacher education and industry-oriented technology programs. This study was designed to explore the outcomes which faculty attributed to organizational configuration and to further explore relationships faculty perceived between the source of technical instruction and effectiveness of technology teacher education programs. Specifically, this study sought answers to the following question: As a result of the organizational structure and technical course configuration adopted by their department, what interaction do faculty, and administrators perceive?

Background

Many organizational configurations exist for technology teacher education programs but most programs coexist in contexts alongside one or more industry oriented technology programs (Savage & Streichler, 1985; Streichler, 1988). Further, most technology teacher education programs provide some or all of the technical content for their students through enrollment of teacher education

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students in technical courses designed for industry oriented technology majors (Andre, Chin, Gramberg, Skelly, and Wittich, 1990).

Historically, both industrial technology and technology education programs evolved from common roots (Rudisill, 1987; Streichler, 1988; Depew, 1991). In most cases industry oriented technology programs were developed in response to the observation that many students who obtained college degrees from industrial teacher education programs went directly into industry. Subsequently, many programs determined that if the time devoted to the education component of these programs were instead focused on content more appropriate to the needs of industry oriented students, it would enhance the preparation of those students. At that time, the technical course content of both types of programs was very tool skill-oriented and the same technical courses were often considered satisfactory for both groups of students.

Andre et al (1990), in a survey of 45 teacher education programs, identified three arrangements that exist for providing technical courses to technology teacher education students:

1. Programs that require technology teacher education students to take separate technical courses.
2. Programs that require technology teacher education students and industry oriented technology students to take some of the same technical courses and additional technical courses unique to their professional aspirations.
3. Programs that require technology teacher education students and industry oriented technology students to take the same technical courses.

Ritz (1991) described the content of traditional industrial arts programs as the "development of knowledge and skills of the processes used by industry" (p. 4). In the mid 1980s the industrial education field began to shift away from its traditional focus on the study of skills and processes used in industry. The industrial arts segment of the industrial teacher eduction field began a series of name changes starting at the national level that reflected a major top down shift in the philosophy and direction of the field. This movement was away from traditional industrial arts and toward technology education as a means of providing students the opportunity to develop technological literacy.

> (T)he mission of technology education is to prepare individuals to comprehend and contribute to a technologically-based society (Savage & Sterry, 1990, p. 20).

Thus, the new goal was not to develop skills, but to increase understanding of the concepts of technology and its impacts on individuals and society. As this shift occurred, a parallel shift developed within traditional industry oriented technology programs as they began focusing more sharply on the goal of preparing "management-oriented technical professionals" for industry (Rudisill, 1987).

As the shift in philosophy and direction slowly progressed through the field, concerns with the compatibility of technology teacher education and its close sibling, industry oriented technology programs, began to emerge in print. Rudisill (1987) described the current environment in the field as one of "conflict and chaos." A number of areas which could be impacted by the technology teacher education program's position in a multipurpose academic unit or as a result of the sharing of technical courses with industry oriented technology programs were suggested (Rudisill, 1987; Depew, 1991; & Streichler, 1988).

Philosophical differences reflected in the curriculum

The missions of technology teacher education and industry oriented technology programs are fundamentally different. Teacher education programs focus on preparing individuals for careers in public education, whereas the primary mission of industry oriented technology programs is to prepare technically competent individuals who will be working in business and industry, primarily in management positions (Depew, 1991; & Rudisill, 1987). "The technical content (in the industrial technology program), in many instances, may be far too sophisticated and devoid of practical hands-on experiences considered essential for the teacher education major" (Depew, 1991, p. 58).

Faculty development needs

"Very often faculty members with backgrounds in industrial arts or industrial-vocational education do not have adequate mathematics and science backgrounds and individuals with engineering backgrounds do not have adequate preparation in the setup and operation of laboratory courses" (Rudisill, 1987, p. 16).

Faculty relationships

There are often deep feelings of conflict and hostility apparent between some faculty from industrial arts/technology teacher education programs and industry oriented technology programs (Rudisill, 1987).

Nature of the leadership within the programs

Streichler (1988) noted that most of the department heads responding to his survey "had strong roots and loyalties to teacher education" (p. 5).

