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ABSTRACT

A study examined trade and industrial (T&I) educators' views regarding the curricular content of technology education (TE). Demographic data sheets and questionnaires were mailed to a random sample of 430 of the 5,565 members of the T&I Division of the American Vocational Association. Of the 156 questionnaires returned from 42 states (response rate 36.3%), 123 were usable for data analysis purposes. All of the responding teachers taught at the secondary level, and their mean level of T&I teaching experience was 16.9 years. The responses were subjected to a computer statistical analysis. The six highest rated statements (dependability/punctuality, ability to follow directions, pride in workmanship, conscientiousness/honesty, cooperation, safety consciousness) were all affective domain competencies. The highest rated cognitive domain statement was a student's ability to measure, followed by identification of common hand tools. The next highest ranked competency was a TE completer's ability to use common hand tools. Knowledge of economic factors, hydraulics/pneumatics, high-tech applications, and the invention process and ability to perform desktop publishing ranked lowest. The respondents thus ranked traditional competencies higher than more contemporary TE skills/knowledge. (Contains 27 references.) (MN)

The Curricular Content of Technology Education

As Identified By

Industrial Educators

A Research Paper
Presented At
The American Vocational Association
1994 Conference
Dallas, Texas

by
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The curricular contents of both technology education and trade and industrial (T&I) education are in a state of stormy transition. Technology education is evolving from industrial arts education to address the needs of a technological society, while T&I programs are identifying their role in the Tech-Prep and School-To-Work movements. Industrial arts education provided a direct articulation link from junior high school industrial arts courses to senior high school T&I programs. However, with technology education's claim as "an integral and critical part of the general education curriculum," its articulation link with T&I education is unclear (Anderson, 1992, p. 22). Roberts and Clark (1994) noted that "many persons directly involved in both programs cannot clearly articulate the purpose, mission, and goals of their respective program" (43).

Betts, Welsh, and Ryerson (1992) noted that technology education programs should provide students with the opportunity to gain knowledge, skills, ability, and confidence to pursue pre-employment technical courses. This thought is echoed by Roberts and Clark (1994) in noting that technology education's role "must be defined to include successful vocational programs" and "continually striving for excellence in preparing students as productive employees" (p. 43-44). In other words, technology education needs to articulate with secondary T&I education, in the same way that T&I education and technical education are establishing their Tech-Prep linkage.

However, an articulation link with occupational preparation programs is difficult for technology education to establish because of its unlimited curricular scope (Lewis, Jr., 1992). For articulation to be successful, agreement on the curricular content of technology education must be established.

REVIEW OF TECHNOLOGY EDUCATION CURRICULAR CONTENT

According to Lewis (1992), curriculum delineation is one of the most challenging facets of the change from industrial arts education to technology education. Gradwell and Welsh (1991) reiterated these thoughts in noting that the critical question is: "What are the basic concepts that (technology education) students should learn?" (p. 26). In a modified Delphi study conducted by Wicklien (1993), leaders in the field identified the major problems facing technology education. That research noted a lack of identity in the technology education knowledge base, varying curriculum development models, and a lack of consensus on the technology education curriculum as the top problems for the discipline.

A decade ago, Bjorkquist (1985) noted that a choice on technology education's curriculum needed to be made.

Bjorkquist continued that, "to attempt to draw content from two bases, industry and technology, both of which are broader than industrial education can comprehensively address, likely will add to an already confusing situation" (p.15).

Numerous manuscripts, such as Technology education: A critical literacy requirement for all students (Pucel, 1992a), Technology education: Its changing role within general education (Pucel, 1992b), and A conceptual framework for technology education (Savage & Sterry, 1990), have attempted to delineate technology education's content. However, as noted by Wicklien (1993), there still is not a consensus as to technology education's curricular content.

Pucel (1992a) noted that the lack of clear goals for technology education has led educators to the focus on the interaction between technology and society. With its focus on humanistic concerns and societal needs, technology education has forgotten to develop knowledge, skills, and attitudes related to the tools, equipment, materials, and processes of industry. According to Nee (1993), students in technology education typically spend less time developing manipulative skills and dealing with industrial processes than their industrial arts predecessors. Nee further noted that in technology education "there is also a chance of neglecting development of craft skills" (p. 47).

