# The Technical Content of Industrial/Technology Teacher Education

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What technical competencies will the next generation of industrial/ technology education teachers possess? At first, this may seem like a simple question. However because of national educational reform movements, colleges and universities which prepare industrial/technology education teachers have changed their teacher education degree requirements and curricula (Volk, 1993). Have these changes created more unified industrial/technology teacher education programs or has the field's teacher preparation become more fragmented? According to Diez (1995), the later is true. He indicated the spectrum of teacher preparation models range from traditional to innovative, both extremes.

Bottrill (1991, p. 6) noted, with regard to industrial/technology teacher education, that: "unfortunately, educationalists have been bound up with education theory and have not kept pace with curriculum development in the field. The impetus has come from educational agencies." Have these educational change agencies taken into account all the aspects of industrial/technology teacher education?

The term industrial/technology education is utilized throughout this study based on the findings of Zuga's (1991) research. Her survey results indicated that 34% of the field's teacher education programs were entitled technology education, while 62% contained the descriptor "industrial" in the program title. Therefore, the title industrial/technology teacher education is used in this study.

The competencies needed by industrial/technology education teachers have been categorized into three areas by W. R. Miller (1990). Miller identified those competencies as personal, professional, and technical. Curricula in some industrial/technology teacher education programs have been configured similarly. Henak (1991) classified the three program elements of industrial/ technology teacher education as general education, professional education, and technical content. Finch, Schmidt, Oliver, and Yu (1991) termed these divisions as general studies, professional education, and technical content.

The general education component, which in many cases is dictated by college and university graduation requirements, has been and continues to be discussed by all of teacher education (Diez, 1995; Grant, 1995). Numerous authors and agencies have indicated their vision of both the general education

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component and a model professional preparation sequence for teacher education programs (Goodlad, 1995; C. D. Miller, 1991; Johnson, Erekson, Dugger, and Blankenbaker, 1990; Holmes Group, 1986).

The professional preparation element of industrial/technology teacher education was examined by Zuga (1991) and Finch et al. (1991). Finch et al., determined that industrial/technology teacher education programs required a mean of 27.5 credit hours for professional education coursework. Of these hours, 9.6 hours were methods courses, 9.9 hours were included in student teaching, with 9.2 hours indicated as other professional education courses.

Zuga (1991) examined only curriculum related courses required in industrial/technology teacher education programs. She noted that 56% of the programs required only one course in curriculum development, while 31% offered two curriculum courses. Her research also indicated that 44% of the professional courses were not offered exclusively to industrial/technology education majors, but were taught to a combination of vocational education students including agriculture education, trade and industrial education, family and consumer science, business education, and marketing education.

**Technical Content**

Technical content of industrial/technology teacher education has been examined by Henak (1991), C. D. Miller (1991), Finch et al. (1991), Polette (1991), Lewis (1992), and Lewis (1993). Of these authors, only Finch et al., provided information on actual coursework required. The technical coursework was grouped in a single category, thus no differentiation was made concerning the types of technical courses required. Finch et al., surveyed 54 industrial/ technology teacher education programs as to the number of credit hours required in their teacher education programs. The results noted a mean technical course requirement of 50.5 credit hours per program.

Henak (1991) described a visionary profile of the technical content that should be included in teacher preparation. He noted that “the thrust of the content and activities [of the technical component] is on helping students understand impacts, processes, and outputs of present-day technical subsystems used in contemporary industry” (p. 11). Henak identified a 48 credit-hour technical component for industrial/technology education teachers. He grouped these technical competencies into biotechnology, communication, construction, manufacturing, and transportation.

C. D. Miller (1991) conducted a survey of leaders in the field of industrial/ technology teacher education to assess their opinions on both an ideal mixture of teacher preparation courses and a practical mixture of courses. His results indicated that leaders felt an ideal program's technical component should contain 45.6 credit hours, while a practical technical credit requirement was felt to be 42.7 hours. However, no course delineation of the type of technical course content was envisioned by these leaders.

Polette (1991), when discussing how to compose a curriculum plan, noted that traditionally the technical content of industrial/technology teacher education was composed of woodworking, metalworking, electricity/electronics, automotive mechanics, graphics, and mechanical drafting. He concluded that

although contemporary program content should include these technical skills, the contemporary focus should shift to include knowledge and skills used in communications, construction, manufacturing, and transportation.

Lewis (1992) surveyed industrial teacher educators to assess what they deemed as relevant content of technology education subject matter. His research noted content in terms of innovative, such as construction, manufacturing, communications, transportation, and power/energy, and traditional, like metalworking, woodworking, and plastics.

