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ABSTRACT

This third edition of a review and synthesis of research for trade and industrial (T&I) education concentrates primarily on studies reported from 1977 to 1982, including some significant work published since the second edition (1969). Relevant research was identified through searches of the Educational Resources Information Center, the National Technical Information Service, Defense Logistics Studies Information Exchange, and the Dissertation Abstracts International databases. A selective discussion of representative and exemplary studies in the field, the document covers these aspects of T&I: (1) philosophy and scope, (2) student characteristics and needs, (3) curriculum development (i.e., models and frameworks, content determination, affective and transferable skills, and competency-based education), (4) instruction and learning (i.e., systems development, technology, computer-assisted instruction, psychomotor skills, cognitive and affective learning, and youth groups), (5) teacher education, (6) administration, and (7) evaluation. Some relevant technical training research conducted by the U.S. armed forces is also included. A summary of the state of the art, areas for future research, and an extensive bibliography of the cited studies conclude the document. (SK)

Information Series No. 260

REVIEW AND SYNTHESIS OF RESEARCH IN TRADE AND INDUSTRIAL EDUCATION, THIRD EDITION

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The National Center for Research in Vocational Education
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1983

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FOREWORD

The Educational Resources Information Center Clearinghouse on Adult, Career, and Vocational Education (ERIC/ACVE) is one of sixteen clearinghouses in a nationwide information system that is funded by the National Institute of Education. One of the functions of the Clearinghouse is to interpret the literature that is entered into the ERIC database. This paper should be of particular interest to trade and industrial education teachers, teacher educators, administrators, curriculum development specialists, researchers, and graduate students.

The profession is indebted to Curtis R. Finch of Virginia Polytechnic Institute and State University for his scholarship in the preparation of this paper. Dr. Finch serves as Professor and Graduate Studies Coordinator, Division of Vocational and Technical Education. In 1980, he was a Senior Fulbright Scholar in Cyprus, Greece, where he served as a consultant to the Greek Cypriot Ministry of Education and the Turkish Cypriot Office of Education in technical education curriculum development, evaluation, and teacher preparation. Dr. Finch, who is currently serving as President of the National Association of Industrial and Technical Teacher Educators, is the author of numerous publications.

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Executive Director
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EXECUTIVE SUMMARY

This third edition of a review and synthesis of research for trade and industrial (T&I) education concentrates primarily on studies reported from 1977 to 1982, including some significant work published since the second edition (1969). Relevant research was identified through searches of the Educational Resources Information Center, the National Technical Information Service, Defense Logistics Studies Information Exchange, and the Dissertation Abstracts International databases. A selective discussion of representative and exemplary studies in the field, the document covers these aspects of T&I: (1) philosophy and scope, (2) student characteristics and needs, (3) curriculum development (i.e., models and frameworks, content determination, affective and transferable skills, and competency-based education), (4) instruction and learning (i.e., systems development, technology, computer-assisted instruction, psychomotor skills, cognitive and affective learning, and youth groups), (5) teacher education, (6) administration, and (7) evaluation. Some relevant technical training research conducted by the U.S. armed forces is also included. A summary of the state of the art, areas for future research, and an extensive bibliography of the cited studies conclude the document.

Literature relating to the topic of trade and industrial education research can be found in the ERIC system under the following descriptors: *Trade and Industrial Education; *Educational Research; *State of the Art Reviews; Curriculum Development; Instructional Systems; Teaching Methods; Student Characteristics; Secondary Education; Postsecondary Education; *Trade and Industrial Teachers; Teacher Education; Technical Education; Educational Technology; Program Evaluation. Asterisks indicate descriptors having particular relevance.

INTRODUCTION

This document reviews and synthesizes research in trade and industrial education conducted since 1969. As such, it aligns with and builds upon two earlier syntheses of this same topic (Tuckman and Schaefer 1966; Pautler and Schaefer 1969). Because of the quantity of research published over the past fourteen years, it was deemed best to concentrate on research reported from 1977 to 1982. Earlier studies have not been excluded, however, and research of major significance to the field is noted regardless of completion date.

The identification of relevant research included both manual and computer-based searches. Computerized databases explored included the Educational Resources Information Center (ERIC), the National Technical Information Service (NTIS), and the Defense Logistics Studies Information Exchange (DLSIE). Professional journals related to the field were likewise examined in an effort to locate relevant studies. Dissertation Abstracts International served as a prime source for relevant doctoral dissertations. Letters were sent to university department heads and state department of education personnel nationwide, asking for assistance in the identification of relevant materials. Finally, an article in News and Views informed all members of the National Association of Industrial and Technical Teacher Educators of the project's existence and the need for studies. Results of the search process are reflected in the sections that follow.

There are two characteristics that distinguish this document from earlier trade and industrial education syntheses. First, although efforts were made to identify all relevant documents, this synthesis is, for the most part, selective in nature, drawing from representative and exemplary studies in the field. No attempt is made to list each study conducted over the past fourteen (or even five) years. Second, the synthesis includes relevant training research conducted by the U.S. armed forces. Although some persons may say that military training is not relevant to trade and industrial education, a close look at the maintenance training enterprise in each of the armed services branches reveals that many instructional, learning, and student characteristics problems have a great deal in common with what is considered to be "traditional" trade and industrial education. Thus, military training research studies are included when they make a meaningful contribution to knowledge about the field.

Several comprehensive synthesis papers and documents may be of value to those who are searching for studies in a specific trade and industrial education area. Of particular note is Miller's (1982) review of research in industrial education. Miller's paper includes sections focusing on industrial arts and technical education as well as on trade and industrial education. Two additional research syntheses may prove useful because of their focus on

closely related areas. Doty, Tornell, and Wenzel (1980) have prepared a comprehensive review and synthesis of research in technical education. This document contains many studies that have relevance to the trade and industrial education researcher A parallel review in industrial arts education by Dyrenfurth and Householder (1979) focuses on numerous studies in the instruction and learning area that may be applied to trade and industrial settings. Finally, a recent research review contains an extensive summary of technical training research conducted by and for the U.S. Department of Defense (Finch 1982).

PHILOSOPHY AND SCOPE

The heritage of trade and industrial education (T&I) extends into the distant past. Historically, T&I may be traced as far back as formal apprentice programs in ancient Egypt. However, contemporary T&I has been shaped to a great extent by federal legislation. The Smith Hughes Act of 1917 helped to delineate T&I as one of several instructional or service areas within vocational education. At that time, program scope, instructor qualifications, and the like were by and large defined through existing legislation. This, in turn, signaled practitioners and researchers to direct research more specifically toward T&I concerns. As a result, it may be found that during the 1950s and early 1960s T&I research and development efforts tended to focus on problems specific to the field.

Changes that began to occur with the passage of the Vocational Education Act of 1963 were continued in more recent legislation. Since these acts encouraged a reduction in service-area-specific research funding and the conduct of more comprehensive, "across the board" research and development activities, there has been a melding of research related to traditional vocational education program areas. Thus, it may be observed that contemporary T&I research is sometimes included as a part of larger projects dealing with broadly based vocational education problems.

Quite realistically, the focus of T&I research has paralleled research conducted in other vocational education areas. Budke (1981) noted the similarities that exist among research foci in various vocational service areas. An analysis of several research review and synthesis documents indicates that research conducted in one service area may have implications for another area. Two points emerge from this discussion. First, some significant T&I research studies are not classified in the T&I area; and second, several of the research studies presented in this document may support or be supported by studies from other areas related to and within vocational education. Although the reporting of T&I research does serve as a means of gathering together closely related studies, it is most important to keep in mind that many of the problems that exist and have been studied cut across several areas of vocational education.

Philosophy

As with many areas, T&I has struggled to shape a meaningful set of philosophical principles. During the 1960s, Barlow (1967) challenged professionals to establish foundation principles of T&I. He noted that

> one measure of future leadership is the extent to which trade and industrial educators (1) know and understand basic principles, (2) interpret

these basic principles in the mainstream of contemporary technology, and (3) implement the principles consistent with social and economic need. (p. 9)

Barlow also cited several principles, including the following:

- o Comprehensive programs of teacher education are imperative.
- o Teachers must be occupationally competent.
- o Programs must be based on considered judgment of labor, management, and education.
- o Programs must consider the primacy of the person.
- o Formal educational achievement of students is imperative.

He concluded by stressing the need to discuss and formulate foundation principles that will carry T&I into the future.

It appears that the National Association for Trade and Industrial Education (NATIE) has responded to Barlow's concerns in the 1975 document titled Trade & Industrial Education Philosophy and Standards of Excellence. Prepared by the NATIE Board of Directors in cooperation with numerous persons from the field, this booklet sets forth a contemporary philosophical base for T&I programs, including discussion of curriculum, program implementation, advisory committees, and public relations. A companion volume, Trade & Industrial Education National Standards for Program Administration, Supervision and Implementation (NATIE 1977) sets forth in further detail the minimum standards by which all T&I programs should be operated and evaluated. These two documents, together with Barlow's statements, as well as the theorems presented many years ago by Charles Prosser and Charles Allen (1925), provide a meaningful philosophical base for T&I.

