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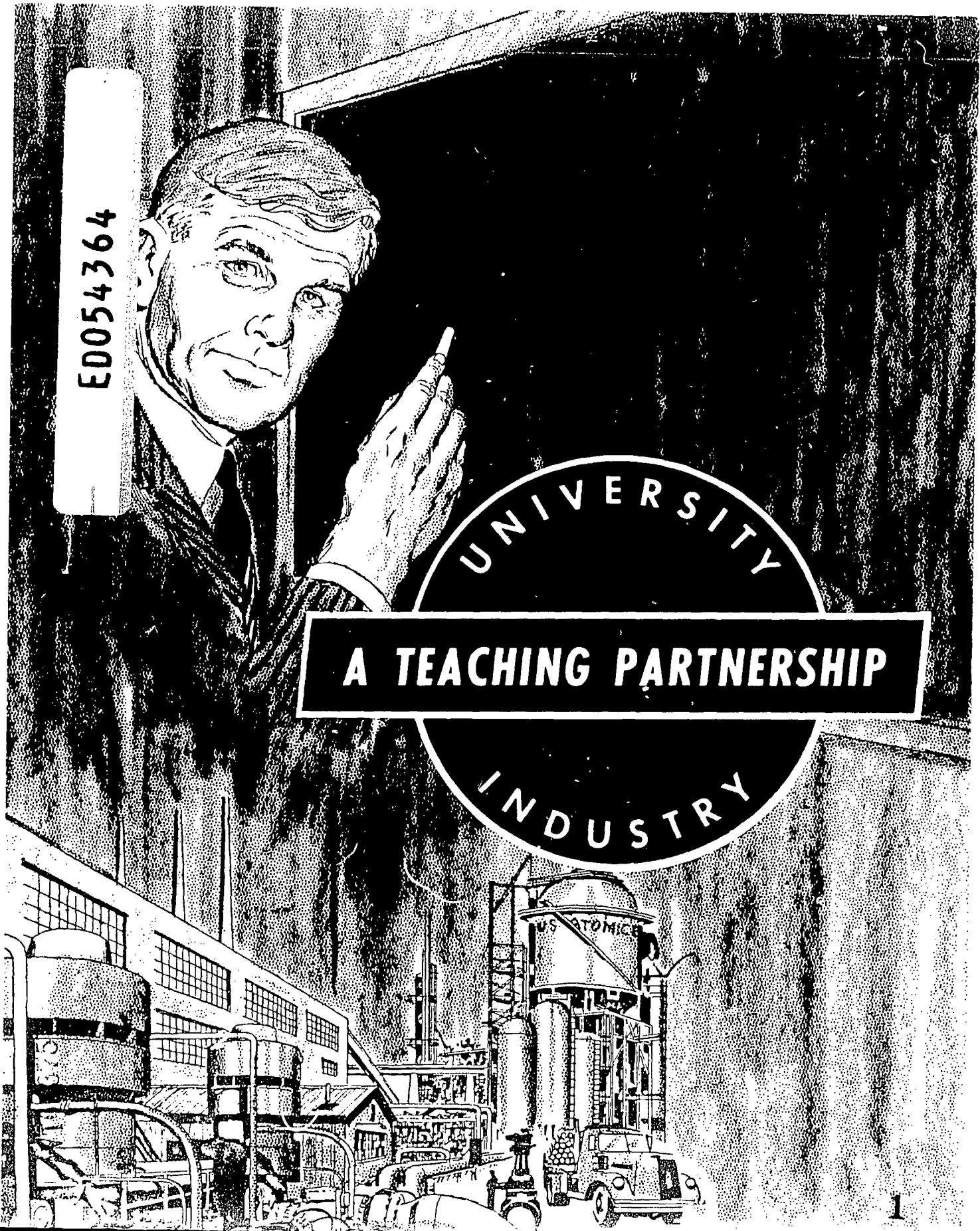
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ABSTRACT

An industry-university partnership was established in 1966 in the form of the Training and Technology (TAT) project at the Oak Ridge G-12 Plant. TAT, designed to bring the expertise of industrial technology closer to those in vocational education, proposed to involve worker trainees, teachers, and industrial personnel in a two-level training program. Now with 4 years of research and experimentation through a combination of industry and university facilities, equipment, and personnel, the TAT project has evolved into two major components: (1) worker training of disadvantaged youth and adults, and (2) the Teacher Institute. This report concerns the Teacher Institute program (1968-70) as operated by The University of Tennessee in cooperation with agencies within the TAT project, and covers: (1) Inservice Teacher Preparation, (2) Prospective Teacher Preparation, (3) The Graduate Fellowship Program, and (4) Conclusions and Recommendations. Included in the Appendixes are sections on: (1) Representative Inservice Machinery Program, (2) Typical Program Schedule, (3) Program Appraisal, (4) Excerpts from The Evaluation Report, (5) Evaluation Questionnaire, and (6) Proposed and Revised Course Syllabi. (Author/JS)

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INDUSTRY

Conducted at the U S Atomic Energy Commission's Oak Ridge, Tennessee, Y-12 Plant, the Training and Technology (TAT) project is operated by:

OAK RIDGE ASSOCIATED UNIVERSITIES

in cooperation with the

NUCLEAR DIVISION, UNION CARBIDE CORPORATION

and the

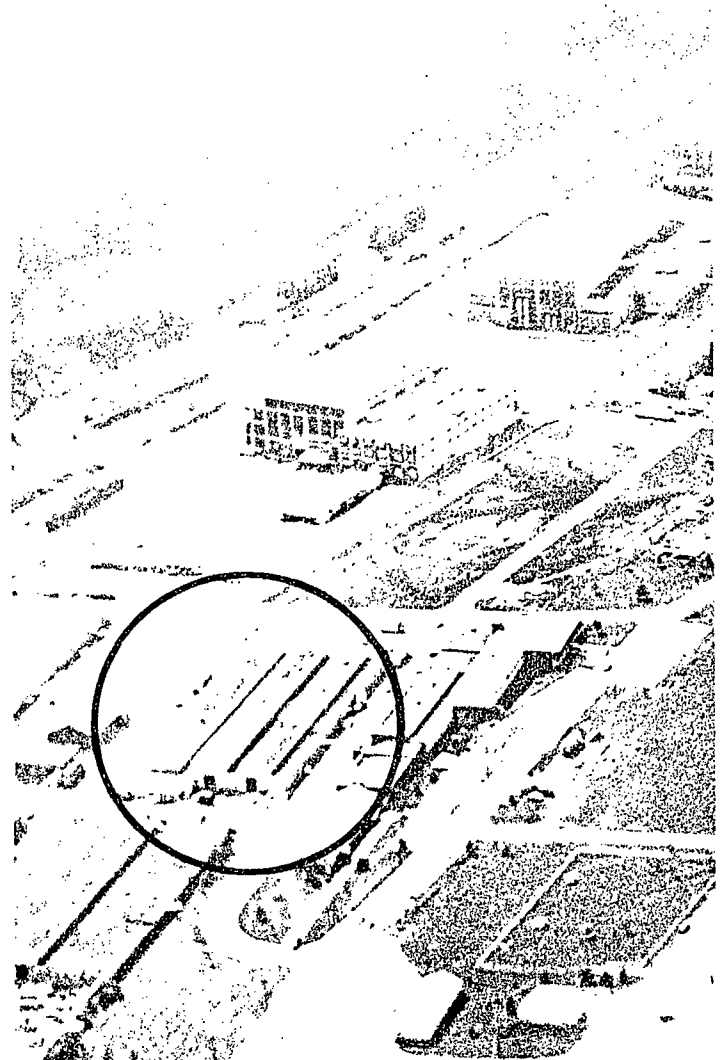
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Y-SB-137 (Revision 1)

Final Report to the
U. S. OFFICE OF EDUCATION

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**INDUSTRY-EDUCATION COOPERATIVE PROGRAM FOR PRESERVICE
AND INSERVICE VOCATIONAL AND TECHNICAL
TEACHER TRAINING**

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Oak Ridge Y-12 Plant

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CHAPTER I

the
teacher
institute

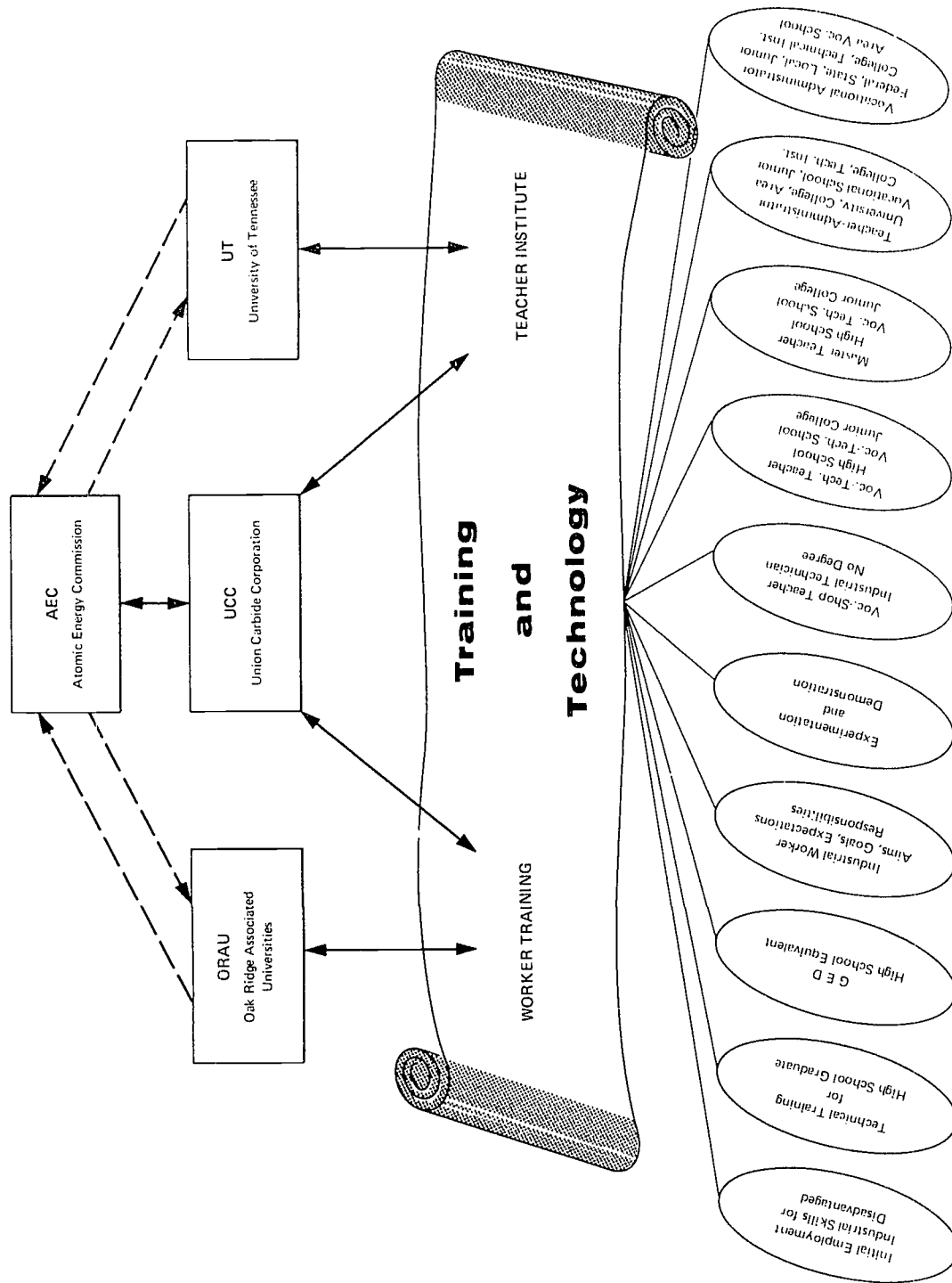


Figure 1. TAT RELATIONSHIPS AND OBJECTIVES.