Lewis (1992) also noted that the location in which the technical courses were taught has a statistically significant impact on the course's content. Technical courses taught outside of a college of education included social, political, moral, and economical aspects of technology and included less technical skill development than the courses taught in a college of education. Thus, the location of the industrial/technology teacher education program must be considered an important demographic statistic. Finch et al., concluded that in 1991, 64.2% of industrial/technology teacher education technical courses were taught outside of a college of education.

Additionally Lewis (1993) concluded that, industrial/technology teacher education has been concerned with the increase of liberal studies into the teacher education curricula, thus squeezing out technical skill development. Lewis (1994) went on to state:

> I believe we have to rethink especially the technical content aspect of technology teacher education programs. Curriculum research in industry could help here. We need teachers who are technically competent to supervise the construction of a workable solar vehicle in their high school laboratories. ... What this means is that pre-service technology teachers need depth, not breadth, of exposure to the major processes of industry. (p. 53)

Teacher education reform along with changes in industry require that the technical competencies currently being taught in industrial/technology teacher education programs be identified. As indicated there is a lack of relevant data on the current technical content required by the nation's industrial/technology teacher education programs. This study was a survey of the technical content of industrial/technology teacher education program in the United States, thus indicating what technical skills the next generation of teachers are being taught.

## Purpose

The purpose of this study was to determine what courses comprise the technical component of industrial/technology teacher education programs currently being offered by the nation's colleges and universities.

### *Research Questions*

More specifically, the research questions examined by this study were:

1. What courses comprise the technical content of industrial/technology teacher education programs across the United States?
2. Is there a difference between the technical content required by teacher education programs in the United States with different program titles: technology education, industrial technology education, and industrial education?
3. Is there a difference between the technical content required by industrial/technology teacher education programs in the United States with regard to their location within or outside a college of education?

## Methodology

*Population and Sample*

The population and sample for this research consisted of the 133 institutions located in the United States listed in the *Industrial Teacher Education Directory* (Dennis, 1994) which offered undergraduate degrees in industrial technology education, technology education, industrial education, or industrial arts education.

A cover letter requesting the institution's program of study and a data gathering sheet were mailed to these 133 colleges and universities. Seventy-eight responses were received from 33 states. Of those institutions responding, four had closed their industrial/technology teacher education programs and 17 of the returned data sheets did not include a program of study. Those 21 colleges and universities were not utilized. Thus, the sample consisted of the 57 responding colleges and universities which offered an undergraduate teacher education program in technology education, industrial technology education, industrial arts education, or industrial education.

*Data Analysis*

Each university's program of study and response sheet was examined to identify: 1) the title of the program 2) the location of the teacher education program, that is college of education, college of engineering, college of technology, and so forth 3) the titles of the required technical courses, and 4) the total number of required technical credit hours.

Thirty-three of the programs (57.9%) were titled technology education, while 24 programs (42.1%) contained the descriptor industrial in their program title. This indicated a shift from the findings of Zuga (1991). Twelve programs (21.1%) were housed in a college of education, with 45 programs (78.9%) being housed outside a college of education.

The mean number of technical credit hours required was 49.8, with a median of 48 credit hours. The range of required technical credit hours was from 91 to 30 credit hours. Three programs (5.3%) did not have a prescribed technical component in their program of study. These institutions develop a technical program of study for each industrial/technology teacher education major as needed.

## Findings

The technical courses required by the responding industrial/technology teacher education programs are displayed in Table 1. Not one common technical course was required by every responding college or university. The most commonly required technical course was electricity/electronics, which was required by 75.4% ($n$ = 43) of the institutions. Mechanical drafting was the second most required technical course identified (66.7%, $n$ = 38).

**Table 1**
*Required Technical Courses*

| Technical Course | *n* | % |
|---|---|---|
| Electricity Drafting | 43 | 75.4 |
| Mechanical Drafting | 38 | 66.7 |
| Manufacturing | 36 | 63.2 |
| Graphics/Desktop Publishing | 32 | 56.1 |
| Construction | 28 | 49.1 |
| Woodworking | 25 | 43.9 |
| Computer-Aided Drafting | 23 | 40.4 |
| Power and Energy | 19 | 33.3 |
| Materials and Processes | 18 | 31.6 |
| Industrial Safety | 13 | 22.8 |
| Lab Management/Planning | 13 | 22.8 |
| Metalworking | 12 | 21.1 |
| Machine Tool Technology | 11 | 19.3 |
| Communications | 11 | 19.3 |
| Transportation | 10 | 17.5 |
| Automotive Mechanics | 9 | 15.8 |
| Introduction to Industrial/Tech | 9 | 15.8 |
| Welding | 8 | 14.0 |
| Plastics/Composites | 6 | 10.5 |
| Industrial Design | 4 | 7.0 |
| Hydraulics/Pneumatics | 3 | 5.3 |
| Robotics | 2 | 3.5 |
| Biotechnology | 2 | 3.5 |

*N*=57

The technical courses suggested by Polette (1991) and Henak (1991), manufacturing and construction, were required by 63.2% and 49.1% of the teacher education programs respectively. Courses in graphics or desktop publishing were required in 56.1% ($n$ = 32) of the programs. Woodworking courses were required by 43.9% ($n$ = 25) of the colleges and universities. Computer-aided drafting was required by 40.4% ($n$ = 23) of the programs.