Scope

It is very difficult, if not impossible, to document T&I's scope. Obviously, since T&I is offered at the secondary, technical institute, community college, and adult levels and encompasses public and private education as well as business, industry, and the military, one can only speculate on the number of persons served each day, month, or year. In terms of the public sector, some assistance has been provided via the National Center for Education Statistics (NCES). NCES reports T&I enrollments for the 1980-1981 school year to be 3,161,000. This figure, which reflects enrollments for all programs administered under the Vocational Education Act, represents 10.4 percent of the total vocational student enrollment. NCES data of a more longitudinal nature revealed that vocational education enrollments in general and T&I enrollments in particular have remained reasonably steady. A comparison of T&I 1978-1979 enrollments with those of 1980-1981 reflects a decrease in enrollment of 6.7 percent. During this same period, areas showing increases in enrollments include health (17.2 percent) and technical (9.2 percent) (Golladay 1982).

The magnitude of expenditures for T&I instruction may be noted in a separate NCES report (Osso 1982). Federal expenditures for T&I instruction during fiscal year 1980 totaled $90,740,522, whereas nonfederal (state and local) expenditures amounted to $1,361,034,894, the highest of any vocational service area.

STUDENT CHARACTERISTICS AND NEEDS

During the 1970s, several external forces caused T&I professionals to look beyond what might be considered traditional student populations. Among these forces has been passage of Public Law 94-142, the Education for All Handicapped Children Act, which emphasized the mainstreaming of handicapped students in regular vocational classes. Parallel legislation aimed at the elimination of sex bias and stereotyping in vocational education programs has affected student enrollments in nontraditional areas (e.g., females enrolling in traditionally male-dominated courses and vice versa). These forces as well as an increasing concern for the overall career development of youth and adults have generated a fresh set of research topics that reflect a deeper concern for how students interact with the educational environment. A sampling of the many studies conducted in this area follows.

Special Needs

With the influx of special needs students into regular T&I programs, considerable thought has been given to how they may be assisted in obtaining the best possible education. Several publications provide teachers with greater insight into these students' characteristics and needs. Weisgerber, Dahl, and Appleby (1981), for example, presented a comprehensive look at preparing the handicapped for productive employment. Scott and Sarkees (1982) focused more specifically on meeting the needs of handicapped T&I students. Bradley and Friedenburg (1982) dealt directly with problems encountered when providing bilingual vocational education. These are among the few publications that make practical information available to assist T&I teachers working with special needs students.

In a more specific vein, researchers have begun to explore the ways teachers may be aided in better meeting individual students' needs. Albright and Preskill (1982) have examined vocational teacher participation in the individualized education program (IEP) process and the inservice needs of these personnel in relation to the IEP effort. Their results provide insight into ways teachers may be prepared to deal with special needs vocational students.

It appears that little research has focused directly on special needs T&I students. Although several studies presented in a later section give consideration to student ability, much has yet to be learned about preparing disadvantaged and handicapped youth and adults for gainful employment in T&I-related occupations. A study that may be of general use in establishing special needs research priorities was conducted by Wimmer and Sitlington (1981). The investigators surveyed 880 members of the Council of Exceptional Children's Division of Career Development to determine research priorities in

career education for the handicapped. Identified as being the highest priority research topic was "effectiveness of various vocational skill training programs for the handicapped." Noting that many of these programs are T&I related, researchers may do well to focus future efforts on examining program effectiveness. A report prepared for the Trade and Industrial Education Research Council (Wichowski and others 1982) mirrors the need to study effectiveness. Of the thirty-two special needs research questions generated by T&I professionals, many may be linked to program effectiveness.

Sex Equity

In recent years, a number of researchers have examined sex equity practices and ways of reducing sex bias and stereotyping in vocational education. A California State University study (Research for Women 1979) sponsored by the California State Department of Education sought to determine the feasibility of developing skills training programs for women interested in skilled labor employment. Findings revealed that (1) two-thirds of the employers surveyed felt women are capable of learning most skilled labor jobs, and (2) the working female population has received little, if any, vocational training. Another study by Knight, Henderson, and Ries (1980) dealt with constructing a model for recruitment, retention, and placement of female students in secondary vocational education programs that have traditionally served males. Ten programs (five in T&I and five in agriculture) were selected for study, since they had successfully recruited, retained, and placed female students in nontraditional instruction. Interview respondents indicated that role models are a significant factor in the success of female students in nontraditional programs. Teacher attitude is likewise critical to class acceptance of students.

Of course, it is not always appropriate to examine T&I programs separately from other vocational programs. Such was the case in a study by Gilbert (1981) conducted at the Wisconsin Indianhead Technical Institute. Its purpose was to identify the impact of regular vocational education programs and nontraditional students in vocational and technical courses. Results revealed that most students held a traditional bias toward sex role stereotyping and careers. This bias remained relatively constant over the entire p. od of enrollment and was apparently not affected by content in regular vocational programs or the presence of nontraditional enrollees.

Research has also focused on women in apprenticeship for nontraditional occupations. Green (1979) surveyed women enrolled in apprenticeship training to identify factors that influence a woman's decision to enter and continue in a nontraditional occupation. Factors that encouraged women to enter nontraditional occupations included challenge, variety, learning, feelings of pride and self-worth, a sense of accomplishment, and the work itself. Women in apprenticeship training are "committed to their work and willing to endure the inevitable hardships of a nontraditional choice" (p. iv). A related study by Corbett (1981) explored the social and personality factors that influence career choices of women in nontraditional, blue-collar skilled trades. The findings suggest that women choosing nontraditional trades experience socialization processes that encourage them to become independent and self-sufficient at an early age.

Fortunately, some materials are being prepared to aid leaders in promoting sex equity concepts and practices across vocational education. One example in T&I is the publication Building Your Own Scenario: Trade and Industry, Sex Equity, and Alternative Futures (Vetter, Spain, and Kelly 1981). Designed for use by T&I leaders, this material is based on the premise that it is necessary to infuse sex equity throughout T&I. The user is provided with reading materials, including exercises and scenarios that show how sex equity concepts may be successfully incorporated into T&I programs.

Student Achievement and Development

Much concern has been expressed over the past twenty years about preparation for careers. The application of this concern reached its height via the career education movement. Promulgated by Sidney Marland, then U.S. Commissioner of Education, and supported by numerous individuals and agencies, career education made many professionals aware that there was more to education than just teaching work skills. Likewise, teachers and administrators began to realize that students are complex beings with personal sets of values, attitudes, and appreciations. During the past decade researchers have attempted (and in some cases succeeded) to quantify these variables and determine how they relate to other factors, such as achievement and success in the work world. Perhaps the most ambitious effort in this regard was the Vocational Development Study conducted by staff members at Pennsylvania State University from 1968 to 1975 (Impellitteri and Kapes 1971). Designed as a multiyear longitudinal effort, one of its main thrusts was directed toward investigating vocational development theories as they apply to today's youth. Research generated from the study's database has numerous implications for T&I programs since many students providing data were enrolled in various T&I courses.

As a part of the overall study, several researchers focused on variables that contribute to student achievement. Kapes (1972) sought to identify those characteristics of tenth-grade males that differentiated among four groups: successful vocational, unsuccessful vocational, successful academic, and unsuccessful academic. Students were enrolled in a broad range of T&I programs. Of the sixteen independent variables examined, fourteen significantly discriminated among the four groups. Cognitive ability and higher level socioeconomic background were more characteristic of successful students than unsuccessful students in either curriculum.

A related investigation (Enderlein and Enderlein 1973) examined relationships between selected student characteristic variables and laboratory achievement, as measured by the Ohio T&I Achievement Test. In this instance, predictors of success were cognitive variables of the General Aptitude Test Battery (GATB). The manipulative portion of the GATB was not related to laboratory performance. These two studies are representative of the many that provide greater insight into variables associated with student success in vocational education settings.

A persistent problem in vocational education is the school dropout. Although many feel that dropout rates should be reduced or even eliminated,

little has been done to provide practitioners with direction in this area. Brantner and Enderlein (1973) attempted to identify potential dropouts at the ninth-grade level, prior to entry into high school vocational programs. Results revealed that predictions can be made as to which students are likely to drop out, but only to a limited degree. In addition, dropouts possess different characteristics than their counterparts who remain in vocational programs. A more applied investigation by Lotto (1982) presented the characteristics of effective dropout prevention programs that utilize vocational education and/or work experience components. She illustrated ways that vocational programming has been used to help keep potential dropouts in school and assist them in developing meaningful skills, knowledge, and attitudes.

A concerted effort has been made over the past decade to identify those factors associated with student career development patterns. In fact, some of the studies conducted in this area have actually involved vocational education students as subjects. Crosby (1975), for example, examined the relationship of mental maturity to vocational maturity for a group of T&I juniors. Total vocational maturity as measured by the Career Development Inventory was significantly related to all measures of mental maturity except nonlanguage IQ. The students with higher intelligence tended to plan more for careers, acquire more occupational information, and make better career decisions.

A more recent study by Kapes and Martin (1978) explored the use of Holland's Vocational Preference Inventory (VPI) with male students. Students selected were enrolled in one of fourteen T&I areas. Fifty-seven percent of the students had personality types that were congruent with their educational environment; however, 43 percent were enrolled in curricula that were incompatible when viewed via Holland's theory of vocational choice. Collectively, the data provided limited support for the idea that Holland's theory of congruence-incongruence applies to male T&I students.