An industry-university partnership was established in 1966 in the form of the Training and Technology (TAT) project at the Oak Ridge Y-12 Plant.^(a) TAT, designed to bring the expertise of industrial technology closer to those in vocational education, proposed to involve worker trainees, teachers, and industrial personnel in a two-level training program. Now, with four years of research and experimentation through a combination of industry and university facilities, equipment, and personnel, the TAT project has evolved into two major components:

1. Worker training of disadvantaged youth and adults in six major vocational fields (machining, drafting, electronics, mechanical operations, physical testing, and welding).
2. The Teacher Institute, designed for:
 - a. preparing prospective technical and trade and industrial education (T&I) teachers in a ladder-of-careers approach;
 - b. inservice training of technical and T&I teachers;
 - c. graduate leadership internship training.

(a) Operated by the Union Carbide Corporation's Nuclear Division for the US Atomic Energy Commission.

This report concerns the Teacher Institute program during the EPDA funding period (1968 – 1970), as operated by The University of Tennessee (UT) in cooperation with the other agencies within the Training and Technology project, as outlined in Figure 1. The TAT project was designed to explore multi-organizational approaches to human resource development at the Y-12 Plant. TAT, shown in the form of a scroll in Figure 1, is symbolic of the conceptual aspect of the program—experimentation and demonstration. Negative aspects of the experimental and evolving project are “rolled up” as new aspects are “unfurled” in the process. Training disadvantaged Appalachia workers and vocational teachers together in a modern industrial setting is indeed a unique concept. Sharing identical machines, laboratory equipment, and classrooms, and establishing rapport and human understanding among these individuals approaches the American ideal—an opportunity for each individual to become a contributing and participating citizen. The multitudinous opportunities for an informal microteaching situation between prospective teachers and worker trainees have strengthened both. These brief unstructured teaching-learning encounters have become recognized as one of the prime exemplary functions of human resource development at TAT.

Documentation of the Program

There is a nationwide shortage of qualified and certified vocational-technical teachers. The

South, however, with its rapid growth in junior colleges, area vocational schools, and technical institutes is especially in need of this type of qualified teacher. This need is further accentuated by the rapid industrial growth of the South, making available more jobs for well-trained vocational graduates. The potential for industrial growth made possible through the Tennessee Valley Authority (TVA); and, particularly, the vast water and power resources that are available in this area, is attracting major industries that have need for trained vocational and technical personnel who are the "products" which teachers must turn out. The necessary pool of well-trained worker personnel can be developed only after well-qualified teachers are available to provide the course work and training. Also, there is a critical need to meet the instructional requirements of the South's expanded efforts



in the engineering and technical fields in the associate-degree programs of the new post-secondary institutions.

Appalachia is recognized as having a comparatively high rate of youth unemployment, and an extremely high dropout rate of pupils in the schools. These factors accentuate the need for better-trained vocational and technical teachers. The Education Advisory Committee of the Appalachian Regional Commission made the following observations in its *Interim Report* (March 1968):

... There will be a sharp rise of demand for occupational preparation at all levels over the next eight years. The number of students desiring such occupational training at all levels could easily double by 1975. (p 31)

Further documentation of the expanding need for the vocational-education and vocational-technical teacher can be found in *The People Left Behind*, a report by the President's National Advisory Commission on Rural Poverty. (U S Government Printing Office, 1967) The Commission recommended:

That the Federal Government in cooperation with the States develop and expand occupational education programs that will enable students to adapt to a changing society. Such programs should be developed at the elementary, high school, and post high school levels. (p 48)

Federal funding of vocational-technical education should include incentives to insure that schools cooperate closely with industry and organized labor. (p 48)

A basic problem in providing good occupational training programs in the public schools is the cost of equipment and facilities and the shortage of good teachers. (p 48)

An assessment and discussion of these vocational education problems in 1966 led to the formation of the Training and Technology Project (TAT). Oak Ridge Associated Universities (ORAU), a nonprofit corporation sponsored by 41 colleges and universities in the South, was chartered in 1946. Its program, in part, is to conduct programs of education, information research, and human resource development under contract to the Atomic Energy Commission. Having a history in educational cooperatives, the founding purpose of ORAU provided a natural mechanism to organize TAT, with the Union Carbide Corporation furnishing the technical training personnel and The University of Tennessee, Department of Industrial Education, furnishing the teacher training personnel. An inter-agency agreement was established between the several agencies to conduct the TAT program at the Y-12 Plant. A facility, Building 9709, not immediately in use by Y-12 was made available for the project. The AEC furnished the facilities, the vocational shop, and laboratory equipment; Y-12 furnished personnel who possessed the industrial expertise required for teaching personnel in the technologies; the U S Office of Education (USEO) funded the Teacher Institute through The University of Tennessee, Department of Industrial Education; the U S Department of Labor, Appalachian Recovery Act, and the AEC funded the worker-training program.



Review of 1966-67 Activities

With the enactment of the interagency agreement, and funding by the USOE, Bureau of Research, the Teacher Institute began in the summer of 1966 with 60 inservice vocational teachers recruited from throughout the southeastern states for a ten-week program (see *Final Report*, USOE BR 6-2329). At the conclusion of this summer program, several retired military people were enrolled in September in the prospective teacher training program. The following summer, 100 teachers were recruited for a second inservice program (which was shortened to eight weeks) and the number of traditional career preparation courses was reduced. Further evaluation of the program indicated that substantial reduction in time was feasible and desirable as a research aspect for future inservice programs.

For the second academic year (1967-68), 23 qualified retired military personnel plus a

few Union Carbide employees were enrolled in the prospective vocational teacher's program. It became apparent that recruitment was to be the critical problem in an attempt to provide a pool of trained prospective teachers with adequate vocational experience. This problem posed a need for additional research and a proposal for funding. Other problems were: (1) to develop a shortened inservice teacher training program (three to five weeks) to be offered during the academic year, and (2) to develop graduate research and leadership programs for technical education personnel.

The Present Teacher Institute

Developing a program of this complexity was possible only through the utilization of the human and capital resources of several organizations. The initial research and development program had brought together the vital atomic age tools and equipment, the expertise of industrial technology and personnel, and the university teacher educators. The four years of development of the industry-education partnership, as a training concept and a cooperative effort among the various agencies, has demonstrated that the results of research activities can be put to practical application. In 1968, having received from the USOE both the Graduate Fellowship grant and approval of the Teacher Institute EPDA grant, The University of Tennessee negotiated a separate interagency agreement with the Atomic Energy Commission and USOE to administer the

Teacher Institute independently of the ORAU. Based upon preliminary evaluation of the initial research program (BR 6-2329) and of the total TAT concept, UT's Department of Industrial Education embarked upon a new program to develop the Teacher Institute as a model for cooperative industry-university training programs for technical teachers and administrators in a ladder-of-careers approach (see Figure 2).

Prospective Teachers

The Graduate Fellowship program began with the recruitings in September 1968, of four retired military personnel who had completed the BS degree requirements in Industrial Education through the Teacher Institute.

Because notification of the award of the Grant from the EPDA had not been received until late November, the prospective teacher program did not begin until January 1969. A major program focus was to draw upon the pool of returning servicemen who had technical training and work experience that would allow them to move quickly toward certification as a vocational or technical teacher and with an ultimate goal of a graduate degree in Industrial Education. Beginning with the Winter Quarter, 13 retired (or discharged) military persons were recruited under a close assessment and interview of the candidates by State Department of Education, university, and industrial personnel. Enrollment was increased

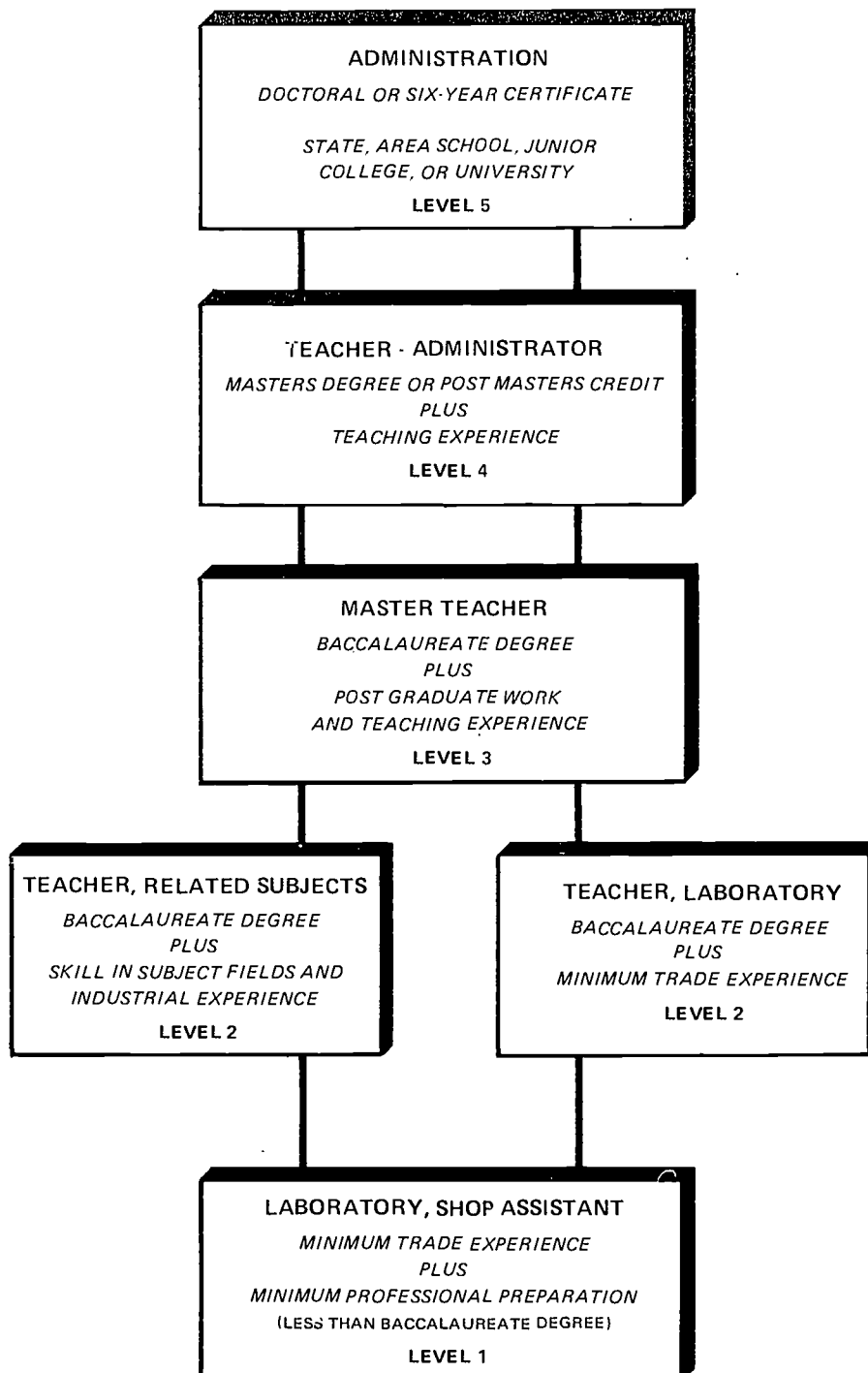
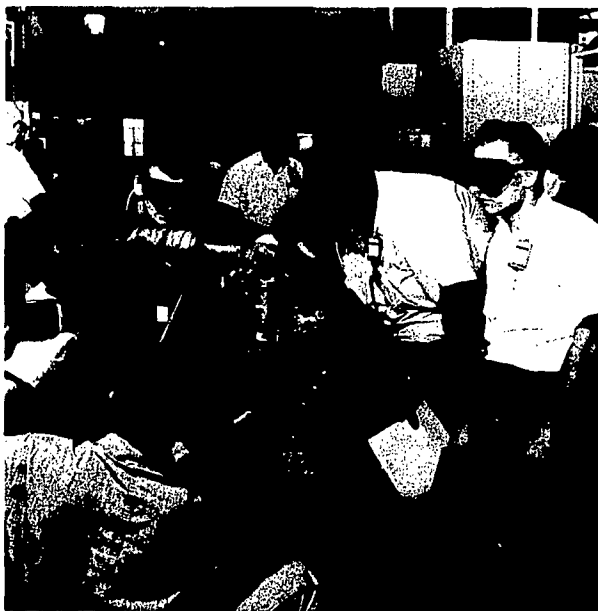


Figure 2. LADDER OF CAREERS IN VOCATIONAL EDUCATION.

to 25 prospective teachers (maximum allowable under contract) during the Spring Quarter and held at that level.