Influences of institutional goals

"In an institutional environment that places great value on enrollment growth, the tendency in most academic units is to promote the programs with greatest potential for meeting enrollment goals" (Depew, 1991, p. 58). Similarly, enrollment trends may make it easier to justify hiring faculty in programs with significant growth patterns than for programs with histories of shrinking enrollments such as industrial arts/technology education (Depew, 1991).

Demands of accrediting agencies

"The program guidelines for NCATE (National Council for Accreditation of Teacher Education) are broad and require that each program apply the guidelines concurrently with state certification requirements. The guidelines for NAIT (the accreditation agency for industrial technology programs) accreditation are program specific and are applied to all programs equally regardless of state teacher certification requirements" (Depew, 1991, p. 58). Demands from accrediting agencies for very specific faculty credentials make the hiring of faculty that can meet the demands of both teacher education programs and industry oriented technology programs not practical or possible (Depew, 1991).

Mathematics and science requirements

Rudisill (1987) states that "Industrial arts/technology teacher education standards require little or no background in mathematics and science while industrial technology standards require a significant number of credit hours in mathematics and science course work and in the application of these principles in technical course work" (p. 13).

Impacts on recruitment and retention

Streichler (1988), from a survey of 11 multi-purpose units across the nation, identified a dramatic shift in enrollment toward the industry oriented programs. Between 1976 and 1986, industrial teacher education enrollments fell from 1070 students to 304 students while enrollments in industry oriented programs rose from 2397 to 4588. Depew (1991) points out that upon graduation from industrial technology programs, the best potential students can make substantially higher salaries in industry than if they opt to teach technology in the public schools.

Service to identified clientele and future directions of the program

Streichler (1988) also mentioned these as possible areas of interaction but not discuss them further.

Methodology

Yin (1989) described a case study as an empirical inquiry which investigates a phenomenon (utilizing multiple sources of evidence) within its real-life context when the boundaries between the phenomenon and context are not clearly evident. Technology teacher education is an example of a real-life context where boundaries are not always clearly identifiable. Pre-service technology teacher education students may be enrolled in technical courses designed for industrial technology students, engineering technology students are sometimes enrolled in classes designed for pre-service technology teacher education students. Faculty and facilities may be shared by technology teacher education programs and industry oriented technical programs. Case study techniques provided the means to develop insight into similarities and differences in this complex context.

Description of Programs

Program 1. Eight faculty members and one administrator participated in the study at this site. The mean reported age of faculty members was 41. The mean number of years in teaching reported by faculty members was 16.25, with two reporting one year, and three reporting from 25 to 31 years each. All of those individuals reporting were members of ITEA and 75% reported membership in CTTE. No more than 25% reported membership in any other single professional organization.

This program was housed in a department that also housed industrial technology and engineering technology programs. The technology education preservice teachers and industry oriented students were required to take separate technical courses. Over the past five years, 190 students, for an average of 38 students per year, graduated with Bachelors or Masters degrees in education. The average number of Bachelors degree graduates in the industry oriented programs over the same five year period was 67.8 per year for a total of 339.

This program was housed in a two-story, 30 year old building that had been well maintained. It shared this facility with several other technical programs. The building layout was very traditional, with many faculty offices located adjacent to laboratories. Laboratory equipment was a mixture of modern table-top training equipment, traditional industrial arts type tools and industrial grade equipment. Some laboratory facilities were shared with faculty members from the industry oriented program.

Program 2. Only faculty members that routinely taught technology teacher education students technical or pedagogical courses were interviewed. Eight interviews were granted: four engineering technology faculty, three teacher education faculty and one administrator. The mean age reported for teacher educators was 49, and the mean age of the industry oriented technology faculty members was 45. The mean number of years in teaching reported by the teacher education faculty members was 25.3 years, while technology faculty members reported an average of 12.5 years. All teacher education faculty reported membership in AVA, ITEA and CTTE. Three of the industry oriented technical faculty reported membership in SME and AVA, 2 reported membership in NAIT and ITEA.