In examining the goals of technology education, as developed by Savage and Sterry (1990), the affective and psychomotor domains of learning are absent. Only cognitive goals related to society and humanistic needs are indicated. These cognitive-only-centered goals are not advocated by Schilleman (1987). Schilleman indicated that technology education programs should place greater emphasis on positive attitudes, work ethics, pride in workmanship, and a desire to continue into T&I programs. This view is shared by Silverman and Pritchard (1993) who recommend "that the technology education curriculum be reviewed to look for ways to make better connections with the world of work" (p. 16).

In order to assess the affective domain competencies secondary T&I students require, Gregson (1991) surveyed Virginia instructors identified work values and attitudes that they perceived as being important to their T&I programs. These affective domain competencies included: dependability, conscientiousness, cooperation, ability to follow directions, workmanship, and carefulness. However, affective domain competencies are absent from technology education curricular literature.

Pucel (1992a; 1992b) advanced ten categories of technology education curricular content. Those categories were: 1) technical method, 2) common tool usage, 3) common equipment usage, 4) basic technological process, 5) materials 6) terminology, 7) environmental concerns, 8) social values, 9) scientific principles, and 10) economic factors. According to Pucel, the first six categories should be the primary focus of technology education programs, while the later four categories are recommended to be taught in other areas of the school curriculum. The first six categories address both the cognitive and psychomotor domains. However, a void exists with regard to students' attitudes. Pucel further noted that it is not possible for technology educators to teach all of its content. Gradwell and Welch (1991) concur that "the list (of technology education content) cannot be endless" (p. 26). So what competencies should technology education instructors teach?

As outlined by Pucel (1992a), "instructors [must] first identify the ideas, tools, equipment, materials, and processes they wish to teach students" (p. 29). However, it should be the scope and sequence of the curricula, generated by student needs, analysis of constraints, and articulation agreements, that dictate what, how, and when course content is taught in technology education (Gallagher, 1993; Pautler, 1984; Taba, 1962). Wicklien (1993) recommended that curriculum development for a technology education curricula with a central theme should be giving priority. Without delineating technology education's curricular content, what besides the teacher's definition of technological literacy is technology education preparing its students for?

PURPOSE

The purpose of this study was to identify technology education curricular competencies utilizing the perceptions of secondary T&I instructors. This data would provide a knowledge base for an articulated technology education curriculum. A secondary purpose of this study was to identify differences between the various secondary T&I programs with regard to technology education prerequisite knowledge, skills, and attitudes.

Research Questions

More specifically, the following research questions were addressed:

1. What knowledge, skills, and attitudes do secondary T&I educators rate as the most and least important for technology education students to possess?

2. Is there a significant difference between the importance of different technology education competencies as rated by secondary T&I educators?

3. What knowledge, skills, and attitudes do secondary T&I educators from different curriculum areas rate as the most

and least important for technology education students to bring into their T&I programs?

4. What knowledge, skills, and attitudes do secondary T&I educators with different levels of education rate as the most and least important for technology education students to bring into their T&I programs?

5. What knowledge, skills, and attitudes do secondary T&I educators with different years of teaching experience rate as the most and least important for technology education students to bring into their T&I programs?

6. What knowledge, skills, and attitudes do secondary T&I educators with different years of occupational experience rate as the most and least important for technology education students to bring into their T&I programs?

METHODOLOGY

Instrumentation

In order to address these research questions, a 28-item questionnaire was developed. Each item on the questionnaire was rated by the T&I instructors on a five-point Likert-type scale (1 = useless to 5 = very important). The 28 items were derived from Pucel's (1992a; 1992b) ten categories of technology education and Gregson's (1991) listing of important work values and attitudes as identified and rated by secondary

T&I instructors. Additional questionnaire items were added to assess both traditional curriculum content and current trends in technology education. Traditional items included the ability to measure and the ability to utilize drafting. Questionnaire items related to current trends were derived from Hearlihy and Company's (1993) Modular Technology Education Program. These items included desktop publishing, knowledge of future technologies, knowledge of hydraulics/pneumatics, and knowledge of computer applications.

A pilot study of the questionnaire was conducted with 33 Central Pennsylvania secondary T&I instructors during the spring of 1993. The questionnaire and its responses conformed to the criteria established by Best and Kahn (1989) and Borg and Gall (1993). Data received via the pilot study assisted in the development of the demographic sheet categories.