Those seeking to explore the student characteristics and needs area may profit by using more relevant research methodologies. Kapes, Enderlein, and O'Reilly (1976) provided an excellent description of how path analysis may be employed to study vocational education variables. Examples of its application to longitudinal data, career development, and evaluation are provided. Another potentially useful methodology, cluster analysis, was discussed at length by Frary and Finch (1981). Cluster analysis is described and illustrated using vocational education student, employer, and teacher data sets.

CURRICULUM DEVELOPMENT

Curriculum development may be thought of as T&I's core or foundation, for it is here that needs are assessed, content is derived, and instructional materials and strategies are first conceived. Curriculum content can, in turn, serve as a basis for objectives, learning experiences, and a host of other instructional activities. Contemporary researchers have thus seen curriculum development as a fertile area of inquiry. There are several research and development thrusts worth noting in the curriculum development area: models and frameworks, content determination, affective and transferable skills, futuristic content considerations, and competency-based education.

Curriculum Models and Frameworks

Models and frameworks are often developed in an effort to facilitate curriculum development. These can be very simple and straightforward designs, or rather lengthy and complex, depending upon the nature of the curriculum scope and content. Initiated by the University of Maryland during the late 1960s, the cluster concept project in vocational education provides a form of vocational education that prepares graduates to enter a broad range of occupations having common work elements, so as to permit entry into and mobility within occupations in the cluster (Frantz 1971). The concept has seen continued support nationwide (e.g., Valentine and Larson 1974) and appears to be widely used today. Maley (1980), in a status study of the cluster concept conducted eleven years after the project's completion, reported that forty-five states and territories have cluster concept programs in operation. Twenty-eight states and territories have cluster programs either in many or most of the geographic sectors. Although the maintenance of cluster concept programs across the nation cannot be attributed solely to one project, it is interesting to note that this approach to arranging curriculum content continues to be widely accepted by local vocational education leaders.

Two models reflect the need to focus on T&I curriculum priorities and needs. Drake, Davis, and Terry (1980) chose to prepare a model for establishing T&I curriculum development priorities. Data were gathered on a variety of curriculum dimensions and ranked to determine which instructional areas would be in most critical need of development. The model was reported to discriminate effectively, and was uncomplicated and inexpensive to administer. A curriculum needs assessment model developed by Wichowski (1981) provides a systematic approach to the consideration of variables affecting T&I curriculum decisions. The model's outputs include (1) identification of program areas with the greatest curriculum need, (2) establishment of weighted decision-making factors used in the allocation of resources, (3) listing of demographic data, (4) profiling of curriculum materials, and (5) identification of textbooks currently in use. Although the application of frameworks and models to

solve T&I curriculum problems is not widespread, there appears to be a reasonable benefit associated with their use. Perhaps the aforementioned examples will stimulate further work in this area.

Content Determination

Numerous T&I curriculum content studies have been conducted over the years; however, only a small percentage of these have provided useful information for teachers. A basic question raised in this regard is, "What actually constitutes relevant curriculum content?" Fortunately, several research and development efforts have begun to address this question in a systematic fashion.

Finch and Crunkilton (1979) noted that there are at least six strategies for deriving vocational curriculum content: philosophical base, introspection, function approach, task analysis, critical incident technique, and the Delphi approach. Few strategies have seen such widespread use as task analysis. This particular approach has been utilized by T&I curriculum developers in varying forms for many years. However, beginning in the mid-1960s refinement of the task analysis process has allowed developers to make more objective decisions about curriculum content. Of particular importance is the research conducted by Morsh and Archer (1967), which has resulted in a procedural guide for conducting occupational surveys. This material has served as a basis for further refinements to the task analysis process, the most notable being Ammerman and others' (1977) procedures for constructing task inventories, surveying task performance, and analyzing survey data to determine curriculum content.

Task analysis has served as a basis for work conducted by the Vocational and Technical Education Consortium of States (V-TECS). V-TECS, which is located with the Southern Association of Colleges and Schools in Atlanta, was chartered in 1973 with the mission of producing valid, up-to-date lists (known as catalogs) of competencies in various occupational areas, many of which are T&I related. The consortium includes some seventeen member states as well as the U.S. Army, Navy, and Air Force. It is perhaps the most extensive public education consortium effort focusing on developing worker-verified curriculum content. A parallel effort developed by the U.S. Air Force and used by the U.S. armed forces, federal and nonfederal agencies, and several foreign military services is termed the Comprehensive Occupational Data Analysis Programs (CODAP). CODAP is comprised of interactive computer programs that organize, analyze, and report occupational information (Berger and Hawkins 1979). The task list is a key element in CODAP since the quality of results is dependent upon meaningful task input. As contrasted with traditional analyses that rely on frequency of task performance, CODAP depends almost entirely upon relative time spent performing tasks. Data may thus be used to help understand interrelationships among tasks in a job or series of jobs.

The DACUM (Developing A Curriculum) approach has been used quite successfully to identify T&I curriculum content. DACUM relies on a committee of experts employed in the occupational area to determine curriculum content by following a systematic process conducted by a facilitator (Adams 1974).

Experiences with this approach have revealed that teachers in the occupation usually do not contribute effectively to the DACUM process. Teachers, therefore, should not be utilized as committee members. The DACUM process results in the development of a single-sheet profile that serves as a curriculum plan and an evaluation instrument for a particular content area.

Affective and Transferable Skills

The aforementioned strategies focus almost exclusively on identifying technical content. And, although this area is certainly important, other dimensions of worker competence must also be identified. Due to the nature of nontechnical content, researchers have tended to move away from the more traditional data-gathering approaches in an attempt to capture the elusive affective components of work. Nelson and O'Neil (1977) conducted a large-scale investigation to identify those occupational skills important for survival in a broad range of occupational areas. Telephone surveys conducted with workers in various occupations revealed that each of twenty-seven skills has some degree of importance for occupational survival. Additionally, such survival seems to depend on a set of skills such as punctuality, dependability, and working under pressure that are broader than technical knowledge and skills.

A study by Foster (1978) verified the usefulness of the critical incident technique as a means of identifying nontechnical skills. The process used to gather data from workers in the electronics field has implications for many other content areas. Critical incident information can indeed serve as a reasonably objective base for affective portions of T&I curriculum content. Beach (1978) reported the conduct of a study designed to identify affective work competencies. As part of the investigation, the Affective Work Competencies Inventory was developed, which provides information about the ways affective competencies vary across groups. Swanson (1981) noted that "all work behavior does not lend itself to the widely accepted job analysis techniques" (p. 11). In response to this concern, he presented a system for analyzing subject matter related to nonobservable work behavior that is designed for use by management training personnel. The subject matter analysis has been utilized by management trainers and appears to be an alternative to traditional analysis techniques.

Several studies relate to the notion of occupational adaptability and transfer of skills from one job to another. Some of the more programmatic efforts related to transferability have been conducted by the National Center for Research in Vocational Education at The Ohio State University. T&I occupations have served as the content base for much of the research conducted in this area. Pratzner (1978) presented many of the substantive concerns that arose during the project activities. Also included are several examples of transferable skills and characteristics. Representative reports produced as part of this programmatic effort include those addressing the employer's viewpoint of transferable skills (Wiant 1977), a task classification approach for identifying transferable skills (Ashley and Ammerman 1977), and teaching for transfer (Selz and Ashley 1978). These and other reports establish a most meaningful research base for the areas of adaptability and skill transfer.

It appears as though public educators are not the only ones concerned about affective and transferable skills. The military establishment has also taken a strong interest in this area in an effort to improve the quality of program graduates and personnel at the unit level. Two examples of how this concern is being addressed include job competence assessment and the extended task analysis procedure.

Job competence assessment (JCA) is based on the assumption that the best way to identify competencies associated with a job is (1) identify the most effective job performers; (2) determine what these people do that distinguishes them from less satisfactory individuals; and (3) identify those specific skills, abilities, and characteristics responsible for this difference (Spencer 1979, p. 3). Typically, job competence assessment consists of the following eight steps: (1) define performance effectiveness criteria, (2) identify criterion sample (superior job incumbents), (3) conduct job task/function analysis to supplement JCA process, (4) perform characteristics analysis to establish hypotheses about critical performer competencies, (5) conduct behavioral event interview of superior and average performers, (6) make direct observations to verify data gathered, (7) conduct a content analysis of data and develop a competency model, and (8) validate the competency model. Once validated, the competency model can be used as a basis for educational programs that focus on competencies needed by workers in the future as well as the present.

As its name implies, the extended task analysis procedure (ETAP) expands the basic task analysis process to encompass identification of component skills and knowledge that must be learned if the whole task is to be mastered. Training development specialists in the military have found this procedure to be most useful since the end result provides a rather complete task description as well as a relevant base for instructional design. That part of ETAP which focuses on analysis of transfer tasks is of primary concern to those seeking to identify a broad range of curriculum content. These tasks (sometimes called soft skills) are ones for which procedures used to execute the activities vary each time the task is performed (Reigeluth and Merrill 1980). Since transfer tasks are generalizable across various job situations, this aspect of the extended task analysis procedure seems an appropriate one for deriving more realistic content.