This program was housed in a department that also housed engineering technology and general technology programs. The technology education pre-service students and industry oriented technical students were required to take some of the same technical courses (a common core), and additional technical courses unique to their professional aspirations. Over the past five years, 57 students, for an average of 11.4 students per year, graduated with Bachelors or Masters degrees in education. Over the same 5 year period, 145 students, for an average of 29 students per year graduated with Bachelors degrees the industry oriented programs.

This program was housed in two adjacent one-story buildings, one of which had a basement that contained additional offices and a machine tools laboratory. The newer building was 40 years old and the older one was 70 years old. Both buildings had undergone recent renovation and modernization. Laboratory equipment was a mixture of new and old, but the emphasis was still on traditional industrial arts type equipment. Computers existed in some laboratories, particularly the drafting laboratory, but traditional hand tools, engine lathes and wood working equipment were still prominent in many of the laboratories.

Program 3. Only faculty members that routinely taught technology teacher education students technical or pedagogical courses were interviewed. Eleven interviews were granted: five industrial education program faculty members, five industry-oriented program technical faculty members and one administrator. The mean reported age for teacher educators was 53, and mean age of the technical faculty members was 50. The mean number of years in teaching reported for teacher education faculty members was 26.75, while the average for technology faculty members was 12.8 years. All teacher education faculty members reported membership in ITEA and CTTE, with three also reporting memberships in AVA. All of the technical faculty reported membership in NAIT and one was a member of ITEA.

This program was housed in a department with business education. Technology education pre-service teachers were required to take all of their technical courses from programs within the Industrial Technology and/or Interdisciplinary Technology departments. Over the past 5 years, 139 students, for an average of 27.8 students per year, graduated with Bachelors or Masters degrees in education. One thousand one hundred fifty five students, for an average of 231 students per year, graduated with Bachelors degrees from the industry oriented programs.

Housed in one corner of a 20 year old building that was dominated by the industry oriented technology departments, only laboratory space for teaching woodworking and elementary technology education was allocated for use with this program. There was an effort underway to procure funding to renovate the traditional woodworking classroom. While they had no technical laboratories of their own, the industry oriented programs which provided the technical courses had modern, well equipped laboratories, many of which had recently been upgraded and contained tools and equipment typical of those seen in modern industry.

All three of these programs were located at State Universities that had strong elementary and secondary teacher preparation traditions. All three programs also had long standing industrial education teacher preparation traditions.

Procedure

This was an exploratory case study. It included three cases, one from each of three approaches for providing technical courses to technology teacher education students.

Data collection. Twenty eight open-ended interviews, using a general interview guide approach (Patton, 1990), were conducted. The interviews ranged in length from 45 minutes to 2 hours with most lasting about one hour. To supplement each interview, the faculty members were asked to complete a questionnaire containing demographic information, historical information, and questions regarding curriculum, instructional methods and materials. Twenty three questionnaires were completed and returned. Related documents such as program catalogs, course descriptions, and graduation requirements were also obtained and analyzed.

Data analysis. The interviews were tape recorded, literally transcribed and coded by looking for patterns and recurring themes which were subsequently filtered through the focus of the research questions. Careful analysis and comparison of each interview against other collected data provided insight into the respondent's perceptions of the effects of the technical course configurations at each site.

Results

This study strategy was inductive. It was an attempt to make sense of the context without imposing preexisting expectations on the setting. It began with observations and conversations and built toward general patterns (Patton, 1980). By its nature it was exploratory. Not all the questions it raised were answered, but understanding was increased.

As a result of the organizational structure and technical course configuration adopted by their department, what interaction do faculty members, and administrators perceive with respect to the following factors?

Ability to support a common faculty philosophical position. The personnel at site 1, where all technical instruction was provided from within the program, talked more about philosophical issues than program survival. The consensus at this program was that the configuration they have adopted makes adherence to their philosophical position possible. The discussion at site 2, where a common core of courses for both technology teacher education students and engineering technology students was utilized, was much more pragmatic. Here there was little discussion about philosophical position. Philosophical position seemed to take second place to the more practical issue of maintaining enrollments at course level.