Population and Sample

The population for this research consisted of the national membership listing of the Trade and Industrial (T&I) Division of the American Vocational Association. According to Link (1994), 5,565 individuals were members of the T&I Division. Sample size was determined at a 90% confidence level utilizing criteria established by Nunnery and Kimbrough (1971) and Cohen (1977). The determined sample size was increased by

67% to account for non-returned questionnaires and T&I Division members who were not secondary instructors (Borg & Gall, 1993). A total of 430 T&I Division members comprised the final sample.

Procedure

The survey instrument, demographic data sheet, along with a cover letter were mailed to the sample of T&I Division members in March 1994. A total of 156 questionnaires and demographic data sheets were return or a response rate of 36.3%. Questionnaires were return from 42 different states. Because of American Vocational Association mailing guidelines, a follow-up mailing could not be conducted to the non-respondents. From the returned questionnaires, a total of 123 were usable for data analysis purposes. Demographic data were tabulated with regard to the instructors' subject area, educational level, years of teaching experience, and years of occupational experience. The mean years of teaching experience was 18.7 and the mean years of occupational experience was 16.9.

Data Analysis

A combination of descriptive and inferential statistics were computer generated with the SPSS-X statistical analysis program. Data were analyze utilized mean ratings for each statement, even though the Likert-type questionnaire provided ordinal data it was felt that the large random sampling allowed for this type analysis (Siegel, 1988). Although nonparemetric tests of significance are not specially designed to analyze variance, Polit and Hungler (1991) and Siegel noted that following established procedures analysis of variance (ANOVA) can test ordinal data. Polit and Hungler and Ferguson and Takane (1989) suggest the use of the Friedman two-way test for ANOVA by ranks to test ordinal data obtained from a single sample.

RESULTS

Table 1 depicts the overall mean scores for the sample of 123 T&I instructors' rating of technology education competencies. It can be noted that the six highest rated statements were all affective domain competencies. The highest rated cognitive domain statement was a student's ability to measure, followed by identification of common hand tools. The next highest ranked competency was a technology education completer's ability to utilize common hand tools. An examination of the lowest rated technology education competencies indicated that current trend statements and items selected from Hearlihy and Company (1993) were ranked at the bottom of the desired student attributes.

To address the second research question, nine comparisons were selected for the Freidman two-way ANOVA. Three traditional industrial arts education competencies; knowledge of basic processes, identification of common tools, and knowledge of basic materials, were compared to three currently popular technology education items; knowledge of the invention process, knowledge of future technologies, and knowledge of high-tech applications. Significance level was established at a=.05 and tested at a $\leq$ .0056 (Siegel, 1988). Seven of the nine comparisons tested significant at that level.

Knowledge of basic processes tested significant when compared to knowledge of the invention process (X=46.96, df=1, p=0000) and tested against knowledge of high-tech applications (X=20.49, df=1, p=.0000). Identification of common hand tools proved to be significant when compared to knowledge of the invention process (X=60.13, df=1, p=.0000), knowledge of future technologies (X=15.87, df=1, p=.0001), and knowledge of high-tech applications (X=31.51, df=1, p=.0000). Knowledge of basic materials tested significant against both knowledge of the invention process (X=43.33, df=1, p=.0000) and knowledge of high-tech applications (X=21.32, df=1, p=.0000).

An examination of the results by the technology education competency's educational domain can be see in Tables 2, 3, and 4. The ratings for both the cognitive and psychomotor domains indicate traditional competencies were ranked higher than more contemporary technology education skills or knowledge.

Insert Tables 1, 2, 3, & 4 about here

In order to identify any statistically significant difference for research questions three, four, five, and six, a Kruskal-Wallis one-way ANOVA was applied to selected competency statements (Ferguson & Takane, 1989). As suggested by Seigel (1988), only meaningful comparisons that appear to be significant were analyzed, thus lowering the possibility of a Type I error.

Table 5 depicts the mean competency ratings by the T&I instructors' curriculum area. A seventh group of instructors (N=18) were classified as "other" and do not appear in Table 5. The statistical treatment tested at the a=.05 level indicated a significant difference between the instructors with regard to curricular area on three competencies. Those statements were knowledge of basic processes (x=21.10, df=5, p=.0036), interpretation of drafting drawings (X=27.20, df=5, p=.0003), and the ability to utilize drafting to construct drawings (X=26.97, df=5, p=.0003).

Insert Table 5 about here

Table 6 indicates the technology education competency ranking by the T&I instructors' educational level. A Kruska-Wallis one-way ANOVA indicated no significant differences on statements ranking with regard to the instructors' educational level. Examination of technology education completer competencies with relationship to the T&I instructors' years of teaching experience can be seen in Table 7. Statistical testing indicated no significant difference between the instructors with regard to years of teaching experience.