Futuristic Content Considerations

All too often, curriculum developers fail to recognize that content must be, to some degree, futuristic. As Finch and Dunn (1982) noted, "The content of vocational education curricula designed to anticipate the future should be based on future worker roles and needs" (p. 38). Nelson (1980) likewise cited the need to monitor new and emerging occupations if educators desire to keep "o the cutting edge of new technology" (p. 43). Nelson presented a systematic process for dealing with this pervasive problem that includes continuous monitoring and analysis of change. Russell (1982) believed that when forecasting curriculum needs, one may play the role of an investigative reporter. Tasks carried out as a part of the investigation include studying new trends, reviewing technical literature, communicating with experts, searching for

occupational projections, locating existing programs, and ultimately making a decision.

Identifying futuristic curriculum content is not a simple task. It takes much more time and energy than would be involved in identifying current content. Among the few strategies used to identify futuristic content, the Delphi approach appears to be a most reasonable choice. Originally developed by the Rand Corporation for predicting alternate defense futures, it has seen widespread use in many areas of vocational and technical education. Lawrence (1980), for example, verified that the Delphi approach can be used to obtain meaningful curriculum content from future projections concerning the automobile industry. A more recent study by Renzelman (1982) pointed out that future changes in industry will have serious implications for the training of mechanics.

Competency-based Education

One educational movement that builds upon the identification of occupationally relevant content is competency-based education (CBE). CBE has emerged as a major T&I curricular thrust and, as such, reflects the need for research to identify those competencies that are important to students. In his comprehensive review of competency-based vocational education, Knaak (1977) commented that "very few educational concepts in recent years have had a great impact on educators and on society as competency-based education" (p. 1).

CBE differs from conventional education in terms of its focus. Essentially, the CBE program focuses on the specification of required competencies and criteria, the assessment of competence in applied settings, the use of student competence as a determiner of progress toward program completion, and facilitation of student achievement of specified competencies. One reason that confusion has existed about CBE is the lack of a clear definition for the concept. As CBE was being introduced in many schools, theoretical notions were presented to teachers with little consideration for practical application. Thus, if a teacher was told that "competencies to be demonstrated are made public in advance," he or she did not have a clear picture of what was expected.

In response to this practical need, some states have begun to sharpen CBE's definition, making it more functional and practical for the individual teacher. Virginia, for example, has defined CBE in terms of four standards that provide a framework for developing and implementing CBE in secondary vocational education programs (Horne 1981):

1. Role-relevant competencies are identified and stated.

2. Competencies are specified to students prior to instruction.

3. Criterion-referenced measures are used to measure achievement of competencies.

4. A system exists for documenting the competencies achieved by each student.

The standards were further refined via explicit criteria so that teachers and administrators would understand what was expected of them as they begin implementing CBE in their schools. This approach appears to have relieved some anxiety and made the transition from conventional to competency-based education less difficult.

Many vocational educators have rallied in support of CBE, and some states have mandated implementation of CBE concepts in all vocational education programs. There are, however, some who feel educators have been too hasty in accepting CBE in its totality. Moss (1981) noted that some vocational educators have begun to go beyond reasonable limits of CBE's application, especially in regard to higher-level skilled and technical occupations. Critics of CBE have indicated that little research is available to show that CBE is any better than conventional education. Despite this lack of research results in the T&I area, however, there are a number of successful CBE programs across the nation that attest to its value.

INSTRUCTION AND LEARNING

The instruction and learning area is indeed expansive. Even when delimited to instruction and learning research in trade and industrial education, synthesis activities could easily fill an entire volume. This section, perhaps more than any other, serves to whet the reader's appetite for reviewing research studies. If more extensive listings of relevant research are needed, they may be obtained by consulting the Encyclopedia of Educational Research, 5th Edition, the Journal of Industrial Teacher Education, and the Journal of Vocational Education Research. Also, the wealth of instruction and learning research studies conducted by the U.S. armed services should not be neglected in considering research in this area.

Instructional Systems Development

During the 1960s and early 1970s, educators sought to provide more systematic means of delivering instruction. The programmed instruction and behavioral objectives movements of the 1960s together with systems engineering concepts gave rise to a more integrated instructional effort called instructional systems development (ISD). ISD has become familiar to T&I professionals through Butler's (1972) book, Instructional Systems Development for Vocational and Technical Training, which outlines the elements of a system focusing on "the identification of the desired behaviors, the specification of what controls these behaviors, and the determination of the techniques needed to shape those behaviors" (p. 43). The system's major attributes are behavioral analysis, optimum step size, active response, immediate confirmation, managed reinforcement, learner-controlled pacing, learner-controlled content, and validation.

At the same time, various U.S. armed service branches were also establishing procedures to systematize the instructional design process. Early developments in this area are detailed by Montemerlo and Tennyson (1976). What resulted was the design of ISD models that have been adopted by the U.S. Air Force, Navy, and Army. Basically, ISD models as presented by the military have five phases: (1) analyze, (2) design, (3) develop, (4) implement, and (5) control. Each of the phases builds upon the others with the result being more efficient and relevant instruction. Documents such as the Interservice Procedures for Instructional System Development. Phase I: Analyze (Branson, Cox, and Raynor 1975), Phase II: Design (Branson, Raynor, Hannum, and Cox 1975), Phase III: Develop (Branson, Raynor, Furman, and Cox 1975), Phase IV: Implement and Phase V: Control (Branson, King, Cox, and Raynor 1975), Executive Summary and Model (Branson, Raynor, and Cox 1975), and Final Report (Branson, Wagner, and Raynor 1977) provide an extensive description of the ISD model. In fact, the five volumes, totaling in excess of 850 pages, merely

serve to describe ISD and do not provide explicit information about such elements as selecting tasks and determining content sequence and structure.

Over the past several years, much effort has been made to clarify ISD and provide greater insight into analyzing, designing, developing, implementing, and controlling instruction. Schultz and others (1979) carried out a development and feasibility demonstration of the ISD model. They recommended continued production of aids for developers that focus on all applicable ISD blocks. An extensive annotated bibliography completed by Berkowitz and O'Neil (1979) served to identify developer aids, procedures, and techniques that may apply to each block of the ISD model. This information is valuable to persons designing programs based upon ISD concepts.

Obviously, some controversy exists as to whether or not ISD is efficient and effective. Geiger and Moody (1977) highlighted some of the real and potential difficulties with ISD in relation to military training. They indicate that problems arise through a misunderstanding of the ISD concept as evidenced by improper training of personnel, unclear charters of responsibility, and a failure to maintain the dynamic integrative nature of the concept. While Aultman (1975) contended that the ISD concept has been overcomplicated and misunderstood by many training managers, he noted that the application of ISD can provide a formalized, logical, and efficient instructional pattern. In sum, ISD has the potential to ensure that T&I programs will be aligned closely with job requirements. However, much must be accomplished in the areas of clarifying model elements, training personnel, and applying this generic concept to specific settings. As Vineberg and Joyner (1980) pointed out, future efforts to implement ISD should concentrate on ways to maintain the integrity of the model.

Instructional Technology

Once classed as the audiovisual aids portion of instruction and learning, the media, hardware, and software used to facilitate achievement of educational outcomes may be more aptly termed instructional technology. For purposes of this document, instructional technology encompasses a broad range of resources that may be used in the instructional environment. Included are items such as trainers, simulators, and various aids that are used in laboratory settings. Computers as applied to hands-on learning of specific skills are also included; however, computer-managed and computer-assisted instruction are presented in a later section.

Instructional technology research conducted in the public sector appears to be rather limited in scope and direction. Typical of research in the simulation area is an examination of how effective simulated practice is in the teaching of welding (Denison 1981). Subjects in an experimental group practiced on a half-hour rotating schedule between simulated practice using the Streak Welding Simulator and conventional arc welding practice methods. Control group subjects practiced in a conventional manner. Results indicated that the simulator could substitute for one-half the practice time normally devoted to actual work. A computer simulation for teaching diagnosis of automobile secondary ignition problems was examined by Diedrick and Thomas (1977).

The PLATO computer system served as a basis for the lesson used in this study. Although a small sample of students was utilized to evaluate the lesson's effectiveness, results revealed that PLATO students performed better than conventionally trained students on each performance criterion. Assuming that educators intend to keep pace with technology, the adoption of existing systems such as PLATO to teach T&I-related skills is clearly a high-priority area.

The military sector has made a major commitment to use of instructional technology and, in the process, has conducted numerous targeted research efforts in this area. Indications of early research on training aids and training devices were provided by Root (1957) and Gagné (1962), while Olsen and Bass (1982) presented an excellent discussion of performance technology in the military from 1960 to 1980. An examination of these documents should provide a feel for the magnitude of effort put forth by military researchers. For example, while public educators are still questioning the utility of using simulators in T&I instruction, the military is exploring ways to make simulators even more effective and efficient. Orlansky and String (1981) pointed out that, since simulators are as effective as actual equipment and typically cost much less, they are cost-effective as compared with their equipment counterparts.