A second focus of the program was to train industrial foremen, supervisors, and technologists at Y-12 to function in the Training and Technology project activities. Returning military men and personnel from industry have thus provided the major pool of personnel for prospective teacher candidates.

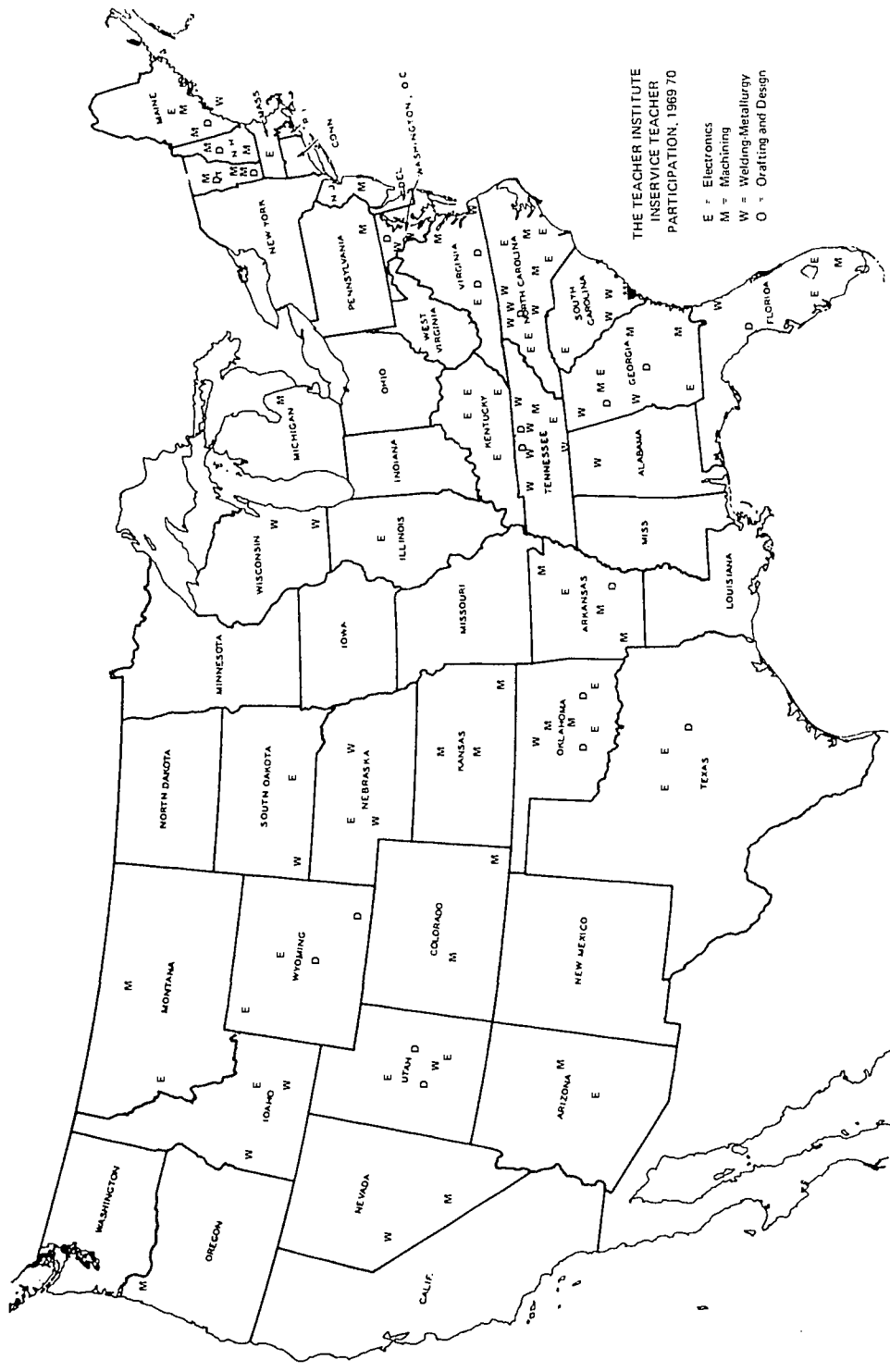


Inservice Teachers

For the inservice aspect of the Teacher Institute, the first short-term inservice program was held during the Summer Quarter of 1969 with an enrollment of 30 welding and

metallurgy teachers from junior colleges, universities, vocational schools, and high schools representing 20 states. During each subsequent academic quarter, an inservice program was also held in the field of electronics, drafting, and machining technology, with a second electronics program held during the summer of 1970. In the five groups of inservice teachers, a total of 114 participants representing 35 states throughout the nation were selected and received training in this inservice program. Each selected teacher or professor was recommended to the Teacher Institute by both the dean or director of the applicant's school and the director of vocational technical education for that particular state. A selection committee composed of both industrial and UT personnel made the final selection of the teachers to represent their respective states in the inservice program.







Industry-University Partnership

Several inservice teachers, returning to their respective states, have reported that they have organized and administered similar inservice-type programs in their own areas for other instructors in their particular technology. Although there have been some clear examples of such program thrusts identified, there has not been, unfortunately, a widespread dissemination and implementation of the partnership idea that can bring about closer cooperation between industry and education. Dissemination of the total industry-university partnership concept has been partially successful, however, as shown by the emergence of programs at the Lockheed Plant in Marietta, Georgia and the NASA facility at Langley Field, Virginia.

The basic elements of the teacher training program as an industry-university partnership have been partially developed, field tested, and evaluated. There is now a recognized need for expanding the industry-university partnership activity to include additional industries and to cover new technical areas for teacher and leadership preparation for post-secondary vocational and technical schools and public junior colleges. The proposal for a multiple industry-education partnership has received some encouragement from other states in the Appalachian Region.

During July 1970, a written evaluation by those students who were Union Carbide employees indicated a significant interest in the industry-university partnership concept to increase technical training and to assist the

individual with his present industrial job and preparation for better job opportunities. Of the more than 50 industry persons enrolled in this portion of the program, there was an almost unanimous recommendation for continuation of the program at the industrial plant. Arrangements are currently being made by the University to negotiate a new inter-agency agreement with the Atomic Energy Commission for continuation of the course offerings by the Department of Industrial Education on site at the Y-12 Plant. Also, Union Carbide Corporation management personnel have, in recent months, approached those people responsible for operating the AEC's Oak Ridge Gaseous Diffusion Plant and Oak Ridge National Laboratory in anticipation of some involvement of their personnel in courses of technology and industrial education.

In summary, the Teacher Institute of Oak Ridge, as a research and demonstration project of the Education Professions Development Act in 1969-70, has demonstrated that:

1. An industry-university partnership can be operated with mutual benefits to both organizations, eg: laboratories, shops, and equipment, not otherwise available for training at a university, and specialized technical instructors and university training not otherwise available to industry, can be utilized.
2. Technical and professional preparation courses can be developed that are viable

and acceptable to both academic and industrial personnel.

3. Industrial employees are interested in and can receive university credit toward a degree in Industrial Education.
4. University courses in Industrial Education are considered of immediate benefit to their jobs by those enrolled.
5. Industrial workers can be recruited as a resource pool of trained prospective vocational-technical teachers through enrollment in the partnership program.
6. An industry-university partnership provides an excellent three-week inservice teacher technical updating program.
7. Military veterans are interested in and can profit by the industry-university partnership prospective teacher preparation.
8. The industry-university partnership program provides an internship environment for the technical upgrading and updating of graduate students.

A more detailed description of the four years of experimentation and evaluation of the Teacher-Institute concept is provided in the three chapters that follow: Chapter II - Inservice Teacher Preparation, Chapter III - Prospective Teacher Preparation, and Chapter IV - Graduate Research and Leadership Programs.

CHAPTER II

inservice

teacher

preparation

Electronics teacher, Mr. Ben Wood,^(b) picking up his office telephone, heard:

Ben, how would you like to come to Oak Ridge for a three-week teacher training session? You were recommended by your local and the state director and selected by our committee along with about 20 other electronics teachers. We will send you a package of material to study at home and a questionnaire to let us know more of your background, interest, and experience and to provide you with more worthwhile experiences while you are here.^(c) For example, you will have a chance for some actual "hands-on" experience with lasers, logic systems, numerical control machining, radiation monitoring, radiography, ultrasonics, printed circuits, and electronics standards. Your time principally will be scheduled with small groups (4 - 5 teachers) in each technology specialty, to best fulfill your needs as described in the questionnaire. Also, we schedule an extra couple of days for you to concentrate on any technology of your choice.

As the weeks passed, Ben considered the invitation and discussed the teacher inservice program with his local director. Ben's major interest was computer electronics circuitry when he left industry four years ago, but now he realized for his student's sake he needed more "hands-on" experience with recent developments such as printed circuits and lasers.

-
- (b) A former Maine technical school teacher.
(c) A typical questionnaire is presented in Appendix A.

With the doubling of technical knowledge every six to eight years, he thought, there are other gray or foggy areas of electronics about which he and most instructors had not been able to keep currently knowledgeable in their present teaching position. In the study materials from Oak Ridge, he had already discovered a new interest in nondestructive testing. These recently developed procedures obviously could improve quality control in printed and microcircuitry—the latest technology in the fourth-generation electronics. The study materials, too, had already posed several questions and he wrote these down, thinking it would be helpful to discuss these questions with the industrial technicians at Oak Ridge, men who are on the actual firing line of everyday production.



A Time for Growing

As Ben traveled to Oak Ridge, the three weeks away from his family and students in order to attend the Teacher Institute program loomed as a huge block of loneliness for him. However, as he concentrated on the study materials, participated in the laboratory experiences, discussed theories and practical applications with technicians, toured facilities designed to advance the atomic age, became somewhat acquainted with the disadvantaged worker trainees, and chatted with his fellow electronics instructors from other states, Ben realized that his time was efficiently spent, that he was growing, that he was making some real personal progress, and that his teaching was indeed improved and more fun because of his attendance at the Teacher Institute. (Typical schedules are presented in Appendix B.)



Some post-inservice reports to state vocation education directors contained statements like:

There was no question in my mind that I have never been exposed to so much technology over so short a period in my entire life . . . I saturated my capacity. I also know that without . . . "hands-on" involvement I would not have learned and retained as much as I did.^(d)

I . . . obtained a good working knowledge of printed circuit board fabrication and have already started incorporating this process in the classroom here . . .^(e)

The effectiveness of this laboratory experience was felt by each teacher when we saw the PC board emerge as a good workable printed circuit. This effectiveness was further emphasized when it was put to work in the IC amplifier.^(f)

Such thoughts are typical of the Teacher Institute evaluation by the inservice teachers from the 35 states who attended. Each participating teacher was asked to submit an analytical and critical report of the Teacher Institute as a project for inservice training of technical instructors. Each teacher, while participating in the inservice program, was informed that his report would be analyzed and evaluated on the basis of its objectivity to thus improve the overall inservice teacher program (see Appendixes C and D).

(d) A South Dakota state college teacher.

(e) A North Carolina technical institute teacher.

(f) A Virginia community college teacher.

In these reports, the Teacher Institute program was often contrasted with the typical in-house stereotype program in which the instructors only talked about what they were doing and the student never had the opportunity to discuss new techniques with industry technologists nor work in a "hands-on" experience with any new developments in technology.