The most diverse philosophical positions were held by faculty members at site 3, where all technical courses were provided by other departments. Faculty here expressed concern that the approach currently utilized at this site may not adequately support their philosophical position; however, there was not total agreement on what their collective philosophical position should be. The technology teacher education faculty at this site had been engaged in negotiations on the future philosophical directions of the program. It appeared that the configuration they planned to adopt would be eclectic. In the future, the technology teacher education faculty hope to begin teaching additional technical courses while some technical courses would continue to be provided by other departments.

Faculty relationships. Faculty relations between the industry oriented technical faculties and the teacher preparation faculties, both where all technical courses were provided from within the technology teacher education program and where all technical courses were designed for students from other non-teaching programs, were strained. Individual relationships occasionally ran counter to group relations. Where technical courses were not utilized from within industry oriented programs, faculty indicated that their teacher education faculty, subsequent to adoption of their present configuration, came together more as a team.

Nature of the leadership within the groups. site 2, where a common core of technical courses was utilized, displayed a unique organizational situation. The administrator and many of the engineering technology faculty members have teacher education backgrounds and orientation. The industry oriented programs, as at many schools, developed historically out of the teacher education program, but here the industry oriented programs have not acquired control of the department. It appears that the department is instead dominated and controlled by and for the benefit of the teacher education program. Some faculty members speculated that as the engineering technology faculty pursues accreditation (which it was exploring), the balance will probably shift away from having faculty with teacher education backgrounds in the technical programs and toward employment of engineers and other industry oriented technical persons as instructors.

Influences of institutional goals. Because the self-contained configuration, like that at site 1, requires laboratories, it is very resource dependant, thus the level of institutional support is a critical factor in the configuration selection process. Faculty members at site 1 observed that, if adequately supported, the configuration that requires technology teacher education students to take technical courses taught by faculty members within their own program demands a larger faculty and offers the chance to be more politically viable.

At site 3, where all technical courses were provided through other programs, a different situation was described. Here administrators beyond the program level appeared to value accreditation while the technology teacher education faculty members appeared to be pursuing a reorganization plan that was described as “not consistent with current NCATE accreditation guidelines.” These faculty members were trying to redesign their technology teacher education program, while continuing to live with the political after-effects of their history (utilizing technical courses from industrial technology and interdisciplinary technology programs that have different focus and mission).

Effects of the demands of accrediting agencies. Because the approach at site 1, which provides all its own technical instruction, allows total control of technical course content for technology teacher education students, faculty members believed it was more easily adapted to the challenge of meeting NCATE guidelines. The faculty at this location believed that their configuration contributed to their successful efforts to obtain accreditation.

Mathematics and science requirements. Table 1 illustrates mathematics, science, and computer science requirements for each site. These requirements were diverse.

Some members of the faculty at all three sites believed that mathematics and science requirements should be higher. Often, however, when discussion turned to the need to raise mathematics and science standards, the over-riding consideration was not whether students need to study higher levels of mathematics and science, but rather, what the impact of higher mathematics and science requirements might have on future enrollments. Some faculty members stated that, traditionally, the student pool that provided students for industrial arts teacher education contained many students who were not adept in mathematics, science, and many other academic subjects. The students with math and science abilities traditionally majored in engineering, science or other higher paying fields.

Impacts on recruitment and retention. Teaching all their own technical courses forces the faculty members at site 1 to recruit students because they can not rely on students from other programs to fill their courses. The ability to depend on engineering technology students enrolled in common core technical courses, conversely, may encourage faculty members at site 2 to become complacent about recruitment, as they can rely on majors from other programs to keep these courses full. Faculty members at site 3 occasionally noted the need for more students in their program but did not discuss recruitment efforts or plans.

Ability to serve the identified clientele. Forced to provide all technical instruction to students in the technology teacher education program, certain site 1 faculty members worried that the technology teacher education faculty may not have sufficient technical expertise to adequately teach certain technical courses. This was not a universal perception, but some individuals clearly were unsure. The balance of this faculty believed the risks of sharing technical courses more than offset any problems the present configuration may produce.