Concern about use of simulators in the armed services over the next decade has prompted investigations of a futuristic nature. Fink and Shriver (1978a) provided an extensive description of issues, problems, and areas of future research associated with simulators for maintenance training. They recommended, among other things, large-scale studies to demonstrate whether or not training based on maintenance simulators actually does transfer to the field. A companion volume (Fink and Shriver 1978b) described a study to identify present and potential need for maintenance training simulators in support of U.S. Air Force technical training. Herrick, Wright, and Bromberger (1977) used the Delphi technique to determine potential future use of simulators for training technicians in naval aviation maintenance training detachments. Information gathered was based on the expectation that the Navy will replace real equipment with simulators for training technicians in future years.

In a more expansive vein, Swezey (1977-1978) looked at future directions for simulation and training. Among the potential areas for development in years to come are holography, social processes, mnemonics, trance learning, and electrical and biochemical stimulation. The above studies and comments support the notion that T&I professionals should take a closer look at ways simulators may enhance classroom and laboratory instruction.

Computers

The computer revolution has brought microprocessers into both home and classroom. And with much greater access to computers in T&I instructional areas, teachers must give serious attention to the many ways these units may be applied to instructional management and assistance. Fortunately, military research and development in this area may provide public educators with some

insight into the problems posed by computer use and the opportunities that exist for program improvement.

Computer-managed instruction (CMI) has had a reasonable amount of success in military maintenance training programs. CMI is often used to manage large-scale instructional systems. Included in this activity would be providing students with feedback on instructional progress, grading tests, and maintaining records. Since there is a high probability that CMI will see increased use in the military services over the next decade (Micheli, Morris, and Swope 1980), basic concerns about CMI would seem most closely related to cost-effectiveness. Orlansky and String (1979) evaluated thirty cost-effectiveness studies of computer-based instruction (CBI) conducted since 1968. These studies included several dealing with CMI. While findings were confounded by effects that could have been due to CMI or computer-assisted instruction (CAI), CMI and CAI save about 30 percent of the time required by students to complete the same course by conventional instruction. Student attrition also appears to increase with CMI and CAI.

Computer-assisted instruction (CAI) has been utilized for over a decade in various vocational education settings. However, within the past several years, the microcomputer revolution has put CAI within reach of virtually every classroom and laboratory. Decreased microcomputer costs and increased software availability certainly have had great impact on the number of units found in our schools today.

Earlier studies have focused on comparing CAI with traditional instruction. Much of the research in terms of general education was summarized by Hall (1982), while the previously mentioned evaluation by Orlansky and String (1979) dealt with CAI effectiveness in the military. As researchers began to note that CAI did have some basic comparative value, studies began to shift toward other aspects of CAI. Misselt and others (1980), for example, conducted a five-year longitudinal study of factors affecting the implementation and operation of CAI in military settings. Among the many findings reported was that staff selection and retention are often the critical features of a CAI project, outweighing hardware and software in terms of what is potentially and actually achieved. Tatsuoka, Misselt, and Maritz (1978) made a series of analyses of related attitudinal and achievement outcomes in computer-based technical training. These analyses revealed that students' positive perceptions of effectiveness in CAI lessons were associated with better achievement gains, while frustration and learning stress led to less favorable effect on the students.

The use of CAI in applied, work-related settings has become a more popular area of exploration. This is perhaps due to the fact that military technicians must ultimately apply what has been learned via CAI to realistic work environments. Rouse and others (1980) summarized six experiments that investigated the feasibility of using context-free, computer-based simulations to train in troubleshooting skills. Research on learning strategies and applied training in CAI performed by a University of Southern California group (Towne, Munro, and Crook 1978) focused on instructional theory and development of a generalized maintenance-trainer simulator that has numerous implications for CAI. Additional areas of study associated with CAI include relationships

between student attitudes toward CAI and training performance (Knerr 1978) and the development of an adaptive computerized training system (Knerr and Nawrocki 1978). These studies point out the need for considering students' needs and characteristics when designing CAI for T&I programs.

Psychomotor Skill Development

With its heavy emphasis on applied learning in laboratory environments, T&I appears to be a natural area for the conduct of research in psychomotor skill development. In fact, most, if not all, T&I occupations require the demonstration of at least some psychomotor skills. This, in itself, presents a most reasonable case for conducting research in the psychomotor skill area. Some of the more representative studies in this area follow.

Several reports provide most meaningful syntheses of psychomotor skill development research. Braverman and DeCaro (1979) presented a comprehensive review of research in psychomotor skill development. In addition to providing implications for the teaching of machine use skills, the authors listed areas that deserve further investigation:

1. A need to develop a procedure for analyzing the component of a machine use skill

2. A need to analyze those student characteristics that affect psychomotor skill performance

3. A need for research related to the effectiveness of a variety of feedback types in machine use skill development. (p. 15)

The retention of motor skills was subjected to an extensive review by Schendel, Shields, and Katz (1978). In their report, which emphasized research conducted by or for the military, variables that may affect retention of motor skills were divided into two categories: task and procedural. Findings indicated that the single, most important determinant of motor retention is level of original learning. Numerous conclusions were presented that are of value to anyone involved in teaching psychomotor skills.

With the range of studies focusing on T&I psychomotor skill development, it is best merely to provide a representative view of what researchers have done and are doing. One such study (Janeczko 1972) dealt with the effect of instructional and general objectives on student self-evaluation of psychomotor performance. Although student mean scores favored the instructional objectives approach, this difference was not significant. It appears that further investigation is necessary to uncover reasons behind data trends, particularly as they related to use of objectives in the psychomotor area. Obreiter (1978) sought to determine the effect of instruction supplemented with behavioral objectives on psychomotor skill development. Results revealed that not all students may benefit equally from instruction supplemented by behavioral objectives and criterion-referenced tests in the development of the drafting skill of penciling. In fact, performance in penciling was largely influenced

by prior drafting experience. Giblin (1982) conducted an experimental comparison of learning selected cognitive information and psychomotor skills using videotape versus live demonstration. Giblin noted that videotape and live lectures were equally effective (or ineffective) in presenting psychomotor skills.

The above studies point to a typical problem in psychomotor skills research. Although insignificant differences among groups are often found, little effort is made to conduct additional investigations that follow-up on basic studies. Since psychomotor skill development is a complex area, it may be beneficial to target meager resources in this area and seek answers to some of the basic research questions. Researchers would perhaps do well to examine Sorenson and Pennell's (1982) volume on the development of instructional treatment alternatives. This report provided guidance in the development and evaluation of alternative instructional approaches that hold promise of improving instructional effectiveness. The authors' major premise was "that there is no acceptable substitute for careful empirical experimentation--often an approach must be tried several times before evidence sufficient for credible evaluation is available" (p. 1). Unfortunately, the one-shot research study often does not fit into this conceptual framework.

Cognitive and Affective Learning

In a synthesis of research on individualized instruction in vocational and technical education prepared some twelve years ago, Impellitteri and Finch (1971) noted that research to that date "was generally simplistic in design, avoiding the examination of interactive effects" (p. 68). They further indicated that doctoral studies particularly demonstrated a tendency toward the univariate approach. Unfortunately, this trend has continued through the early 1980s. In fact, there appears to be little current interest in examining learning variables using experimental research methods.

However, at several institutions across the country, research of this sort is still alive and well. The result has been generation of a few studies that are responsive to research questions in the cognitive and affective learning areas. Brown (1977), for example, focused on the effects of two learning treatments on informational achievement, retention, and attitudes of students varying in problem-solving ability. Two instructional approaches were compared: the exercise experiment laboratory approach and the individual project laboratory approach. Although findings included a significant difference between the two treatments in terms of information retention, no other differences were noted. Since students had been divided into two levels of problem-solving ability prior to the experiment, this dimension of ability was clearly accounted for. If such data had been absent from the study, one could only have speculated on the ways that ability might interact with achievement.

Several other studies that align with the cognitive learning area should also be noted. Beach (1978) examined the effects of competency/evaluation profile feedback on achievement in electronics. Results indicated that when students receive competency/evaluation profiles of their examination results

rather than less comprehensive information, they may be expected to obtain significantly higher levels of cognitive achievement.

The relationship between educational cognitive styles and achievement was examined by Koscierzynski (1979). The author's recommendation that this relationship be explored in an experimental setting is well founded, since the study failed to produce a meaningful correlation between student achievement and the match of individual student cognitive styles to the collective cognitive style. Should such a study be followed up with experimental investigations, the body of knowledge about cognitive styles may be expanded many times.

A final example from the cognitive learning area was provided by Lorenz, Frantz, and Bledsoe (1976). The investigators compared student achievement in single occupational and multioccupational metals programs. Findings supported the contention that students in multioccupational programs perform better on combined tests that cut across several metals areas. It was noted that the multioccupational students were also superior to the machine shop group in its specialty.

Affective learning has become a popular research topic in recent years. This is perhaps due to increased recognition that learning a task is of no greater importance than developing values, attitudes, and appreciations. Several studies are representative of research in this intriguing area. Morgan's (1980) study of the effects of two different instructional methods on affective work competencies reflected the complexities inherent in affective learning research. Findings did not support one treatment over the other in relation to student learning. However, the modules utilizing slide/tape instructional methods may be provided in less time.

Relationships between selected student characteristics and their affective work competencies were studied by Sapko (1978). The researcher found that twelfth-grade T&I students possess a higher degree of affective work competency than industrial arts students after controlling for the effects of sex, family size, birth order, ethnic group, and parents' educations and occupations. No differences between study groups were associated with urban, suburban and rural community sizes.