Inservice Narrows the Gap

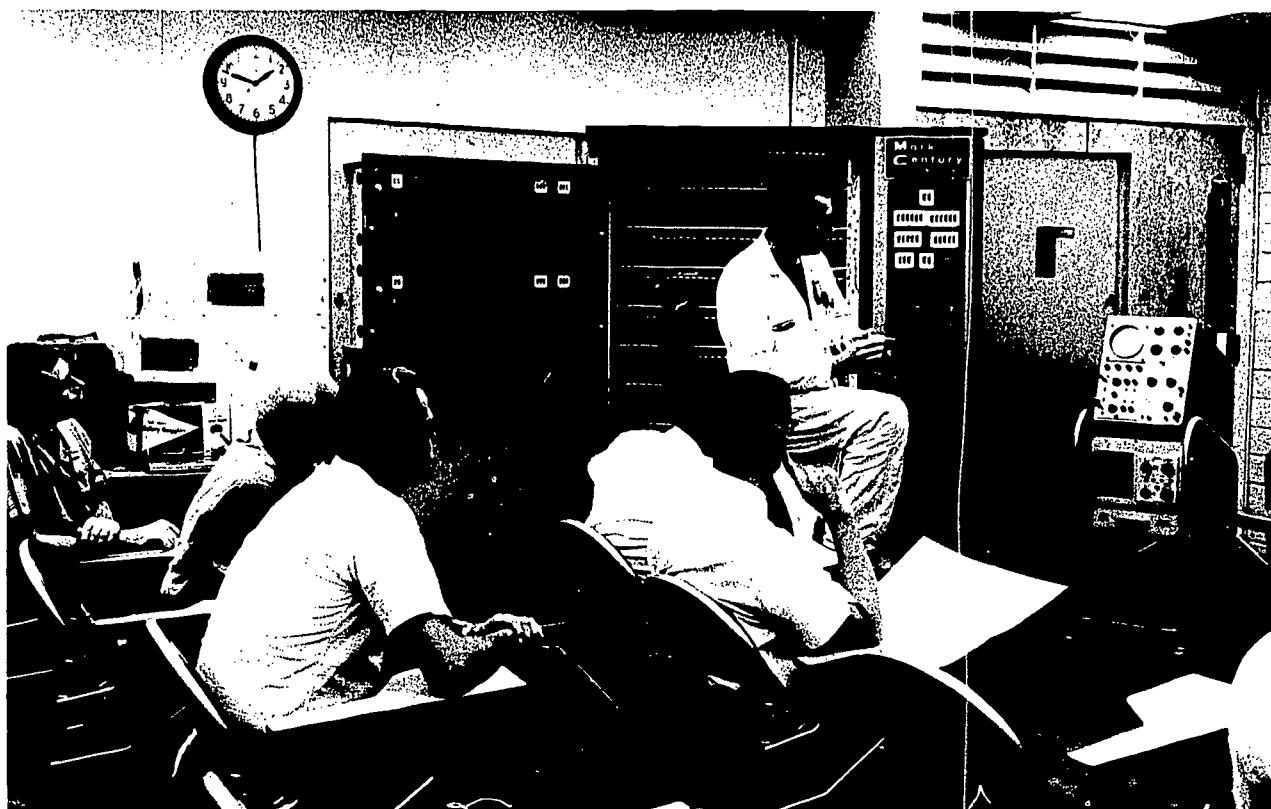
One of the basic concepts of the teaching partnership was an attempt to narrow the gap somewhat between the classroom and modern industry. The 1966 summer inservice program enrolled 60 teachers from the ten southeastern states. Three occupational areas: machine shop, drafting, and electronics each enrolled 20 teachers. The course work was conducted five days a week, eight hours a day for the ten-week program and provided for 12 quarter hours of university undergraduate or graduate credit, as applicable. Each teacher was required to choose two of the five traditional Industrial Education courses that were offered and a technical seminar, while the remaining four hours each day were set aside for lectures, demonstrations, and shop work in their respective technical areas.

The 1967 summer inservice program was conducted for 100 teachers in four technical areas by adding a physical testing-welding program. While the program length was reduced to eight weeks, the Institute offering of traditional Industrial Education course work



and technical or shop seminars and lectures remained much the same.

Both summer programs were evaluated by those participating and by certain nationally recognized professionals. The evaluation indicated that there was a need to: (1) modify the Institute schedule (shorten the time and schedule the program throughout the year), (2) modify the program content to provide an opportunity for more "hands-on" activity in the particular technology during the Oak Ridge activity, and (3) provide a means for determining the teachers' interest and level of experience prior to that activity. Evaluation also signaled the importance of selective recruitment of participants for this innovative program. Local directors or deans of technology were suggested as the most logical individuals to initiate a recommendation. Each state director of vocational education

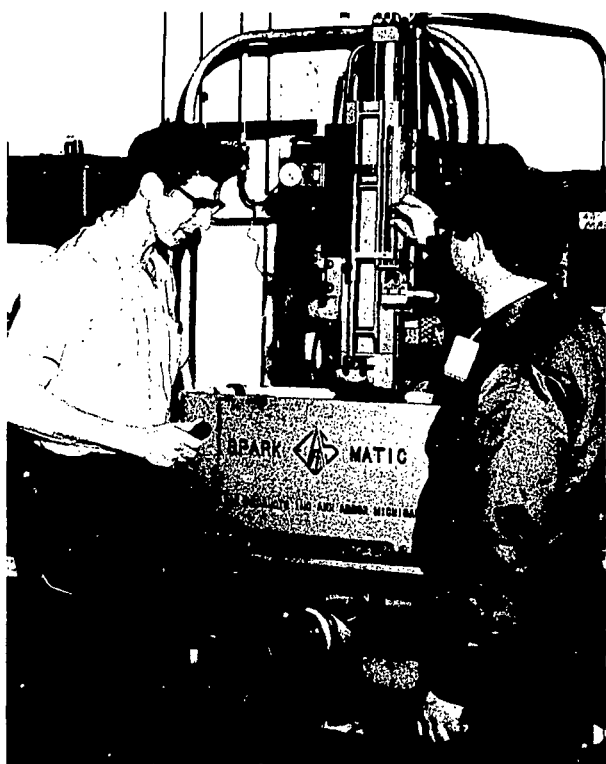


would be asked to recommend to the Institute those teachers in his state who would provide some impetus for bringing the industry-education partnership concept back to the individual state. The inservice teaching partnership thus progressed from a rather general recruitment of vocational practitioners in 1966 to a more restrictive and concept-development selection process in the 1969-70 program.

Home Study and Program Refinement

The first short-term inservice program was held during the Summer Quarter of 1969 with

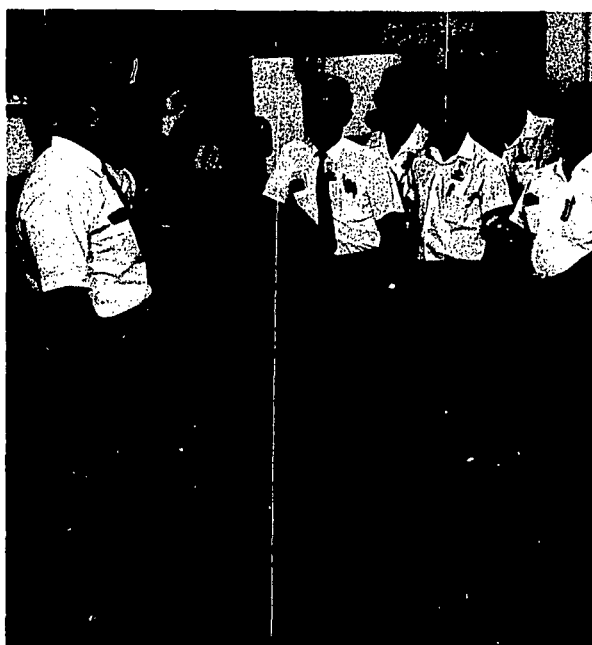
an enrollment of 30 welding and metallurgy teachers from junior colleges, universities, vocational schools, and high schools from 20 states. During each subsequent academic quarter, an inservice program was also held in the field of electronics, drafting, or machining technology. A second electronics program was held during the summer 1970; but, because its home study materials and shortened schedule allowing for only three weeks of activity at Oak Ridge, the program did not provide adequate time for any of the traditional courses. Rather, a daily seminar, conducted for one hour each day, was provided which would involve the teachers actively in a review



of the basic learning theories, development of specific objectives, and new developments in Industrial Education including media, methods, and technical progress. Emphasis was focused on exploration, discussion, and an interchange of ideas among these technical teachers with encouragement from UT faculty members. (For example, video units were used to capture the arc and metal puddle in welding metal.) The seminars have proved to be a focal point for technical instruction by industrial technicians and for laboratory experiences. Each seminar was planned around some activity or involvement of the teachers relative to the particular learning theory or new development, followed by an exploration and discussion of the involvement.

Assist and Strengthen Individual Teachers

The inservice program technical training, in accordance with the evaluation recommendations made earlier, was highly laboratory oriented with maximum "hands-on" involvement of each teacher in a technical experience followed by the thinking and theory aspect of the concept. Projects, long recognized as important in the motivation of all vocational programs, have provided the basic "hands-on" experiences with the industrial laboratory-oriented practices. However, these projects were not the main emphasis for the inservice program; rather, through a written assessment of each teacher's background, experience, and interest, the Teacher Institute designed the "hands-on" experiences to assist and strengthen the individual teacher's technical needs.



(For example, in the Machining Technology Inservice program, each teacher was provided the opportunity of using the common machine lathe, a vertical boring mill, a tracer lathe, and a point-to-point computer numerical control lathe, and thus fabricate a beautiful desk piece and pencil holder from a solid aluminum alloy.) In addition, time was scheduled for electrodischarge machining (EDM), precision tool grinding, and numerous other remedial, updating-type activities as needed and selected by the individual teacher.

Informal Microteaching of the Disadvantaged

Also, during these laboratory experiences, the inservice teacher was in close personal contact and observed the nearly 200 Appalachian disadvantaged worker trainees at the Oak Ridge TAT Project. Sharing identical machines, laboratory equipment, and classrooms helped establish a more meaningful rapport and human understanding between teacher and student. There were manifold opportunities for an informal microteaching situation between the inservice teachers and worker trainees. These brief instructional teaching-learning encounters were recognized as an exemplary function of the human resource development of the teaching partnership.

Several industrial tours were arranged during after hours or on Saturdays to provide more scheduled time in the technology during the week. Typical tours that were arranged included visits to a cyclotron, a graphite

atomic pile, a molten salt atomic reactor, a high-density isotope reactor, the thermoplasma laboratory, the ORGDP Computer Center, the Knoxville Area Vocational School, and a TVA steam-electric plant.

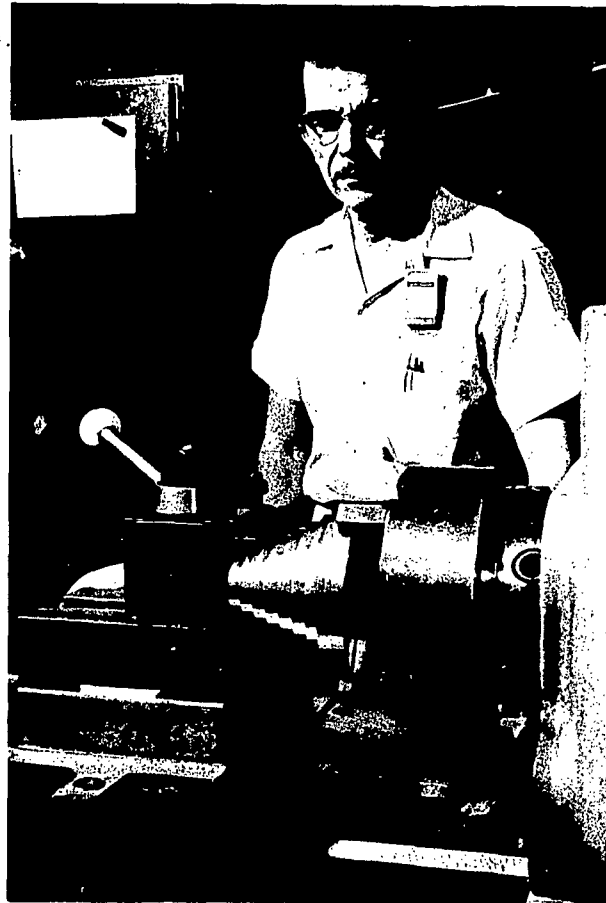
In the many opportunities for exchange of ideas among the teachers of the inservice program, the following was an actual and typical experience:

A teacher from Vermont, in casual conversation with a teacher from New Jersey, expresses a particular interest in electrodischarge machining (EDM), but does not contemplate receiving a



school budget that will permit purchasing the equipment in the near future. The teacher from New Jersey also has no EDM facility but knows a teacher from Delaware (who is not even attending the inservice program) who has built a working model EDM apparatus at a very low cost in his shop. A letter from "Mr. New Jersey" to "Mr. Delaware" soon places the teacher from Vermont in the EDM business that spread the interchange idea (in both time and distance).

In summary, the inservice program brought the teacher in touch with some of the vital developments in his field of technology and provided an opportunity for him to associate with other teachers with similar problems. It also offered him an opportunity to be realistically involved in some new learning experiences and their application to technical teaching.