At site 2, members of the technical faculty expressed fear that the content and level of instruction in some common core technical courses may not be ideal for preparing either public school teachers or engineering technology students. This concern was partially grounded in the observed tendency of teacher education students to model their own classrooms and teaching techniques after the classrooms they experienced successfully as pre-service teachers. There was also consternation among some engineering technology faculty that some of the courses were “common core” primarily to maintain enrollments for the teacher education program and were not always the best use of the engineering technology student's resources. The teacher education faculty generally accepted the present configuration as necessary for survival of their program.

While not in the majority, some members of the technical faculty at site 3 believed their present approach, that of providing technical instruction for technology teacher education students through courses designed for industry oriented technology students, assured that the teacher education students received more in-depth technical skills and knowledge. The assumption was that technology teachers needed “industrial strength” competencies.

Future directions of the program. Most of the teacher education faculty members at site 3 viewed their lack of control over the content of technical courses with consternation. They talked at length about the problems with utilizing technical courses from other departments. Additionally, they acknowledged that many of their students are community college transfer students that come to their program with their technical courses already completed.

The concern with utilizing technical courses from other departments or colleges may have been partially related to the perceived need to teach more courses within the program as a means of making the future of the program more secure. This was consistent with comments made at site 3 about the long history of providing large numbers of service courses for elementary education through the technology teacher education program. Apparently the future of those service courses was uncertain. If those courses were lost and the faculty were unable to find replacement audiences, they may not generate sufficient instructional units for the program to remain viable in its present size and form.

Table 1
Comparison of minimum mathematics, science, and computer science requirements across programs

Discipline	Program 1 Graduation Requirements	Program 2 Graduation Requirements	Program 3 Graduation Requirements
Mathematics	Intermediate Algebra	3-5 hrs. College Math, or any other math and/ or computer science course(s)	Pre-calculus, or Calculus, or Math Analysis for Social Science 1
Science	Physics (1 course, Energy and Space Sciences)	4 hr. Biological science & 4 hr. Physical science (can include Astronomy or Geology	Fundamentals of chemistry & Fundamentals of Mechanics, Heat & Sound
Computer Science	computer competency to be acquired through technical course content	can be substituted for a mathematics course	1 course of Computer Science

At site 1, where technical instruction was provided from within the program, teacher education faculty continued to meet, discussing philosophical questions and generating strategic plans. They were attempting to develop an expanded recruitment plan. There was an emphasis on national leadership, publication and grant writing, activities valued by most universities regardless of the departmental configuration. Their configuration provided the opportunity for larger numbers of faculty members and more laboratories which may help make their future more secure.

The prevailing attitude at site 2, where common core technical courses were utilized, was that the future of the program would essentially mirror the status quo. Facility improvements and course changes were in process, but the changes appeared evolutionary in nature. There was some talk about the need to recruit, however, it was apparent that there was but limited enthusiasm for personal involvement.

The future program direction at site 3 was even less certain. A struggle to overcome its history and agree on a new philosophical position while faced with budgetary shortages was underway. Once established, organizational configurations seemed to take on a life and direction of their own that was often hard to change.

Conclusions

History

Themes in the history of how the programs developed as related by faculty members often seemed to provide a general set of advanced organizers categorizing more recent events. Conflict and cooperation at the faculty person level and interaction at the program level were those common themes. Faculty recollections of the history and factors that preceded the current organizational configurations and technical course delivery systems provided insights into how each program came to its present form. Philosophy of program leadership, student enrollment patterns, available faculty numbers, areas of faculty interest and expertise, available facilities and organizational politics both within and beyond the program itself, shaped the evolution of these programs. For the most part, the same environmental factors were present in varying degrees at all three sites as key decisions were being made. The subsequent differences appeared to depend on how faculty members in each program elected to react to their perceived environment.

Conflict and cooperation at the faculty person level. One technology teacher education faculty member (who was active at both the state and national level in technology education) stated that technology education has a commonly agreed upon definition, and therefore the goals of all technology teacher education programs should be common. Interviews at the three sites did not support this supposition. In spite of the fact that ITEA leadership has carefully defined technology education, no single operationally defined content for either technology education or technology teacher education has been universally accepted by technology education teachers and/or technology teacher educators. Philosophical differences appeared to exist at each of these three sites.