Insert Tables 6 & 7 about here

Table 8 depicts the technology education competencies grouped by the T&I instructors' years of occupational experience. A Kruskal-Wallis one-way ANOVA test indicated a significant difference between T&I instructors with regard to their occupational experience on two competency statements. A technology education student's ability to identify common equipment (X=8.12, df=2, p=.0172) and a student's ability to operate common equipment (X=8.49, df=2, p=.0144).

Insert Table 8 about here

Findings

The data from this research and its analysis indicated the following findings for the fields of trade and industrial education and technology education.

1. Secondary T&I instructors rated affective domain competencies developed in technology education programs as being the greatest benefit to their T&I programs.

2. The ability of technology education program completers to 1) measure, 2) identify and use common hand tools, and 3) identify and use common equipment rated higher that knowledge of high-tech applications, such as robotics, lasers, or satellites, by secondary T&I instructors.

3. Disparity between the different T&I curricular areas with regard to technology education knowledge, skills, or attitude prerequisites was not indicated in any breath.

4. Disparity between the mean technology education competency ratings was not indicated in any depth with regard to the T&I instructors' educational levels, years of teaching experience, or years of occupational experience.

Recommendations

The findings of this research indicate the following recommendations for the fields of technology education and T&I education.

1. T&I instructors and leaders need to express their articulation concerns to technology education curriculum developers. Likewise, technology education leaders need to communicate with their cohorts in the T&I arena to identify competencies that will articulate for technology education into further technical/industrial education.

This communication between the different segments of industrial education was initially suggested by Rudisill (1987) and more recently noted as lacking by Roberts and Clark (1994) and Wicklien (1993). Wicklien suggested that "serious efforts should be established and implemented to communicate the purpose and scope of technology education" (p. 70). However, leadership in the technology education curricular change movement has failed to institute this vital communication link.

2. Technology education should stress the following affective domain attributes:

a. Following directions

b. Pride in workmanship

c. Being dependable and punctual

d. Exhibiting a safety attitude

e. Being conscientious and honest

f. Cooperating with others

3. The following cognitive and psychomotor competencies should be included as the core content of any technology education curriculum:

a. Measurement

b. Identification of common hand tools

c. Utilization of common hand tools

d. Identification of common equipment

e. Utilization of common equipment

f. Knowledge of technical terminology

g. Knowledge of basic processes

h. Knowledge of basic materials

4. The following competencies should not hold a major part of the technology education curricular content:

a. The invention process

b. High-tech applications

c. Desktop publishing

Reflection

The field of industrial arts/technology education has weathered some heavy storms and many crushing waves, but it is still afloat. However, to be a vital component of the modern education establishment, the field must place its feet on firm ground. In order to accomplish this, technology education must establish a curricular content that is linked to its mother ship in the vocational education armada. Technology education must establish articulation with trade and industrial education. In the same lifesaving breath, trade and industrial education must communicate its prerequisites to the technology education field.

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Table 1

Descriptive Results for All Domains

Item Statement	Mean	SD
Being dependable/punctual	4.97	.18
Ability to follow directions	4.93	.25
Showing pride in workmanship	4.92	.28
Being conscientious/honest	4.91	.32
Cooperating with others	4.91	.29
Exhibiting a safety attitude	4.89	.36
Ability to measure	4.79	.41
Identification of common hand tools	4.23	.81
Utilize common hand tools	4.20	.88
Showing concern for the environment	4.14	.84
Knowledge of technical terms	4.10	.96
Operate common equipment	4.08	.96
Knowledge of basic processes	4.03	.87
Identification of common equipment	4.01	.99
Knowledge of basic materials	4.00	.80
Ability to perform basic processes	3.97	.94
Apply scientific principles	3.96	.92
Knowledge of computer applications	3.95	.88
Interpretation of drafting drawings	3.88	1.05
Knowledge of scientific principles	3.84	.95
Knowledge of future technologies	3.80	.80
Utilize basic materials	3.76	.92
Knowledge of economic factors	3.63	.84
Construct drafting drawings	3.60	1.02
Knowledge of hydraulics/pneumatics	3.49	.98
Knowledge of high-tech applications	3.33	1.06
Knowledge about the invention process	3.07	.91
Ability to perform desktop publishing	2.84	1.02