CHAPTER III

prospective

teacher

preparation

With the nationwide emphasis on vocational education, recruiting and training of qualified teachers is a cause of increasing concern. With the rapid expansion of vocational technical schools and public junior colleges, and the growing number of occupational specialties, many more teachers must be found with appropriate industrial experience. Also, the expanded effort of engineering-related fields at the associate-degree level has led to a serious under supply of teachers for technical programs.^(g)

Historically, trade and industrial teachers have come from the ranks of journeymen who usually have at least three years of work experience beyond the learning period (apprenticeship). Traditionally, these vocational teachers began teaching but a few days after leaving industrial employment and without formal training. In an attempt to break this tradition and to provide a pool of resource persons trained and experienced in industry as prospective teachers, the Teacher Institute program was initiated in 1966 as a component of the Training and Technology project. The experience gained in the first two years of operation of the Institute revealed a number of possible approaches to the complex problem of recruiting and training qualified persons in the area of vocational and technical teaching.

(g) Cheney, J. M.; "Teacher Education for Post-Secondary Programs", *American Vocational Association Journal*, p 26; March 1970.

Recruitment

Although a goal of 30 full-time day students was set for the first year of the academic program at the Institute, only seven were recruited. The second year of the program proved to be somewhat more successful with the recruitment of 23 recently retired or discharged military personnel. Emphasis was placed upon military veterans since there was a regular supply who were generally seeking new careers. Also, GI benefits and/or retirement pay was available to them for financial assistance and many had acquired substantial technical skills while in service to qualify them for vocational teaching. Some of the professional preparation classes were offered after normal industrial working hours at the Teacher Institute during the second year of this operation, thus providing encouragement to the industry-employed person at Carbide. Throughout the present program, candidates for the prospective teacher program were recruited from various sources: the armed forces, industry, other university departments, and technical institutes. Data that have been compiled during the four years of operation at the Teacher Institute indicate a high probability of vocational-technical teacher success of mature military veterans and retirees who have had one or more years of college credit and a strong background in vocational or technical experience. Although individuals with industrial experience have proved to be successful as teachers, they have been difficult to recruit because of salary level differences, pen-

sion rights of industrial workers, and a lack of fully developed recruitment knowledge and procedures. The present research program at the Teacher Institute has made some extensive efforts to develop successful recruitment procedures for industry-employed prospective vocational-technical teachers.

In the past two years, enrollment growth in the prospective teacher program at the one major industrial plant (AEC's Y-12 Plant) has been encouraging and the potential is even more promising. The initial 1966-67 program had seven participants, the June 1968 enrollment was 23, and by June 1970 it had increased to 77 through recruitment of both industrial workers and retired military personnel. Figure 3 indicates the progress of this growth in the Teacher Institute. Stipend funds under the EPDA grant supported only 13 participants, yet 25 individuals who were not employed at the industrial plant were recruited for the program (maximum allowable by contract). Fifty-two prospective teachers were recruited from Union Carbide employees

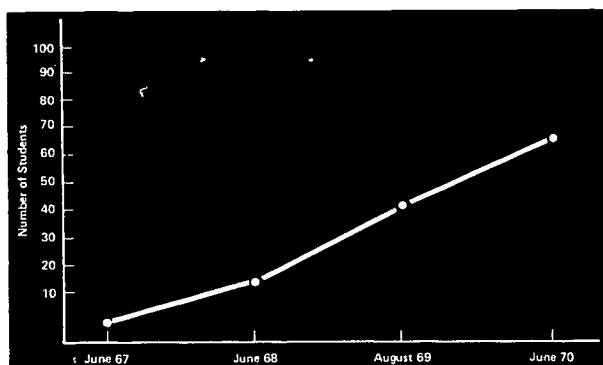


Figure 3. TEACHER INSTITUTE ENROLLMENT LEVELS.

taking courses during their nonworking hours. It is apparent that stipend money provided under the present grant has acted as a catalyst to the prospective teacher program in terms of veterans and retired military persons. It may be noted that although stipend funds occupy a substantial portion of the total budget, the average cost per participant has decreased from \$4,093 per academic year (9 months) in the first year to \$606 in the 1970 academic year (see Figure 4). As noted earlier, the sizable pool of prospective teachers from a single industry is largely responsible for this reduction in average cost per participant. The

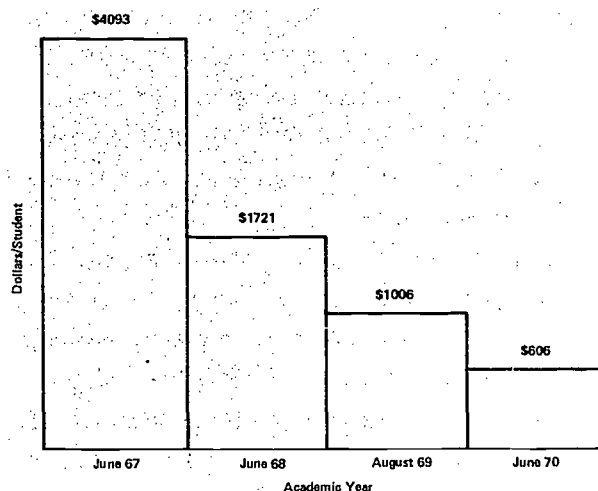


Figure 4. FEDERAL COST PER PARTICIPANT PER ACADEMIC YEAR (9 MONTHS) AT THE TEACHER INSTITUTE.

industry-university partnership developed at the AEC site, beginning with Union Carbide Corporation (UCC) technologists who were assigned to teaching positions, has encouraged other industry employees to enroll in the UT courses. As with many industries, it is the

policy of Union Carbide Corporation to encourage employees to continue their education, and partial cost is reimbursable. There has been no publicity campaign to procure industrial enrollment during the research phase of the program. Through a personal (man-to-man) basis, each individual was encouraged to give the Teacher Institute a try. The Teacher Institute has enabled a number of employees to take college-level courses while simultaneously increasing their technical skills—an overall benefit to both the employee and the corporation. During the first biennium program, prospective teachers had little involvement with the University's Knoxville Campus. The prospective teachers were told that in order to meet the degree requirements they must attend the Knoxville Campus after completing the Teacher Institute program. The present program has emphasized the need for enrollment for on-campus courses along with enrollment at Oak Ridge. Many classes have been offered at the plant site after 4:30 pm



which were not previously available to industrial workers. The Teacher Institute thus provides a coordinating function between UT and the prospective teacher, thus encouraging him by making the necessary arrangements to complete his degree requirements. For example, two industrial workers lacked only a few courses and their directed-teaching requirement to complete their degree in education. Through the TAT project, arrangements were made for these two participants to perform their directed teaching during off-working hours under the supervision of Teacher Institute personnel.

Industry Participation

In July 1970, a questionnaire survey was made of the Y-12 Plant employees who were presently enrolled at the Teacher Institute. All of the respondents said that they had used the program to increase their technical training and indicated that the Institute training had both aided them in their present job and helped them in preparing for a better job. All also stated that the Institute had made it easy for them to take UT courses while 73 percent said they would not have taken the courses without the Institute program. Nearly 90 percent of these industrial employees began courses at the Teacher Institute during the present biennium program (63% enrolled in 1969-70; 26% in 1968-69). In this questionnaire, the employees listed degree goals as follows: 72 percent for the bachelor degree, 24 percent for the master degree, and 4 percent for a doctorate degree. A copy of the

questionnaire and a table of its results are included as Appendix E.

Technology Courses Development

The Teacher Institute program allows candidates to exit at several levels in the career ladder to begin their teaching (see Figure 2). During their teaching careers they are encouraged to return to school through inservice and extension training and increase their teaching skills to advance through the career ladder framework. An experienced journeyman, for example, may separate from the Teacher Institute after one academic year of residence to become a certificated T&I instructor at the high school level or some area vocational schools. On the other extreme, several



military retirees have completed both a BS and an MS degree in about two years at the Teacher Institute.

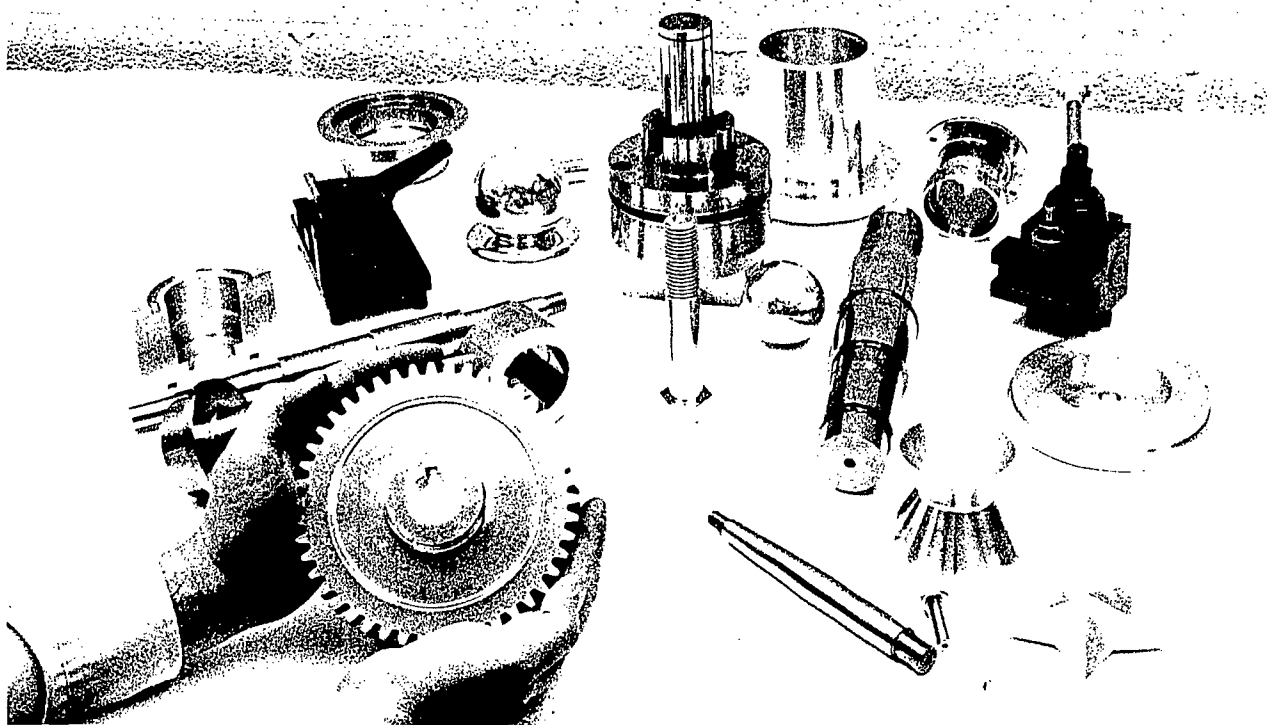
From such a diverse clientele, varying from minimum university admittance to graduate

level and leadership internship study, the need for an organized yet flexible program was recognized. To provide for the in-depth technology training of these prospective teachers, sequences of courses were outlined to cover the five areas of technology at the Institute.

The Department of Industrial Education in 1967 submitted a proposal to The University of Tennessee undergraduate committee for the addition of 39 separate courses in technology in five areas, namely: physical testing, welding, electronics, drafting, and machining. These courses received official University approval, as recommended by the Department, and subsequently were listed in the official University catalog for undergraduate credit.

The prospective teacher was placed within the sequence at his level of knowledge and working experience. Prospective vocational-technical teachers were required to complete both a major and a minor field and to be competent teachers in both areas. During the past two years at the Teacher Institute, a concentrated effort has been placed upon defining the specific technology content and the anticipated behavioral objectives of each of these courses. One typical sequence with the revised descriptions is:

CATALOG NUMBER	COURSE DESCRIPTION
Original	
4040-41-42	Physical Testing Inspection
4043-44-45	Technical Physical Testing
4040	Physical Testing Metallography
Revised	
4041-42	Physical Testing Ultrasonics I, II
4043-44	Physical Testing Radiography I, II



Samples of some of the proposed and revised course syllabi are presented in Appendix F. A total compilation of these course offerings in terms of a syllabus alone would amount to nearly 200 pages and, therefore, was beyond the scope of this report. University personnel working closely with the industrial technology instructors (UCC management personnel) have reached approximately the half way mark for specific objective evaluation of each of these 39 courses. While curriculum construction from the analysis of the job component is historically typical in vocational education, a breakdown into specific objectives of behavioral patterns is a rather recent

development.^(h) It is believed by more progressive educators that the measurable behavioral objectives are more precise in evaluating the learning situation, the direction taken by the Teacher Institute in technical course development.