Hydraulics/pneumatics, biotechnology, and robotics were listed at the bottom of the required technical courses. A course in hydraulics/pneumatics was required by only 5.3% ($n$ = 3) institutions, while biotechnology and robotics were included in only 3.5% ($n$ = 2) industrial/technology teacher education programs.

Table 2 shows an examination of the industrial/technology teacher education programs by their title; technology education, industrial technology education, or industrial (studies, arts) education. The most frequently required technical course, when the respondents were divided by program title, was electricity/electronics in industrial technology education programs (92.9%, *n* = 13). The chi-square test for independence was utilized to test the relationship between technical course usage with regard to program title (Gravetter and Wallnau, 1996).

**Table 2**
*Required Technical Courses By Program Title*

| Technical Course | TE | | ITE | | Industrial | |
|---|---|---|---|---|---|---|
| | *n* | *%* | *n* | *%* | *n* | *%* |
| Electricity/Electronics | 24 | 72.7 | 13 | 92.9 | 6 | 60.0 |
| Mechanical Drafting | 20 | 60.6 | 10 | 71.4 | 8 | 80.0 |
| Manufacturing | 23 | 69.7 | 10 | 71.4 | 3 | 30.0 |
| Graphics/Desktop Publishing | 18 | 54.5 | 8 | 57.1 | 6 | 60.0 |
| Construction | 20 | 60.6 | 5 | 35.7 | 3 | 30.0 |
| Woodworking | 11 | 33.3 | 7 | 50.0 | 7 | 70.0 |
| Computer-Aided Drafting | 12 | 36.4 | 6 | 42.9 | 5 | 50.0 |
| Power and Energy | 11 | 33.3 | 6 | 42.9 | 2 | 20.0 |
| Materials and Processes | 11 | 33.3 | 7 | 50.0 | 0 | 00.0* |
| Industrial Safety | 4 | 12.1 | 5 | 35.7 | 4 | 40.0 |
| Lab Management/Planning | 5 | 15.2 | 4 | 28.6 | 4 | 40.0 |
| Metalworking | 7 | 21.2 | 3 | 21.4 | 2 | 20.0 |
| Machine Tool Technology | 4 | 12.1 | 4 | 28.6 | 3 | 30.0 |
| Communications | 11 | 33.3 | 0 | 00.0 | 0 | 00.0* |
| Transportation | 9 | 27.3 | 1 | 7.1 | 0 | 00.0 |
| Automotive Mechanics | 4 | 12.1 | 2 | 14.3 | 3 | 30.0 |
| Introduction to Industrial/Tech | 4 | 12.1 | 4 | 28.6 | 1 | 10.0 |
| Welding | 2 | 6.1 | 4 | 28.6 | 2 | 20.0 |
| Plastics/Composites | 1 | 3.0 | 1 | 7.1 | 4 | 40.0* |
| Industrial Design | 2 | 6.1 | 1 | 7.1 | 1 | 10.0 |
| Hydraulics/Pneumatics | 0 | 00.0 | 0 | 00.0 | 3 | 30.0* |
| Robotics | 1 | 3.0 | 1 | 7.1 | 0 | 00.0 |
| Biotechnology | 2 | 6.1 | 0 | 00.0 | 0 | 00.0 |
| | 33 | | 14 | | 10 | |

*p<.05

Four comparisons tested significant at the $p < .05$ level. A communications course was required by 33.3% ($n = 11$) of the technology education programs, while no industrial technology education or industrial education program required this technical course. This preference of a communications course by technology education programs tested significant via the chi-square treatment, $X$ (df = 2, $n = 57$) = 9.913.

A course in plastics or composites was required by 40.0% of the industrial education programs, while only 3.0% of the technology education programs and 7.1% of the industrial technology education programs required this technical class. Analysis indicated a significant difference between programs with regard to a plastics/composite course, X (df = 2, *n* = 57) = 11.363. Hydraulics/ pneumatics courses were preferred by industrial education programs which the chi-square treatment indicated significant X (df = 2, *n* = 57) = 10.592. Materials and processes courses were statistically more likely to be required by industrial technology teacher education programs (50.0%) and technology education programs (33.3%) than industrial education programs (0.0%), X ( df = 2, *n* = 57) = 6.861.