Recognizing these philosophical differences, no single best approach to providing technical courses or to organizational configuration for technology teacher education programs was identified. It appears that careful identification of the philosophy and basic assumptions behind a program are necessary steps in this very important planning process. The stated mission of the program and its clearly defined goals, when combined with the political and economic realities at that institution, should dictate the most effective configuration for any specific technology teacher education program. The approach utilized in any technology teacher education program should be carefully planned, based on the philosophical assumptions and goals of the faculty. In practice, it appeared that at these three sites, economic realities, political alliances, and the ideas or interests of a few faculty members with strong personalities and power bases may have often been more important than philosophy.

Interaction at the program level. Configuration type can apparently impact on faculty relations and cooperation, but is not the only source of either positive or negative relations. Where teacher educators conducted all their own technical courses, increased teamwork was apparent among the technology teacher education faculty. This same spirit of cooperation unfortunately did not extend to the industry oriented technical faculty. Faculty relations between teacher educators and industry oriented technical faculties were strained in both the program where all technical courses were taught by the technology teacher faculty and in the program where all technical courses were taught by faculty from other departments. This seemed to be a result of competition for resources and a historical split that falls roughly along “hard science,” “soft science” lines, or perhaps is reminiscent of the historical split between industrial arts (general education oriented) faculty and vocational education faculty.

When technology teacher education and industry oriented technology programs share technical courses, the needs of the program with the largest enrollments are likely to dictate technical course content and availability. Enrollments in the field have consistently shifted toward the industry oriented programs over the last 3 decades. The accreditation guidelines for technology teacher education, industrial technology and engineering technology are very different. This is predictable, considering different professional job requirements and uniquely different missions. Concerns related to accreditation at both site 2, with its common core of technical courses and newly designated engineering technology program, and site 3, with its historical dependance on other industry oriented technology programs for technical instruction, appeared to be exacerbated by the inflexibility inherent in the approaches adopted.

Industrial technology and engineering technology programs seem to be evolving in directions that include less hands-on activity and more math-based theory and management theory. The trend in their technical courses appears to be toward more specialization and depth. As this trend continues, technical courses designed for industry oriented students may become even less compatible with the goals and mission of technology teacher eduction. Before technology teacher education faculty members consider which, if any, industry oriented program technical courses to utilize for the preparation of technology education teachers, members of the faculty should reexamine their curricular goals and attempt to arrive at consensus about and the philosophy behind those goals.

There has long been an argument in technology education about whether the technical content should be focused on the functions of industry or broad aspects of technology. If the program goal is to focus on industry, the configuration that utilizes a common core of basic technical courses shared between the technology teacher education students and the industry oriented technology students may, if carefully structured, be advantageous because these courses could offer introductory content that is basic to both the processes found in industry and those explored in the secondary classroom. The configuration that utilizes only technical courses designed for industry oriented technology programs can provide sophistication and technical content depth and equipment that is compatible with certain segments of industry but may not be readily incorporated into the secondary technology education classroom. Conversely, if the goal is to focus on the broad aspects of technology, most technical courses designed for industry oriented technology students may be too narrow in focus. In this case the approach that provides all technical courses for technology teacher education students through instruction by technology teacher education faculty may be most appropriate because both its depth and breadth of technical content can be controlled by the technology teacher education faculty. This configuration can also provide the opportunity to focus the technical course content and laboratory equipment more directly on the needs of the teacher education student.

Recommendations

The effects of the approach to providing technical instruction can reach far beyond the technical competency attained by its students. Within the pool of larger organizations, policy decisions made by sub-groups, like rocks dropped in a pool, have effects that ripple throughout the larger organization impacting many other individuals and sub-groups. Program goals ultimately define the most effective organizational configuration. Inquiry should be conducted to find means to facilitate consensus building processes that lead to broad agreement on program mission and goals.

Further, studies should be conducted into the effects of organizational configuration upon enrollments, curriculum, facilities and faculty relationships within technology teacher education programs. Additional insight into the effects of providing technical instruction from outside teacher preparation programs might also be gained by studying teacher education programs outside our discipline.

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