(h) Barlow, Melvin; *Developing Behavioral Objectives for Vocational Education*; UCLA Press; June 1969.

Developing Technology Resources

Offering these technology courses on a continuing basis is predicated upon a continuation of a Teacher Institute (industry-university partnership program) in as much as appropriate technology laboratory facilities are not available to the UT Department of Industrial Education on the Knoxville Campus. Conversely, it may be anticipated that upon expansion of the Industrial Education partnership concept to other industry in this geographical area, a necessity would exist for the addition of more technology courses to the Department's curriculum. With the expansion of the knowledge of technology purportedly doubling each six to eight years, it is also recognized that new technology can be expected to develop in the future which would replace the need for certain technology courses offered in the present curriculum.

In view of the University commitment to community service, it may appear valid to offer industrial technology curricula in cooperation with the Colleges of Engineering and Education.

Medical technology furnishes another broad area of technical education that might be developed between the College of Education, the School of Health, Physical Education, and Recreation, and the appropriate departments in the Biological Sciences in involving the University and hospitals and related industries in the area. The key to developing such a program is that the groups who are directly



involved must cooperate and coordinate their activities similar to that implemented and demonstrated by the Teacher Institute program as an industry-university partnership. Such programs not only would assist in training some necessary technology personnel to business and industry, but would also provide a nucleus of technical teachers. Rather than accepting the first technically experienced person who applies for a teaching position, the school administrator would have an alternative of interviewing a number of those technologists already prepared for technical-teaching from a resource pool.

CHAPTER IV

the
graduate
fellowship
program

The Graduate Fellowship program is described separately in this report since it was funded by a separate grant under authority of Public Law 89-329, Title VC. The program was administered by The University of Tennessee, Department of Industrial Education, to attract and prepare vocational-technical teachers by offering graduate study leading to an advanced degree other than the doctorate. The program was offered through the combined efforts and facilities of The University of Tennessee, the Atomic Energy Commission's equipment, and Union Carbide Corporation's technical personnel as instructors in the electronics laboratories. The internship experience involving intensive technical training in electronics took place in the modern AEC shops for one or more academic quarters. The industrial know how in electronics was made available to these graduate students through consultation during their research internship at Oak Ridge.

The total program, in design and concept, was based upon the development of the two-year experimental Training and Technology project supported by the Bureau of Research (Grant BR 6-2329). While prospective teachers had been trained during this earlier research project, graduate study, as such, had been given only minor emphasis.

The major objectives of the graduate program were as follows:

1. To provide prospective technical teachers with experience in contemporary indus-

trial development and technology in electronics.

2. To provide a series of educational experiences leading to the MS degree in Industrial Education.
3. To increase the supply of qualified professional teachers in electronics.

The scope of the program was limited to those applicants who professed an intention to teach electronics, who were somewhat experienced in the field, and yet had no previous formal teaching experience in electronics. The academic background and work experience of each participant was evaluated against the content of the program, and his course of study for the degree goal was developed in accordance with the individual needs. The graduate program was, therefore, highly individualized for each participant in order to augment his individual competence in the field of electronics and simultaneously broaden his experience background as a prospective teacher.

The Graduate Fellowship program began in September 1968 with four retired military personnel with no prior teaching experience in attendance. These recruits, however, had completed a BS degree requirement in Industrial Education through the Teacher Institute. In pairs, the graduate students were scheduled for one or more academic quarters of internship at the Teacher Institute in order to strengthen their technical knowledge

and experience and to develop an electronics model as a learning medium. The research projects were developed as an Industrial Education "problem in lieu of thesis" for graduate-level credit toward the master of science degree. During the quarter of research at Oak Ridge, while developing the project, the graduate students held a bi-weekly seminar with the Director of the Teacher Institute. The selection of the project, which was designed to update and upgrade the student's technology major, was determined by a project committee composed of both University and industry members. The secondary objective of the project was to provide some new classroom learning media or training aids for the teaching of electronics.

The Research Projects

Three learning devices were completed as research projects under the Graduate Fellowship program during the course of the two-year fellowship grant. The project committee approved as a first project the construction of a computer simulator that would serve as a classroom training device for the teaching of computer logic, operation, and programming. The computer project was designed and constructed at the Y-12 Plant facility with the materials and technical assistance furnished or made available by Union Carbide, and subsequently reimbursed by the grant funds. For technical assistance, the graduate students were permitted to consult on an informal yet scheduled basis with plant electronics engineers and technicians as well as through frequent

seminars with the Institute Director. Invaluable technical assistance was rendered by members of the Y-12 Plant Electronics Department and was acknowledged by the two graduate fellows in their report. Making use of some already constructed printed circuit boards with components and other salvaged parts and supplies, a training device estimated at approximately \$1,500 in value was fabricated for less than \$200. The technical report included a guide to instructors using the training device for a few simple computer demonstrations. Some of the techniques suggested were the teaching of Boolean algebra and basic maintenance of the necessary computer programming technology. The project report consisted of some 200 pages which included individual circuit diagrams, descriptions, and explanations of the component as well as the response pattern of switching and circuit tie ends. The writers also made provisions for noting any modifications of the unit as well as a maintenance history of the training device. At the midpoint in the



research experience it became evident to the graduate students that it was going to be necessary to design and construct a special power supply to furnish the appropriate voltages required. This need provided a new depth to the design and fabrication problems to be surmounted by the graduate students. One unique characteristic of the project was the operator's panel which utilized the direct application of a simulated printed circuit design rather than symbols. For training electronic technicians in computer maintenance, this design feature appears to have an invaluable memory recall.

The computer simulator provided not only an in-depth technology experience for these two graduate students but also learning experiences for dozens of MDT trainees and those electronics prospective teachers at the Teacher Institute in the past two years.

The second project under the Graduate Fellowship program was entitled a "transistor characteristics curve demonstrator". The primary purpose of this project was to design, construct, and evaluate a circuit system which could be used in a classroom laboratory demonstration of the static characteristics of bipolar transistors. It is generally recognized that the conventional method of meter reading and plotting is slow and provides no immediate feedback to the student. The simpler curve-trace method presents a visual image and requires no involvement by the student. Combining the desirable features of both into a single unit, therefore, offers

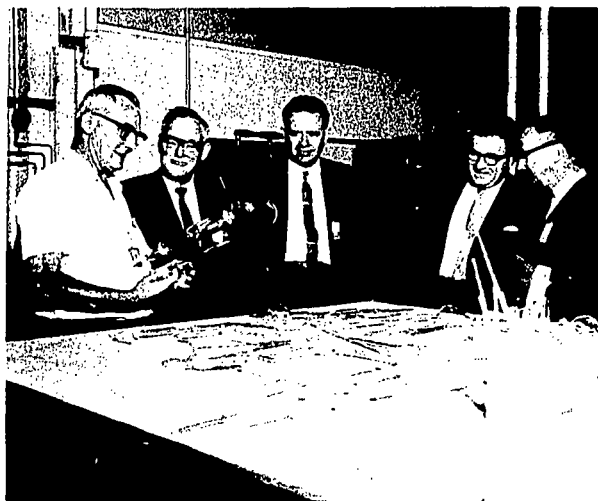
numerous learning advantages. The research demonstrator developed by the two graduate students is designed to incorporate both manual plotting and oscilloscope display, making the unit practical for everyday use in the classroom with almost any type of oscilloscope. A manual describing and depicting the design and operating characteristics of the transistor demonstrator was submitted by the graduate students at the conclusion of their full quarter of research internship. The function and practicality of the demonstrator have been demonstrated by its use in training both the MDT and prospective electronics teachers.

The third research project was the design and fabrication of a video camera remote control. An electronic remote control for the video camera is not manufactured commercially at this time. There are several mechanical and/or hydraulic systems which have been utilized both in the communications and electronics industry. Development of this project by the two graduate students in the Fellowship Program during the second year required more than two full academic quarters of research and experimentation. Commercial applications of electromechanical circuitry had not been made to video cameras at the Y-12 Plant. Accordingly, the graduate students soon discovered that the University Electrical Engineering Department faculty and the Engineering Library provided other necessary resources. Combination of the University theory of electromechanical devices plus

the practical technology of Y-12 personnel provided an excellent combination resource for this research project. The remote control has already demonstrated its validity in use as a monitor for the microteaching involvement of the prospective teachers at the Teacher Institute. Because of the uniqueness of these research projects, the Union Carbide Corporation-Nuclear Division Patent Section has made the appropriate records of names, dates, and details of the design and fabrication.

While these three major research projects served as a focal point for the Graduate Leadership program and the technical updating and upgrading of industrial instructors, it should be pointed out that dozens of minor projects became evident through the industrial environment in the program. One other graduate student in the program during the past year, for example, has completed a noteworthy thesis study of an industrial work-measurement incentive plan. The study was based upon a specific evaluation of one lock manufacturing plant and was coordinated with the management questionnaire survey of 100 other industrial plants within the State of Tennessee. The opportunity for further thesis studies and research development projects appears to be almost innumerable.

The future of the Graduate Leadership program in terms of need, particularly in Tennessee and the surrounding states with

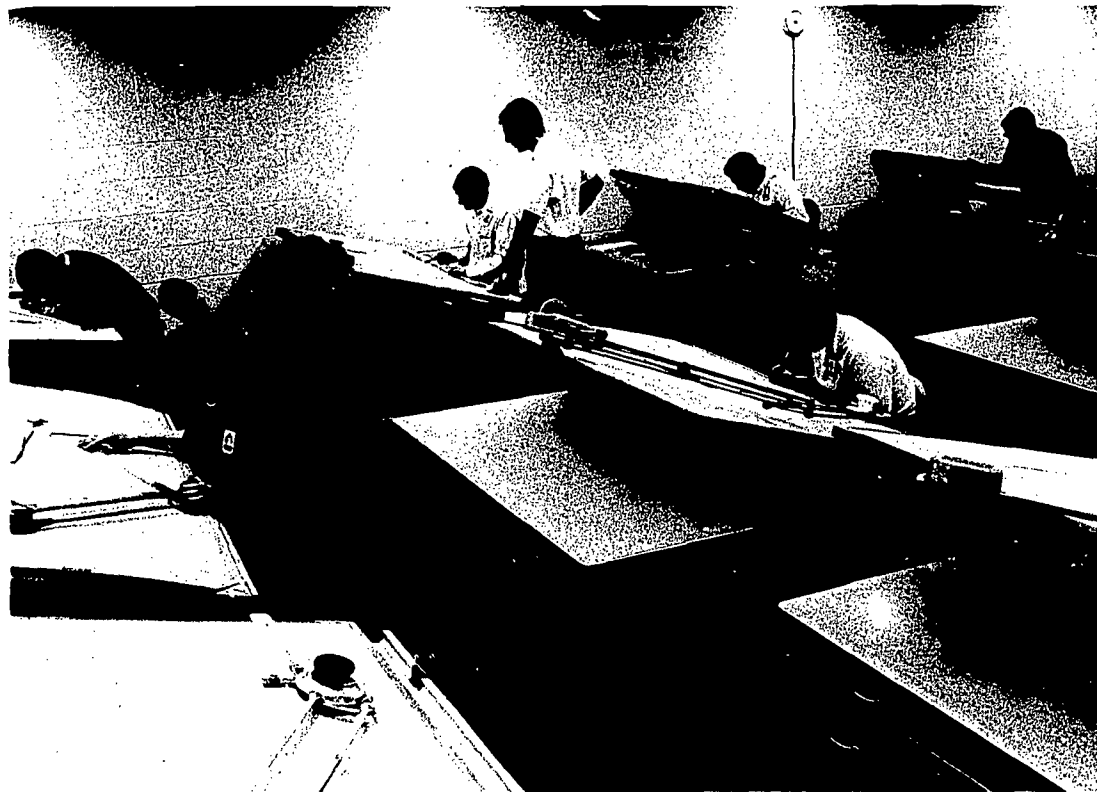


new emphasis being placed on the public junior college and other post-secondary institutions involved in technical and vocational education, is one of growth and progress. There is a demand for expansion of the industry-university concept to other industry that is perhaps somewhat less specialized than that of Union Carbide's Y-12 Plant in the areas of technology. Included



in these possible areas are the metal fabrication, electronics, chemical, and textile manufacturing industries, to mention a few. With the advent of the educational specialists degree and the doctoral-level program in occupational education approved at the University, the need for a diversified internship graduate leadership type program is self evident. Discussions between State Department of Education, University, and industry personnel have indicated the desirability also of possible internship programs with the public junior colleges and technical vocational schools of the area. Beginning with a history of internship in the medical profession in the

late nineteenth century, professional training in education has come to recognize the internship program as a vital training component at the doctoral level. In deference to the indications of a surplus of academic teachers, vocational and technical education is in critical need of teachers and technical administrators. With the spiraling cost increase of facilities and equipment for training vocational-technical teachers it is reasonable to expect that the industry-education partnership concept is one means of alleviating the problem through the education of realistic pools of trained and technically experienced vocational-technical teachers.