Persons conducting research in the cognitive and affective learning areas should certainly examine relevant military documents. Griffith (1979), for example, reviewed the literature on memory enhancement. An analysis based upon scientific and popular literature indicates that memory enhancement techniques (mnemotechnics) can be used to increase the effectiveness of military training.

An instructional quality inventory job aid developed for the U.S. Navy by Ellis and Wulfeck (1978) was based upon extensive research related to the learning environment. Its purpose was to aid in providing quality control and/or evaluation procedures for instructional development. Dimensions of quality that may be assessed include objectives adequacy, test consistency, test adequacy, presentation consistency, and presentation adequacy. Materials such as the review of memory enhancement techniques and instructional quality

inventory development are merely representative of the many high-quality documents prepared under the auspices of the U.S. Department of Defense. T&I researchers would do well to search various military databases as they begin to plan affective and cognitive learning studies.

Youth Groups

A federal mandate that vocational student organizations become an integral part of vocational program operation has led to an increased interest in this area. Educators and researchers alike have developed concerns about what contributions student organizations make to the overall development of youth and what goals such organizations should have. T&I researchers have chosen to focus on various aspects of the Vocational Industrial Clubs of America (VICA). The increased number of studies conducted dealing with VICA over the past several years gives some indication that VICA-related research will continue to flourish.

A fundamental study in the area focused on establishing goals for the collegiate organization of VICA (Ross and Morgan 1982). The Delphi technique was employed to obtain consensus among a panel of consultants who represented various segments of the collegiate VICA population. Sixteen goal statements were formulated based on several Delphi iterations. These statements may serve as a foundation for future planning of the national, state, and local collegiate VICA organization. In view of the difficulties encountered in identifying external (e.g., employment-related) criteria for vocational student organizations, it appears that the Delphi technique may be of value to VICA and its counterpart organizations. Ruark (1973) examined the relationship between various groups' perceptions of VICA's role and the achievement of VICA goals. Administrators, teachers, students, and state department of education staff provided information for the study. It appeared that different groups had varying perceptions of VICA's role. Additionally, the major factor that enhances a club becoming a high VICA goal achievement club is one of positive perceptions of the role of VICA. Negative perceptions, on the other hand, serve as a major impediment in this regard.

Although the effects of VICA on T&I students have continued to be an area of concern, only a few studies have actually sought answers to questions about affect. One such investigation by Hudson (1978) examined the effects of VICA experiences on attitudes of T&I students. Hudson concluded that T&I students' attitudes toward conformity to society and toward the meaning of work may be influenced by instructional experience offered in the Vocational Initiative and Club Achievement Program or by VICA activities. Attitudes toward the values of work, self-esteem, support, recognition, independence, benevolence, and leadership do not appear to be influenced by these programs or activities.

The effect of short-term leadership training on attitudes of regional and state VICA officers was studied by Kelly (1980). This quasi-experiment included a three-day leadership workshop as treatment and the Leadership Opinion Questionnaire as criterion measure. Neither initial differences nor treatment-associated differences were found between the two groups. The insignificant results raise questions about how leadership training may or may

not affect leaders, as well as about what impact short training sessions may or may not have on participants. This finding has implications for future study, particularly since so much time and effort are being expended in the area of leadership training.

Teachers are certainly an important aspect of VICA's success. Dygert (1978) sought to determine the relationship of teacher self-concept to participation in VICA. VICA participant and nonparticipant groups completed the Tennessee Self-Concept Scale as well as other related questionnaires. Data analysis revealed that teachers with more work experience are significantly less likely to sponsor VICA than those with fewer years of work experience. Evidently, self-concept does not vary as a function of VICA participation.

TEACHER EDUCATION

A T&I research review is certainly not complete without mentioning teacher education. This area has been a research mainstay for many years. Even a cursory view of the literature reveals that numerous T&I teacher education research studies have been conducted. There may be plausible reasons for this phenomenon. First, many doctoral advisors are themselves T&I teacher educators who have a continuing interest in the area. Second, many doctoral students aspire to become T&I teacher educators. Their research studies may reflect an actualization of aspirations and interests. Regardless of the reasons, however, there is no lack of studies in the T&I teacher education field.

Those seeking to gain a historical perspective on this research area are urged to examine several reviews conducted over the past two decades. A review of research in vocational-technical teacher education conducted by Moss (1967) dealt with the period from 1962 to 1967. The review includes a classification model that may be useful to persons interested in organizing studies and exploring the interrelationships among them. In a more specific context, O'Brian and Schaefer (1968) provided a comprehensive review of T&I teacher education research through 1967. They commented at that time about little having "been done over the past decade to take a hard look at T&I teacher education" (p. 44). The authors recommend more targeted, sophisticated studies in this area. Bjorkquist and others (1968) provided similar observations, indicating that "research in T&I teacher education is still in an embryonic state" (p. 12). They also provided, as a vehicle for improvement, a research framework that takes a more comprehensive view of T&I teacher education research.

Several other documents should also be noted. Vocational teacher education research reviews conducted by Peterson (1973) and Adamsky and Cotrell (1979) include a number of T&I-related citations. These may be examined by persons who want to view T&I teacher education research within the context of vocational teacher education.

The remainder of this section focuses on several research areas associated with T&I teacher education. These include supply and demand, teacher characteristics, program development, teacher behavior, and professional development.

Supply and Demand

Recruitment and retention have plagued the T&I teacher field for many years. Since T&I teachers typically have many years of successful work experience in industry, they must sometimes be lured into teaching and often take a sizable salary cut in the process. Once the teacher is employed, there

is always the problem of retention, since individuals may easily move back to their former work fields if they become disenchanted with the teaching field. Lindsey (1979) examined the turnover of T&I teachers in Texas secondary education programs in an attempt to identify why the turnover rate was so high. It was determined that inadequate salary was the primary reason given for terminating teaching positions. Lindsey also noted that a significant difference existed in the salary paid those who continued to teach and those who left teaching for other positions. A related study by Brockway (1980) focused on factors related to the newly employed, nonprofessionally trained teacher's decision to leave the profession. Those who left teaching did so because of poor student attitudes and because teaching took more time than they were willing to commit. Those who remained in teaching did so because they enjoyed helping students learn and sharing their experiences with them.

In an effort to deal with teaching shortages in T&I programs, Cap (1980) explored the use of retired craftsworkers as volunteer aides in Ohio high schools. The study revealed that the actual pool of available volunteers from retired craftsworkers may be rather small, due to lack of interest or health problems. The teachers and the retirees saw volunteer use in different ways. Teachers felt volunteers would be most helpful in supportive areas, such as guidance and public relations, whereas retirees believed they could provide the greatest assistance in actual areas of instruction.

Thomas and Boyett (1976) provided insight into the ebb and flow of teachers in Florida by developing a statewide supply and demand model for vocational teacher education. Results indicated that, with one exception, supply and demand were fairly well balanced. The current number of graduates from teacher education institutions was not creating an oversupply of teachers. Although these data may have changed over the years, a comprehensive approach to teacher supply and demand appears sound. States and perhaps regions should consider such a strategy since it can be a useful aid to program planning processes.

Teacher Characteristics

Several reports have been made over the years about how T&I teachers differ from their academic counterparts. Others have highlighted the personal characteristics of T&I teachers (e.g., Finch 1969). More recently, however, researchers have begun to explore how the T&I teacher views a range of such teaching-related areas as job satisfaction. Others have explored relationships between teacher characteristics and student achievement.

Garcia (1980) explored the relationship of job satisfaction and selected demographic variables with vocational teachers' desires to change careers. A subset of these teachers represented the T&I area. Although linked in many respects to studies in a previous section, this investigation included collection of extensive job satisfaction and career change information from respondents. Results indicated that barriers influencing teachers' desires to change careers include a lack of financial security, a lack of geographic mobility, and a feeling of uncertainty about other careers. Important reasons

behind the desire to change careers were a desire for higher salary, need for greater achievement, and concern about student quality.

The comparison of actual and anticipated roles of T&I teachers was made by Bach (1974). The Delphi technique was used to seek consensus of perceptions about teacher roles from the teacher, colleagues, and students. An analysis of the percentages of consensus indicated the following:

> All groups had consistently larger percentages of consensus for the behaviors which they thought the trade teacher should carry out than for the behaviors they thought the trade teacher should actually perform. This was even true of the trade teachers' own perceptions. (p. 43)

Thus, each respondent group perceived what the T&I teacher was doing as being significantly different from what ought to be done.

An additional perception study should be noted. Bradley and Du Cette (1976) sought to compare perceptions of T&I teachers and general education teachers in terms of the ideal child and the successful student. Participants included 104 T&I teachers and 138 teachers of general education subjects. In the case of both groups, perceived attributes that are most important to the ideal child were noted as being the same as those most important for the successful child. There was, however, no agreement between teacher groups on the perceived importance of specific attributes. T&I teachers characterized the ideal student as being cooperative, honest, ambitious, competitive, and obedient, whereas general education teachers characterized the ideal student as being curious/inquisitive, open-minded, a critical thinker, honest, and independent.