Table 2

Cognitive Domain Results

Item Statement	Mean	SD
Ability to measure	4.79	.41
Identification of common hand tools	4.23	.81
Knowledge of technical terms	4.10	.96
Knowledge of basic processes	4.03	.87
Identification of common equipment	4.01	.99
Knowledge of basic materials	4.00	.80
Knowledge of computer applications	3.95	.88
Interpretation of drafting drawings	3.88	1.05
Knowledge of scientific principles	3.84	.95
Knowledge of future technologies	3.80	.80
Knowledge of economic factors	3.63	.84
Knowledge of hydraulics/pneumatics	3.49	.98
Knowledge of high-tech applications	3.33	1.06
Knowledge about the invention process	3.07	.91

Table 4

Affective Domain Results

Item Statement	Mean	SD
Being dependable/punctual	4.97	.18
Ability to follow directions	4.93	.25
Showing pride in workmanship	4.92	.28
Being conscientious/honest	4.91	.32
Cooperating with others	4.91	.29
Exhibiting a safety attitude	4.89	.36
Showing concern for the environment	4.14	.84

Table 3

Psychomotor Domain Results

Item Statement	Mean	SD
Utilize common hand tools	4.20	.88
Operate common equipment	4.08	.96
Ability to perform basic processes	3.97	.94
Apply scientific principles	3.96	.92
Utilize basic materials	3.76	.92
Construct drafting drawings	3.60	1.02
Ability to perform desktop publishing	2.84	1.02

Table 5

Descriptive Results for T&I Subject Areas

	Auto	Bldg	Draft	Elect	Mach	Weld
Item Statement	Mean	Mean	Mean	Mean	Mean	Mean
Being dependable/punctual	4.97	4.95	5.00	5.00	4.80	5.00
Ability to follow directions	4.94	5.00	5.00	5.00	4.90	4.62
Pride in workmanship	4.97	4.90	4.90	5.00	4.80	4.75
Being conscientious/honest	4.90	4.90	5.00	4.96	4.90	4.88
Cooperating with others	4.97	4.90	4.90	4.96	4.80	4.75
Exhibiting a safety attitude	5.00	4.90	4.50	4.92	5.00	4.88
Ability to measure	4.81	4.85	4.90	4.76	4.80	4.75
Identify common hand tools	4.41	4.40	3.50	4.28	4.00	4.25
Utilize common hand tools	4.35	4.45	3.30	4.44	4.00	4.13
Environmental concern	4.34	4.30	4.30	3.96	3.90	3.63
Technical terminology	4.26	3.95	4.20	4.36	4.10	3.88
Operate common equipment	4.38	4.25	3.60	4.20	4.00	4.25
Basic process knowledge	4.19	4.50	4.00	3.60	4.30	4.00
Identify equipment	4.32	3.80	3.90	4.16	3.70	4.13
Basic material knowledge	3.97	4.40	3.90	3.68	4.00	4.25
Perform basic processes	4.00	4.45	3.70	3.75	4.30	4.00
Apply scientific principles	4.06	3.60	4.30	4.50	3.50	3.62
Computer applications	3.87	3.75	4.40	4.24	4.20	3.62
Interpret drafting drawings	3.42	4.35	4.60	4.12	4.20	4.00
Know scientific principles	3.84	3.53	4.50	3.92	3.70	3.75
Future technology	3.94	4.05	3.90	3.92	3.50	3.62
Utilize basic materials	3.68	4.30	3.50	3.68	3.70	4.00
Economic factors	3.66	3.85	3.90	3.72	3.50	3.25
Construct drafting drawings	3.07	3.95	4.50	3.92	3.70	3.75
Hydraulics/pneumatics	3.97	3.25	3.40	3.52	3.60	3.13
High-tech applications	3.39	3.10	3.60	3.72	3.10	3.25
The invention process	3.03	3.05	3.50	3.20	2.90	2.87
Desktop publishing	2.74	2.75	3.30	3.04	2.30	2.50
N	32	20	10	25	10	8