CHAPTER V

conclusions

and

recommendations

In a study of North Carolina employers, reported in June 1969 by Fox, the following recommendations were made:

1. Vocational educators need to cooperate with industry in its training of skilled manpower.
2. Vocational education must provide for more information to business and industry regarding their purposes and programs.⁽ⁱ⁾

The Teacher Institute has demonstrated that a valuable partnership can be formed between industry and education by utilizing such resources as industrial laboratories and equipment, industrial technology instructors (engineers, technicians, journeymen), and University and State Department of Education personnel. This Teacher Institute program combined the resources of a major industry (Union Carbide Corporation) with the teacher training competencies of The University of Tennessee at an Atomic Energy Commission Plant. The industry-university partnership offers not only a unique opportunity for technology instruction and use of atomic-age laboratory equipment and machinery, but also demonstrates at least six additional unique factors which contribute to the production of quality vocational-technical teachers. These unique features are discussed in the paragraphs that follow.

(i) Fox, Alen B.; In *The Open Door*, p 21; Raleigh, North Carolina; Summer 1969.

Perhaps the most important contributing factor, human relations development, was brought about by a mingling and close association between the disadvantaged Appalachian personnel in the Training and Technology worker MDT program and the prospective and inservice teachers. This close association demonstrated the "who" involvement in vocational education as expounded by the Vocational Amendments Act of 1968. Sharing identical machines, laboratory equipment, and classrooms between the prospective teachers and the disadvantaged was instrumental in establishing the rapport that is necessary and important in developing an understanding of the disadvantaged. The TAT worker-training personnel, consisting of 42 percent nonwhite, 64 percent high school dropouts, and some physically handicapped persons, are successfully learning to develop the basic skills required for job entry in an industrial technology. Prospective teachers learned to know and work with them.

A second factor, that of microteaching on an informal basis, is an additional enrichment experience for the prospective teacher. Here, he has manifold opportunities to present himself as a "big brother" in an attempt to demonstrate or explain some facet of the technology process or procedure. This natural recurring opportunity is the ultimate in microteaching. Future plans for the development of the Teacher Institute program call for a remote control video tape recording unit (as developed by the graduate fellowship program) to be

utilized to help the candidate teacher to evaluate his microteaching situation with the advice, if desirable, of a teacher educator.

The third unique feature of the Teacher Institute program is the University's evaluation of prior training in a particular technology or course area. Although military technical training has been evaluated by many universities in recent years, according to the *USOE Standard Bulletin*, industrial experiences as such, traditionally, has not been awarded due credit, probably because of the lack of appropriate evaluation. The University of Tennessee has offered occupational proficiency examinations through the Department of Industrial Education which provide for academic credit up to 27 quarter hours to be applied toward a BS degree in Industrial Education. These examinations consist of three parts: (1) paper and pencil tests, (2) laboratory proficiency tests, and (3) tests covering related information (ie, science and mathematics). Through the Teacher Institute, new proficiency examinations have been developed in technical areas not before considered, namely: drafting, electronics, metallurgy (or physical testing), and environmental science. The proficiency examination is an integral part of the overall University policy to recognize individual learning whether in a classroom or not. The UT catalog states:

In the Colleges of Liberal Arts, Engineering, Architecture, Education, and Home Economics the proficiency examination may be given to qualify students in any academic course offered

in the University on the recommendation of the Head of the Department and the payment of a \$10 fee.^(j)

Credit by examination, then, may be offered upon application and qualification in any established course on record within the University's curriculum.

A fourth factor of uniqueness is that of providing special problems for individual study at the industry installation. Library research and industrial or laboratory technical research, or a combination of these two, again provide many opportunities for professional and personal progress in an area of industrial technology chosen by the prospective teacher. Each participant is encouraged to develop his best knowledge and experience by enrolling in special problems courses.

The fifth factor, that of providing developmental or remedial instruction, is offered as a two-barrel opportunity at the Teacher Institute. Those services and courses offered by the University in conjunction with the Speech and Hearing Clinic and the English Department are supplemented at the Training and Technology project by testing and professional counseling; programmed instruction in reading, spelling, mathematics, and science; and special tutors who are available to the prospective teacher to improve his foundation in

(j) *The University of Tennessee Record*, p 29, (1969-70)

deficient areas prior to his involvement in traditionally university academic courses.

The antithesis to the remedial concept—that of offering to the exceptionally bright or experienced prospective teacher more than the usual challenge in either the academic or technology area—is the sixth factor of uniqueness. At the Institute, for example, a student may register for a sequence of two technology courses at one time; and, upon completion of one or more during the academic quarter, he would thus be assigned a grade. The exceptional student may complete at the end of two quarters from one to perhaps four technical courses in a sequence, depending upon his Individual ability. For those courses not completed, the student receives an incomplete (I) grade to be changed during the next quarter.

Continuing Program Recommendations

The industry-university partnership is a unique concept for the development of technical teacher programs, as demonstrated by the Teacher Institute at the Y-12 Plant. In four years the program has demonstrated its validity as a research development program in technical teacher education. A highly diversified Atomic Energy Commission facility has provided excellent laboratory equipment and machines for the training of drafting, electronics, machining, and welding-metallurgy teachers. To train technical teachers for the vast variety of curricula offered by the area

vocational schools, the public junior colleges, and the technical institutes of the state and area requires a movement of this program to involve multiple industry. There is a need to develop a teacher training program for the various engineering technologies, health related technology, civic or government technology, and chemicals and metallurgical technologies, to mention a few. Business and distributive education partnership programs may also be desirable to develop.

The personal involvement of industrially employed personnel at the Teacher Institute has demonstrated a unique model of recruitment for vocational-technical teachers. Further enrollment of employed personnel from several industrial plants can update and upgrade the personnel in their industrial technology specialties and, at the same time, prepare them as a prospective pool of resource material for vocational-technical education. The University, since its inception, has devoted itself to the service of the community (the entire State of Tennessee); and, by providing faculty and facilities for the updating and upgrading of industrial technology on the job and developing a resource of education people for the other state institutions, will be performing an invaluable service to the state. Expansion of the industry-university partnership to other participating industries should provide a means of further refining the recruitment of vocational-technical teachers. Universities and colleges throughout the State and region should be contacted as a source of prospective

teachers in need of special experiences offered through the industry-university partnership. Interuniversity agreements can be negotiated to permit the students to gain experience for a portion of their normal academic year. Such a continuing program would offer experiences unique to the advanced graduate student in terms of an industry-university partnership internship by developing and sharpening his tools of research and for direction under the guidance of a capable administrator.

The present prospective teacher curriculum, in an emerging development state, is currently directed at five levels of vocational-technical teaching activity. These five levels provide a career-ladder approach to the full professionalization of the industrial and technical educator (see Figure 2, Page 5). The present curriculum should continue to be evaluated, revised, and refined following the recommendation of an advisory committee representing the various technologies in industry and educators from at least three levels of education—secondary, postsecondary, and higher. Particular attention should be paid to the evaluation of individual courses, and the relevancy and need within the total program to develop both the teaching credentials and technology experience required of the particular vocational-technical teacher. The present mathematics requirement (one quarter) for a degree in Industrial Education is minimal for trade teaching and completely inadequate for the technical teacher. Technical teachers in the engineering technology, in particular,

require extensive basic science requirements above and beyond those provided for in the present curriculum. Curriculum flexibility is of utmost importance in defining the program requirements to comply with the technology. Flexibility is also a requirement for identifying and assimilating the new technology fields as they emerge. Training electronic data processing and chemical technology teachers is an example of such new evolving technology.

As Professor Cheney of the New York State University has so aptly said:

It has been suggested that our ability as a nation to solve our environmental and social problems—such as air and water pollution, diminishing natural resources, crime, and hunger—will be determined by our educational capacity to supply a sufficient number of trained technicians and subprofessionals. Inherent in this challenge is the problem of producing a corps of qualified technical teachers.

Because of rapid advances and changes in technology, and the resulting greater sophistication required of the technician, it appears that broader education of a pretechnical nature will be required at the secondary level and that more students must pursue technical education in postsecondary programs.

Because the objectives of technical education are pegged to a higher level and because of the "differentness" of the students, the pedagogical competencies required of the technical teacher vary considerably from those required of other vocational teachers.^(k)

(k) *American Vocational Journal*, p 27; March 1970.

Following is a specific program that is proposed for a technical-teacher education program, for the typical university that is contemplating the formation of an industry-university partnership:

A PROPOSED TECHNICAL-TEACHER EDUCATION PROGRAM

BS Degree in Technical- Teacher Education	Quarter Hours
General Studies (English and Speech, Humanities, and the Social Sciences)	36
Mathematics and Laboratory Sciences	27
Technology Specialization (course selection made on the basis of the student's occupational and education background and the particular technology he is planning to teach)	60
Occupational Internship (employment selected appropriate to his chosen technology)	12
Professional or Career Preparation	24
Principles of Technical Education	3
Theory of Learning	3
Occupational Analysis	3
Course Development	3
Instructional Media	3
Evaluation Techniques	3
Teaching Internship	6
Electives	<u>32</u>
	191

representative

inservice

machining

program

appendix a

NAME _____

TEACHER INSTITUTE
MACHINING INSERVICE PROGRAM
February 9-27, 1970

EQUIPMENT	NO KNOWLEDGE OR EXPERIENCE	SLIGHT KNOWLEDGE	THOROUGHLY FAMILIAR AND YRS. EXP.	WANT ADDITIONAL TRAINING
ENGINE LATH				
DUPLICATOR LATH				
VERT. TUR. LATH				
HORZ. MILL				
VERT. MILL				
HORZ. BORING MILL				
SHAPER				
BAND SAW				
SURFACE GRINDER				
CYLINDRICAL GRIND.				
TOOL & CUTTER GRINDING				
ELECTRO DISCHARGE MACH.				
N. C. JIG BORE				
N. C. TURNING MACHINE				
DIMENSIONAL INSPECTION				
METALLURGY				
COMPUTER PROGRAMMING				

typical

program

schedules

appendix b

WELDING METALLURGY INSERVICE PROGRAM

TIME	MON. 7/14	TUE. 7/15	WED. 7/16	THU. 7/17	FRI. 7/18	SAT. 7/19
8:00 - 11:00	Orientation	Radiography	Ultrasonics	Mechanical Prop.	Magnetic Dye Penetrant	
11:00 - 12:00	Lunch	Lunch	Lunch	Lunch	Lunch	
12:00 - 3:00	Welding Intro	Lab. Practice	Welding Lecture	Lab. Practice	Welding Lecture	
3:00 - 4:00	Tour Labs.	Seminar	Seminar	Seminar	Seminar	
	MON. 7/21	TUE. 7/22	WED. 7/23	THU. 7/24	FRI. 7/25	SAT. 7/26
8:00 - 11:00	Radiography	Ultrasonics	Mechanical Properties	Metallography	Magnetic Dye Penetrant	
11:00 - 12:00	Lunch	Lunch	Lunch	Lunch	Lunch	
12:00 - 3:00	Welding Lecture	Lab. Practice	Welding Lecture	Lab Practice	Welding Lecture	
3:00 - 4:00	Seminar	Seminar	Seminar	Seminar	Seminar	
	MON. 7/28	TUE. 7/29	WED. 7/30	THU. 7/31	FRI. 8/1	
8:00 - 11:00	Radiography	Ultrasonics	Mechanical Prop.	Metallography	Metallurgy Proficiency Exam	
11:00 - 12:00	Lunch	Lunch	Lunch	Lunch	Seminar and Check Out	
12:00 - 3:00	Welding Lecture	Lab. Practice	Welding Lecture	Welding Tech. Test		
3:00 - 4:00	Seminar	Seminar	Seminar	Seminar		