Several researchers have chosen to focus on the occupational competence of T&I teachers. Since most T&I teachers must successfully complete occupational competency examinations before they are fully certified, questions are often raised about how these scores relate to other areas. Whitener (1981) explored the relationship between National Occupational Competency Testing Institute (NOCTI) examination scores and occupational experience, teaching experience, and educational level. Four T&I areas were chosen for examination: auto mechanics, carpentry, machine trades, and quantity food preparation. Since relationships varied from one occupational area to another, it was recommended that minimum requirements for the selection and certification of T&I teachers may need to vary for each occupation to reflect optimum occupational competence. A similar study by Abrams (1981) focused on data from 154 Kentucky T&I teachers. NOCTI data were correlated with a host of personal characteristics variables. No relationships were found between NOCTI examination scores and education, work experience, number of places worked, teaching experience, and level of teaching. Similar results were found by Schenck (1979) when the occupational competence for T&I teacher education students was compared across three work experience combinations. However, Hux (1980) refuted Schenck's results, citing methodological weaknesses that may have affected results.

Several researchers have begun to explore relationships between teacher characteristics and student achievement. Pantalone (1979) analyzed relationships between T&I teachers' backgrounds and graduating students' gainful employment. Extensive work experience or employer contacts made by teachers did not relate to student employment. The amount of teaching experience and education level was likewise unrelated to student employment. Relationships between T&I teachers' personal characteristics and student achievement as measured by the Ohio Vocational Education Achievement Test Program were examined by Brannam (1980). Brannam concluded that none of the twenty selected demographic or personal characteristics were sufficiently strong to be used as predictors of teacher effectiveness. Based upon these two studies (as well as others conducted in earlier years), it appears that T&I teacher characteristics variables have little association with student achievement.

Program Development

One of the more sustained programs or curriculum development movements has been that of competency-based teacher education (CBTE). Since the early 1970s, CBTE has been explored extensively and initiated in many colleges across the country. Serving as a base for much of the CBTE movement was the research conducted by Cotrell, Chase, and Molnar (1972). The 384 vocational teacher competencies identified by this research team eventually led to the development of 100 learning modules that focus on many of the key professional skills needed by vocational teachers.

Cotrell's research stimulated the conduct of numerous statewide studies in various vocational service areas, each of which was intended to identify those competencies needed for successful teaching (e.g., Andreyka 1976; Turner 1979). Although space does not permit a listing of competency studies, reports in this area range from special needs (Farmer 1979) to reading (Horlivy 1977). A closely related study by Walker (1978) reported the development and validation of a criterion-referenced test that focuses on selected pedagogical performance elements of a CBTE program. Five development and validation stages were reported. This study pointed out that even though valid instruments can be developed in support of CBTE programs, their development costs may be quite high. Those choosing to implement CBTE in their institutions would do well to explore the various costs associated with high quality programs.

Several studies relate to more general concerns about T&I teacher education. Recognizing the need to organize T&I teacher certification processes in a more efficient manner, Lear (1980) designed a management information system that provides certification status information to four user groups: teacher educators, teachers, state staff, and local education agency directors. The system was developed in concert with the Criteria Acquisition Model for educational product development. Wright and Hess (1974) indicated that such a model assumes there are specific stages in the life of educational products and that specific criteria must be met before a product is advanced to the next stage of development.

T&I teacher education delivery systems across the United States were assessed by Sheppard (1981). He found that T&I teachers were not prepared in a manner similar to general education teachers or other vocational teachers. The researcher also noted that teacher preparation in instructing disadvantaged and handicapped students, as well as in topics dealing with sex stereotyping, is not generally required. This lack of emphasis on sex stereotyping may relate in some way to the low numbers of women who teach in traditionally male-intensive vocational education. A retraining program to help meet the need for more women in nontraditional teaching roles was described by Kane (1978). Such a program should focus on the T&I and industrial arts areas. Program planning efforts would include heavy emphasis on recruitment, selection, counseling, and use of various support groups.

Teacher Behavior

A most elusive area in teacher education research is the identification of relationships between teacher behavior and student achievement. In fact, most teacher education programs cannot be justified on the basis of contribution to student achievement. Program administrators merely indicate that various content elements are important to success as a teacher.* Fifteen years ago, Popham (1968) sought to develop performance tests that would distinguish between experienced T&I teachers and nonteachers. Comparisons of pupil performance data revealed no systematic differences between the performance of the teacher and nonteacher group in the areas of either auto mechanics or electronics. Though it would appear that Popham's research on T&I teacher performance tests is a dead issue, this area still has much potential, particularly with the advent of performance-based teacher education (PBTE).

Several additional studies highlight the potential for sustained effort in studying teacher behavior as it relates to student achievement. McKinney (1979) sought to identify relationships between T&I auto mechanics teacher behavior and the achievement of students in their classes. Teacher behavior was measured by the Vocational Teacher Observation of Process System (VTOPS), and student achievement was assessed via the Ohio T&I Achievement Test. Significant correlations were found between student achievement and two VTOPS measures: variety quantity and variety range. This study reveals the opportunity researchers may have to identify key relationships between teacher behavior and student achievement.

Ongoing efforts at the National Center for Research in Vocational Education may result in more meaningful measures of teacher behavior. Halasz and McCaslin (1982) reported the development of procedures to measure vocational teacher time on task (a most crucial factor that affects student learning and achievement). Their findings included a most interesting profile of the productive time spent by vocational teachers in their various classes. More important, however, is the potential that time-on-task assessment has to uncover more meaningful linkages between T&I teacher behavior and student achievement.

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*This concern is expressed periodically by those who oppose CBTE.

Professional Development

Since many T&I teachers do not have bachelor's degrees, heavy reliance is placed on continued professional development to upgrade teachers both pedagogically and technically. The notion of professional development goes beyond "Band-Aid" preparation to focus on career-long development processes that may include a range of personal experiences such as internships, technical courses, and seminars. Swanson (1974) noted that vocational teacher education has unfortunately operated more as a delivery system than as a development system.

Increased interest in the development of T&I teachers as professionals has given rise to several studies in the area. The inservice needs of T&I teachers in Colorado were assessed by Hicken (1977). This study apparently built upon the previously mentioned competency studies, with those items ranking higher in importance than in ability to perform constituting the areas of need. Such a study can be of major significance if linked to a professional development system. Otherwise, it is merely a one-shot approach to teacher needs. Sortore's (1982) study of T&I teachers' professional development practices appears to have dealt with this issue. The researcher assessed needs and then applied them to a conceptual inservice training and professional development model. Perhaps this reflects a change in our traditional perceptions, one that may move toward a comprehensive view of professional development systems for T&I teachers.

ADMINISTRATION

During T&I's early years there appears to have been a reasonable interest in research related to T&I administration. More recently, however, research in this area has dwindled, perhaps because T&I administrators are being replaced by more broadly based vocational education administrators. It may also be that community college leadership more often includes technology directors and chairpersons than leaders organized by specific service areas.

Could it be that T&I administration has in some respects been subsumed under broader leadership categories? If this is indeed the case, research may have shifted to the study of more comprehensive leadership roles. Lacking a sufficient number of studies to provide specific groupings, it may still be useful to discuss a few individual efforts that have been completed over the past several years. These serve as examples of research that more or less relate to a T&I administration theme.

An analysis of tasks performed by T&I district supervisors in Alabama was conducted by the Alabama Research Coordinating Unit (An Analysis of the Tasks 1976). Designed to define and describe the T&I supervisor's role as perceived by instructor coordinators and administrators, this study required respondents to rate both task importance and frequency of performance. Some of the most important tasks identified included providing leadership and assistance in the improvement of teaching and informing teachers of new developments in the field. In a more general view, French (1977) sought to identify the role perceptions of local vocational supervisors in selected Ohio schools. T&I supervisors constituted a portion of the 235 people studied. Data analysis revealed a significant difference between the degree to which supervisors perceived their present frequency of task performance and ideal frequency of task performance. There was no difference among the five service area subgroups in their perceptions of the combined task areas of supervisory performance.

As with teacher education, competency identification studies have become quite popular in the vocational administration area. Norton's (1977) verification of competencies important to secondary and postsecondary vocational education administrators is perhaps the most comprehensive study to date since it focused on a national population. Use of a DACUM (Developing A Curriculum) panel and facilitator resulted in 166 verified task statements or competencies. Other researchers have conducted administrator competency studies in various states with comparable results. Finch (1977) identified sixty-three tasks that were important to vocational administrators as perceived by the administrators and their respective superintendents of schools. Need for improvement served as a basis for the development of competency-based administrator education modules. Andreyka's (1978) administrator and supervisor competency identification study in the state of Florida resulted in a list of

eighty-four competency statements. Most of the competencies were rated as being needed by all vocational administrators and supervisors. A more recent study by Drake (1980) utilized the DACUM approach to identify and verify essential competencies for vocational education supervisors in Pennsylvania. A resultant DACUM profile included sixty-nine competencies listed under eight categories that were considered important to a supervisor's success.

As has been noted, much of the research dealing with administration is fairly broad in focus; references to T&I administration and supervision remain limited. For those who choose to study this more narrowly defined field, it may be best to examine T&I administration within the context of vocational education. Several of the studies cited in this section have done this with the result being beneficial for both vocational education research and T&I research.