Table 3 presents the industrial/technology teacher education programs with relationship to their housing within or outside of a college of education. Power and energy was required by 40.0% of programs outside of a college of education, while only required by 8.3% of programs in a college of education. A technical course in transportation was not required in any college of education program, while transportation was a part of 22.2% of non-college of education programs. However, utilizing the chi-square analysis, no comparison tested significant at the $p < .05$ level.

## Conclusions

The results of this study indicated that industrial/technology teacher education programs in the United States required a mean of 49.8 semester hours of technical courses. The data analysis noted only two courses were required by more than two-thirds of the nation's colleges or universities. There appeared not to be a core of technical courses required for an undergraduate teaching degree in industrial/technology education.

Data indicated some difference between teacher education programs relevant to their program title, which should be expected. Four technical course comparisons tested significant via the chi-square treatment at the $p < .05$ level. Research question two, is there a difference between the technical content required by teacher education programs in the United States with different titles; technology education, industrial technology education, and industrial education, would receive a positive response for the courses of communications, plastics/ composites, hydraulics/pneumatics, and materials and processes.

This study's results further indicated that the industrial/technology teacher education curricula did not reflect current curriculum trends as indicated by Lewis (1992), Polette (1991), and Henak (1991). The requirement of woodworking, mechanical drafting, and graphics was not significantly different between technology education programs and industrial education programs. Likewise, there was no significant difference between the inclusion of hydraulics/pneumatics, robotics, and plastics/composites between industrial

**Table 3**
*Required Technical Courses Relative to a College of Education*

| Technical Course | COE | Non-COE |
|---|---|---|

| | *n* | % | *n* | % |
|---|---|---|---|---|
| Electricity/Electronics | 7 | 58.3 | 36 | 80.0 |
| Mechanical Drafting | 6 | 50.0 | 321 | 71.1 |
| Manufacturing | 6 | 50.0 | 30 | 66.7 |
| Graphics/Desktop Publishing | 5 | 41.7 | 27 | 60.0 |
| Construction | 7 | 58.3 | 21 | 46.7 |
| Woodworking | 3 | 25.0 | 22 | 48.9 |
| Computer-Aided Drafting | 5 | 41.7 | 18 | 40.0 |
| Power and Energy | 1 | 8.3 | 18 | 40.0 |
| Materials and Processes | 2 | 16.7 | 16 | 35.6 |
| Industrial Safety | 2 | 16.7 | 11 | 24.4 |
| Lab Management/Planning | 3 | 25.0 | 12 | 26.7 |
| Metalworking | 3 | 25.0 | 9 | 20.0 |
| Machine Tool Technology | 2 | 16.7 | 9 | 20.0 |
| Communications | 2 | 16.7 | 9 | 20.0 |
| Transportation | 0 | 00.0 | 10 | 22.2 |
| Automotive Mechanics | 3 | 25.0 | 6 | 13.3 |
| Introduction to Industrial/Tech | 2 | 16.7 | 7 | 15.6 |
| Welding | 2 | 16.7 | 6 | 13.3 |
| Plastics/Composites | 1 | 8.3 | 5 | 11.1 |
| Industrial Design | 0 | 00.0 | 2 | 4.4 |
| Hydraulics/Pneumatics | 1 | 8.3 | 2 | 4.4 |
| Robotics | 0 | 00.0 | 2 | 4.4 |
| Biotechnology | 1 | 8.3 | 1 | 2.2 |
| | *n*=12 | | *n*=45 | |

education programs and those titled technology education. Additionally graphics, a course noted by secondary industrial education teachers as not relevant in today's curriculum (Rogers, 1995), was required in 56.1% (*n* = 32) of the programs.

In addressing research question three, a chi-square statistical treatment of the data displayed on Table 3 indicated no significant difference between the required technical courses of programs housed within and outside a college of education.

The findings of this study indicated that the field of industrial/technology teacher education lacks consistency in what technical courses are required. This lack of consistency could have a detrimental impact on the field, as graduates from its teacher education programs do not possess a common base of technical competencies. Graduates, practicing teachers, and administrators will be left asking what technical competencies do industrial/technology education teachers need to be successful?

*Recommendations*

Industrial/technology teacher education must establish national teacher education standards addressing the discipline's technical content. Documents,

such as *Elements and Structure For a Model Undergraduate Technology Teacher Education Program* (Henak, 1991), have not been utilized by the teacher education field. The root of this lack of implementation may stem from the non-acceptance of technology education by industrial education teachers (Rogers and Mahler, 1994).

Demographic data also indicated a greater percentage of programs (78.9%) were housed outside of a college of education than noted by Finch et al., in 1991 (64.2%). Inferring from Volk's (1993) analysis, with only 21.1% of the industrial/technology teacher education programs housed in a college of education, the loss of more industrial/technology teacher education programs across the United States is a strong possibility.

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