Table 6

Descriptive Results for Educational Level

	Below BS	BS	MS
Item Statement	Mean	Mean	Mean
Being dependable/punctual	4.98	4.97	4.96
Ability to follow directions	4.93	5.00	4.90
Pride in workmanship	4.93	4.97	4.87
Being conscientious/honest	4.95	4.90	4.87
Cooperating with others	4.91	4.94	4.90
Exhibiting a safety attitude	4.91	4.87	4.90
Ability to measure	4.86	4.77	4.73
Identify common hand tools	4.30	4.35	4.08
Utilize common hand tools	4.30	4.29	4.04
Environmental concern	4.18	4.32	3.98
Technical terminology	4.26	4.06	3.98
Operate common equipment	4.09	4.19	4.00
Basic process knowledge	4.07	4.13	3.94
Identify equipment	4.00	4.26	3.85
Basic material knowledge	4.07	4.03	3.92
Perform basic processes	4.05	4.00	3.87
Apply scientific principles	3.98	4.10	3.85
Computer applications	3.74	4.03	4.08
Interpret drafting drawings	3.81	3.94	3.90
Know scientific principles	3.74	4.10	3.77
Future technology	3.95	3.90	3.58
Utilize basic materials	3.81	3.68	3.77
Economic factors	3.84	3.58	3.48
Construct drafting drawings	3.47	3.71	3.66
Hydraulics/pneumatics	3.72	3.42	3.33
High-tech applications	3.12	3.52	3.40
The invention process	3.05	3.00	3.15
Desktop publishing	2.86	2.71	2.92
N	44	31	48

Table 7

Descriptive Results for Years of Teaching Experience

	1-9	10-19	20 plus
Item Statement	Mean	Mean	Mean
Being dependable/punctual	4.94	4.97	4.98
Ability to follow directions	4.87	4.93	4.98
Pride in workmanship	4.90	4.93	4.92
Being conscientious/honest	4..97	4.90	4.88
Cooperating with others	4.87	4.92	4.92
Exhibiting a safety attitude	5.00	4.83	4.88
Ability to measure	4.77	4. 78	4.81
Identify common hand tools	4.39	4.22	4.13
Utilize common hand tools	4.26	4.21	4.15
Environmental concern	4.26	3.97	4.20
Technical terminology	4.32	4.00	4.04
Operate common equipment	4.32	3.85	4.12
Basic process knowledge	3.97	4.03	4.08
Identify equipment	4.23	3.74	4.08
Basic material knowledge	4.13	4.12	3.83
Perform basic processes	3.87	3.93	4.02
Apply scientific principles	3.90	4.05	3.92
Computer applications	3.77	3.87	4.12
Interpret drafting drawings	3.81	3.82	3.96
Know scientific principles	3.87	3.95	3.75
Future technology	3.74	3.72	3.88
Utilize basic materials	3.84	3.82	3.67
Economic factors	3.1	3.63	3.65
Construct drafting drawings	3.45	3.69	3.63
Hydraulics/pneumatics	3.68	3.49	3.33
High-tech applications	3.32	3.15	3.46
The invention process	3.03	3.00	3.15
Desktop publishing	2.90	2.90	2.77
N	31	40	52

Table 8

Descriptive Results for Years of Occupational Experience

	1-9	10-19	20 plus
Item Statement	Mean	Mean	Mean
Being dependable/punctual	4.97	4.91	5.00
Ability to follow directions	4.91	4.91	4.96
Pride in workmanship	4.91	4.81	4.98
Being conscientious/honest	4.91	4.94	4.89
Cooperating with others	4.91	4.78	4.98
Exhibiting a safety attitude	4.88	4.91	4.89
Ability to measure	4.88	4.78	4.74
Identify common hand tools	4.24	4.31	4 18
Utilize common hand tools	4.15	4.25	4.20
Environmental concern	4.12	4.22	4.11
Technical terminology	4.24	3.97	4.09
Operate common equipment	4.26	4.31	3.84
Basic process knowledge	3.91	4.34	3.93
Identify equipment	4.33	3.88	3.86
Basic material knowledge	4.12	4.06	3.89
Perform basic processes	3.74	4.16	4.00
Apply scientific principles	3.82	3.97	4.04
Computer applications	4.18	3.91	3.84
Interpret drafting drawings	3.85	3.88	3.89
Know scientific principles	3.71	3.97	3.85
Future technology	3.82	3.72	3.82
Utilize basic materials	3.71	3.91	3.71
Economic factors	3.71	3.56	3.63
Construct drafting drawings	3.67	3.50	3.63
Hydraulics/pneumatics	3.65	3.50	3.39
High-tech applications	3.59	3.22	3.23
The invention process	3.00	3.06	3.12
Desktop publishing	2.88	2.63	2.95
N	34	32	57