EVALUATION

Evaluation may be considered as the process of determining the worth of something. In terms of vocational education this may include deciding whether or not a program will be offered and, if so, what its scope will be; deciding what resources will be best used to achieve goals and objectives; determining what effects programs have on students in school; and examining program effects on former students.

As with the administration area, evaluation has undergone a transformation over the past ten or so years. The initiation of statewide vocational evaluation efforts and the establishment of a national vocational education data system (VEDS) have apparently emphasized evaluation's comprehensive nature rather than its service-area specific character. Consequently, there are not a great number of T&I-specific evaluation studies or reports available. It is clear that numerous state and local evaluations have been conducted since the passage of the Education Amendments of 1976. However, most of these state and local efforts may be classed as compliance evaluations rather than evaluative research, which, as Suchman (1967) pointed out, is "the specific use of the scientific method for the purpose of making an evaluation" (p. 31).

In an effort to provide useful information for both researchers and practitioners, two subsections are presented: one dealing with evaluation source documents and another focusing on evaluation studies. Collectively, these should provide a view of contemporary evaluation practices and research in the field.

Source Documents

Although in-school achievement is a basic consideration for all T&I programs, the quality of educational products or graduates is an even greater concern. Wentling (1980) cited a number of approaches that may be used to evaluate a program and its graduates. These include assessing learner performance, student follow-up, the employer survey, the consultative team evaluation, and cost analysis evaluation. Such approaches, either individually or collectively, are typically used when T&I programs undergo evaluation.

Concern about postschool outcomes is also reflected by authors of several most useful evaluation papers commissioned and produced by the National Center for Research in Vocational Education. Among those developed are a thesaurus of questions to judge vocational education outcomes (Farley 1979), a compendium of evaluation instruments (McCaslin, Gross, and Walker 1979), and a review and interpretation of employer satisfaction with vocational education graduates (Asche and Vogler 1980). The employer satisfaction paper is most interesting in that the authors did not choose to "promote an adversary or

advocacy position relative to collection of employer satisfaction data" (p. 1). Instead they identified numerous conceptual and methodological problems associated with this important area. Abstracts of employer satisfaction studies are appended. A more recent document prepared by Moss and Copa (1982) focused on evaluation, inquiry, and local planning in federal vocational legislation. This is one of the few evaluation papers that deal more directly with federal policy issues. Although some may disagree with the authors' perspective, there is no question of the need to improve the link between vocational education evaluation practices and federal policy. Perhaps others will take this notion and expand upon it in the future.

Evaluation Studies

Several evaluation studies reflect the great concern about postschool outcomes. This appears to be a key area of focus and one that will likely receive continuing research attention. Richardson and McFadden (1976) examined the employment patterns and earnings of secondary school vocational education graduates in Indiana. Evidence of program effectiveness was provided by analysis of short-run follow-up data. Comparative information was provided for each major vocational education service area.

The education and employment of postsecondary vocational-technical and transfer education students after five years was reported by Noeth and Hanson (1976). A national sample of students was assessed using outcome measures such as education and employment status, job relatedness, perceptions of effect on level of employment, and satisfaction with present job and past education programs.

Franchak and Meehan (1977) evaluated a school-based program for placing youth on jobs. Effectiveness of the program was examined in three secondary-level area vocational-technical school settings. Examinations were made of program utility in terms of services provided, costs of services provided, and attitudes of the various client groups being served. An evaluation study focusing on secondary T&I programs in Massachusetts concluded that male T&I graduates have greater earning power than other male graduates (Conroy 1976). Comparative evaluations such as the Conroy study are difficult to conduct but they can provide a more realistic view of what T&I programs are accomplishing in relation to other programs.

Over the years, researchers have chosen to deal directly with the concept of education and work, which relies on the study of how these two areas interrelate. Vocational education, on the other hand, may be studied without major consideration of the work world. Becker (1982) pointed out that "there are numerous issues related to education and work in the early years of America's industrial development which are still vital today" (p. 14). His work supported this notion with a most interesting comparison of debate over education and work during the early 1900s and debate carried on early in the 1980s. Becker's chapter is part of a comprehensive volume on education and work produced by the National Society for the Study of Education (Silberman 1982). Included are meaningful chapters ranging from the equity and effectiveness of

secondary vocational education to the structure of the labor market and associated training patterns.

Grasso's (1982) examination of the role and outcomes of vocational education provides much insight into the education and work area. Although included in this section, the document has implications for all who choose to study the outcomes of vocational educatio . The author began by citing the numerous sources of national data that may be used to assess vocational education outcomes. Some of these data may be used in service-area-specific studies, but Grasso also reviewed research in two outcome domains: (1) the role of vocational education in affecting high school completion versus dropping out, and (2) the post-high school wage outcomes of participation in vocational education.

Since the study of vocational education in an education and work context provides much greater insight into the outcome area, researchers would do well to consider such a thrust in future years. Policy concerns, likewise, seem to fit the education and work mold. Evaluation that has implications for policymakers should be conducted within the education and work context. Otherwise, it may not have much useful impact on legislators and other high-level decision makers.

SYNTHESIS

It is somewhat difficult if not impossible to provide absolute direction for the field on the basis of this brief review. Instead, two sets of comments are provided, one dealing with the current state of T&I research and the other focusing on thoughts for future research and development efforts.

State of T&I Research

Since comments associated with both quantity and quality of T&I research have been spread throughout this document, it may be useful to synthesize studies in a more general fashion. It should first be noted that curriculum research efforts have become more sophisticated in recent years. Quantitative approaches are being used successfully to identify meaningful curriculum content. The field has begun to struggle with affective content and appears to be making some headway in this area. Unfortunately, research in the instruction and learning areas has not been as successful. Of the studies examined initially, many were discarded, leaving but a few that were programmatic and systematic. Although one would expect the instruction and learning area to generate much research interest, it appears to be one with little activity. What has been conducted includes a preponderance of one-shot research that does not fit into a larger research framework or mosaic. One of the few exceptions to this is research conducted and supervised by H.C. Kazanas and colleagues at the University of Missouri and more recently at the University of Illinois (see for example, Kazanas 1978; and Kazanas and others 1973).

Some research has followed the ebb and flow of federal legislation. Research areas cited include articulation, vocational student organizations, and sex equity. Although it is important to conduct research that will provide aid to newly legislated activities, one must also look at the potential for programmatic research thrusts. In some cases, research has been conducted at one level of inquiry when a need exists to go beyond initial studies and conduct in-depth investigations focusing on more sharply defined variables.

T&I teacher education research has been conducted on a scale that appears to exceed its importance in the field. Plausible reasons were given for this in a previous section, but these do not justify continuing strong research emphasis on teacher education to the exclusion of research on instruction and learning. Studies focusing on relationships between teacher behavior and student achievement have the potential to link these two areas, but, unfortunately, this potential has yet to be realized.

Research in the administration and evaluation areas has focused to a great extent on vocational education in general rather than on T&I in particular. Recognizing that some specific T&I research in these two areas is essential,

it may be important to look first at the more general research and note how T&I fits into this context. Several of the studies cited have given consideration to both vocational education and T&I. These clearly have greater value to the field.

It is difficult to avoid the many references to military research. Training research conducted by and for the U.S. Department of Defense exemplifies the type of programmatic inquiry that should take place in vocational education and T&I. Although sustained research efforts over the past two decades have resulted in systematic improvements to the military training environments, most T&I researchers have chosen not to draw from the wealth of research the military has generated. Persons have, instead, merely cited the meager public education research reported in ERIC and various journals. It is indeed unfortunate that two groups sharing many of the same problems have not exchanged ideas and results more readily.

Future Research and Development

Based upon comments made in the preceding subsection, it may be most fruitful for future research to focus on significant, targeted problems and to deal with them programmatically. Since much of the T&I research reviewed has been generated by doctoral students, it is perhaps best for university faculty to take up this banner. As students begin to choose research topics, advisors could direct them toward an ongoing division or department-wide research thrust. Each student would then select his or her topic within a broader research framework. The result would be a series of studies that contribute to our overall knowledge about a targeted area.

Future research should seek to highlight the somewhat unique aspects of T&I and then zero in on them. The maintenance and nondegreed teacher areas serve as but two of the many areas that reflect T&I's special character. Targeted research in unique areas will benefit T&I more directly, particularly with the limited resources available for research. Using this approach will likewise keep the "shotgun" type of studies down to a minimum and allow researchers to focus in on problems with "rifles."

When T&I research is conducted in a broader context, researchers should give basic consideration to that context. This is particularly true in the administration and evaluation areas. T&I teachers and students are not kept in isolation. Researchers should, therefore, consider more global databases and sources of data. Consideration should also be given to the use of naturalistic inquiry as an alternative to quantitative methods (Guba 1981). It may be useful to employ more creative research approaches as we study T&I within a larger context.

Finally, a time may come when we have to reassess the value of research in certain T&I areas. Shrinking budgets, decreasing funding, and other considerations may force the T&I community to set research priorities in line with basic needs and potential benefits. Whether this occurs five, ten, or even twenty years in the future, T&I researchers would do well to begin thinking about where research dollars and efforts should be placed to do the most good.

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