ELECTRONICS INSERVICE PROGRAM

TIME	MON. 11/3	TUE. 11/4	WED. 11/5	THU. 11/6	FRI. 11/7	SAT. 11/8
8:30 - 11:30	Orientation	Ind. Alarms	X-Ray	Thermocouples and Recorders	Tour 9201-2	
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	
12:30 - 3:00	Tour Museum	Tour 9737	X-Ray Monitor	Lasers	X-10 Reactor	
3:00 - 4:00	Seminar	Seminar	Seminar	Seminar	Seminar	
	MON. 11/10	TUE. 11/11	WED. 11/12	THU. 11/13	FRI. 11/14	SAT. 11/15
8:30 - 11:30	Leak Detector	Integrated Cir.	Tour Bull Run	Logic	Numerical Control	
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	
12:30 - 3:00	Leak Detector	Integrated Cir.	Printed Circuit	P.C., Logic, Sc.	P.C., Logic, X-Ray	
3:00 - 4:00	Seminar	Seminar	Seminar	Seminar	Seminar	
	MON. 11/17	TUE. 11/18	WED. 11/19	THU. 11/20	FRI. 11/21	
8:30 - 11:30	Numerical Control	Computers	Standard Lab.	Tour K-25	GRADUATE	
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch		
12:30 - 3:00	Numerical Control	Computers	Standard Lab.	Examination		
3:00 - 4:00	Seminar	Seminar	Seminar	Seminar		

MACHINING TECHNOLOGY INSERVICE PROGRAM

TIME	MON. 2/9	TUE. 2/10	WED. 2/11	THU. 2/12	FRI. 2/13	SAT. 2/14
8:30 -- 9:30	UT Orientation	E. Gate 9:00 A M	UT Seminar	UT Seminar	UT Seminar	
9:30 -- 11:30	UT Orientation	X-10 Graphite T	Slo Syst Exhibit	Machine Inst	Machine Inst	
11:30 -- 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	
12:30 -- 4:15	Orientation to Shop Program	General Shop	General Shop	Machine Inst	Machine Inst	
4:15				AEC Museum Tour		
	MON. 2/16	TUE. 2/17	WED. 2/18	THU. 2/19	FRI. 2/20	SAT. 2/21
8:30 -- 9:30	UT Seminar	E. Gate 9:00 A M	UT Seminar	UT Seminar	UT Seminar	
9:30 -- 11:30	Machine Inst.	X-10 Cyclotron T.	Machine Inst.	Physical Testing	Machine Inst.	
11:30 -- 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	
12:30 -- 4:15	Machine Inst.	Special Shop	Machine Inst.	Special Shop	Machine Inst.	
4:15				K-25 Computer T.		
	MON. 2/23	TUE. 2/24	WED. 2/25	THU. 2/26	FRI. 2/27	
8:30 -- 9:30	E. Gate 9:00 A M	UT Seminar	UT Seminar	UT Seminar	GRADUATE	
9:30 -- 11:30	Knox. Voc. Sc. T.	Y-12 Thermal Tour	Machine Inst.	Welding Dept.		
11:30 -- 12:30	Lunch at Knox.	Lunch	Lunch	Lunch		
12:30 -- 4:15	Fulton Syl. Tour	Machine Inst.	Special Shop	Special Shop		

DRAFTING TECHNOLOGY INSERVICE PROGRAM

TIME	MON. 4/6	TUE. 4/7	WED. 4/8	THU. 4/9	FRI. 4/10	SAT. 4/11
8:30 - 11:30	Orientation	Value Engr.	Metallurgical Testing	Metallurgical Testing	Numerical Control Machine	9:30 Graphite Reactor
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	High Radiation Tour
12:30 - 3:30	Introduction True Position	X-10 Cyclotron ORELA Tour	Electrical Drafting	Numerical Control	Special Lab	
3:30 - 4:20	Seminar		Seminar	K-25 Computer Tour		
4:20	AEC Museum Tour					
8:30 - 11:30	MON. 4/13 True Position Dimension	TUE. 4/14 Critical Path Problem	WED. 4/15 Y-12 Thermo Nuclear Tour	THU. 4/16 Metallurgical Testing	FRI. 4/17 Area Vocational School Tour	SAT. 4/18 Built Run Steam Electric Plant
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	
12:30 - 3:30	Critical Path	Industrial Weld.	Welding Design	Struct Drafting	College of Architecture Tour	
3:30 - 4:20	Seminar	TAT MDT Program	Seminar	Seminar	Dempster Tour	
8:30 - 11:30	MON. 4/20 Tech. Illus.	TUE. 4/21 Metallurgical Testing	WED. 4/22 True Position Dimension	THU. 4/23 Special Lab	FRI. 4/24 GRADUATE	
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch		
12:30 - 3:30	Sanitary Water Systems	Radiation Safety	Testing and Evaluation	Special Lab		
3:30 - 4:20	Seminar	Seminar	Seminar	Seminar		

ELECTRONICS INSERVICE PROGRAM

TIME	MON. 7/13	TUE. 7/14	WED. 7/15	THU. 7/16	FRI. 7/17	SAT. 7/18
8:00 - 11:30	Orientation	P.C. Studs. Lab ¹	Laser	Logic	Computer	X-10 Graphite
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	Reactor
12:30 - 3:30	P.C. Studs. Lab	P.C. Studs. Lab	Laser and P.C.	Logic P.C.	Computer	
3:30 - 4:20	Tour 9709, 9737	Seminar	Seminar	Seminar		
4:20	Tour AEC Museum					
	MON. 7/20	TUE. 7/21	WED. 7/22	THU. 7/23	FRI. 7/24	SAT. 7/25
8:00 - 11:30	Computers	Numerical Control	N.C. ²	B.D.I.S. ³	Ultrasonic	TVA Watts Bar
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch	Lunch	
12:30 - 3:30	Computers	N.C.	N.C.	B.D.I.S.	Cyclotron	
3:30 - 4:20	Seminar K-25 Computer Center	Seminar	Seminar	Seminar		
4:20						
	MON. 7/27	TUE. 7/28	WED. 7/29	THU. 7/30	FRI. 7/31	
8:00 - 11:30	I.C. ⁴	I.C.	Radiography	Thermonuclear		
11:30 - 12:30	Lunch	Lunch	Lunch	Lunch	GRADUATE	
12:30 - 3:30	I.C.	I.C.	Special Lab	Radiation X-10 Monitoring		
3:30 - 4:20	Seminar	Seminar	Seminar			

¹ Printed Circuits

² Numerical Control Machines

³ Basic Dimensional Inspection Systems

⁴ Integrated Circuits

program appraisal

appendix c

APPRAISAL OF INSERVICE TEACHER PROGRAM
DRAFTING AND DESIGN TECHNOLOGY
April 6 - 24, 1970
Teacher Institute, P. O. Box Y
Oak Ridge, Tennessee

Introduction

You are being asked to make a personal and individual evaluation of the Inservice Teacher Program for the benefit of your supervisor, the State Director, and the U. S. Office of Education. The following consists of a list of topic areas which are considered important in the evaluation of this research and dissemination project. As you realize, this list is by no means complete and we anticipate that you might add considerable depth to your critique by additional topics of concern particularly to you.

Your appraisal of the Inservice Teacher Program will also constitute a means of grading you as a University of Tennessee student. Please take care accordingly to express your thoughts of evaluation concisely, clearly, and in typewritten form. You should submit a copy of your evaluation report to your immediate supervisor, to the State Director of Technical-Vocational Education in your home state, and to the Director of the Teacher Institute.

PLEASE NOTE: You will receive a grade of I (incomplete) from the University Records office shortly after the end of this quarter because of the time delay in receiving reports from you. The final grade will be changed during the next quarter providing you send to the Director a report on the program.

Topics

A Look at the Nuclear Age
Classroom Technology Instruction
Laboratory Hands-On Involvement
Meeting Individual Needs
Interchange and Discussion Among Instructors
Laboratory Equipment
New Industrial Processes
UT Seminars
Living Accommodations
Industrial Tours

excerpts from
the evaluation reports

appendix d

EXCERPTS FROM THE EVALUATION REPORTS

It is hopeful that in the near future such programs as this will be expanded to a scale that all vocational-technical instructors will be afforded the opportunity of attendance. . .

Program material relevant and instructional. . .

Organization of program efficient. . . interest maintained at a high level through program diversification.

Only through programs such as this. . . can the instructor be kept abreast of his profession.

Through my participation at the inservice program I have a better understanding of the needs of industry. This I feel will cause me to do a better job of preparing my students for the "world of work".

The "hands-on" project work was the "meat" of the Teacher Institute experience.

Materials received in physical testing, tool and cutter grinding, inspection, and numerical control. . . are being currently used in my teaching.

It reinforced my belief in conceptual learning. . . reinforced my belief in understanding of learning and measurement in terms of behavior.

The machining technology schedule was complete and as well planned as humanly possible. . .

This was the best and most complete program that I have ever attended or participated in.

It was the use of several industrial technology experts that made the program so strong! . . .

It was truly an ideal approach to team teaching. The diversity of this group representing twenty states proved to be an outstanding asset. . .

Through personal contacts and group discussions, much was learned about different programs now in existence in many parts of the United States.

The objectives for this inservice program were built around meeting individual needs. This was another of the valuable aspects. Each individual was free to pursue his areas of interest both in lectures and in the shop.

I feel that these types of programs are the life blood of Industrial Education.

evaluation

questionnaire

appendix e

We are attempting to determine the benefits to Union Carbide (and to Carbide personnel) derived from the Teacher Institute, a part of the Training and Technology (TAT) Project. As a past or present participant in the program, you can be of great help to us in evaluating the program and in helping us to decide upon any alterations in it. Please fill out the questionnaire below and return it to: John G. Hutton, c/o Facilities Engineering Department, Building 9739, within five days. Thank you.

Name _____ Dept. _____ Job Title _____

Involvement in Program: From (Date) _____ to _____

Are you using the Teacher Institute program to increase your technical training? Yes _____ No _____ Do you feel that the Teacher Institute training in technology has helped you on your present job? Yes _____ No _____ Will it help you prepare for a better job? Yes _____ No _____

Have you enrolled in the Teacher Institute Foremanship, teaching methods, etc., courses? Yes _____ No _____

Are you using the Teacher Institute Program for work toward a degree? Yes _____ No _____

When do you expect to obtain a degree? _____

What degree is your goal? B.S. _____ M.S. _____ Doctoral _____

How many total quarter hours toward a degree have you accumulated? _____

How many of these hours have been taken at the Teacher Institute? _____

Did the Teacher Institute make it easier for you to take these courses? Yes _____ No _____ If so, in what ways? _____

Would you have taken these courses if the Teacher Institute had not been in existence? Yes _____ No _____ Why? _____

Are there any courses which you would like to see added or which you are hoping to take at the Teacher Institute? _____ If so, which courses? _____

RESULTS OF REVISIONS:

1. Will start in the program?

1965:1 (4.2%)	1969:13 (50.0%)
1967:2 (7.7%)	1970:3 (11.5%)
1968:7 (26.9%)	
2. Used the Institute to increase technical training?

Yes: 23 (100%)
No: 0 (0%)
3. Has the Institute Training helped on present job?

Yes: 23 (100%)
No: 0 (0%)
4. Will the Institute help prepare you for a better job?

Yes: 23 (100%)
No: 0 (0%)
5. Have you enrolled in foremanship, teaching methods, etc., courses?

Yes: 21 (80.8%)
No: 5 (19.2%)
6. Using the Program for work toward a degree?

Yes: 25 (96.1%)
No: 1 (3.9%)
7. Degree expected?

1970:2 (7.7%)	1975:0 (0%)
1971:9 (34.5%)	1976:1 (3.9%)
1972:5 (19.2%)	Other
1973:1 (3.9%)	No Response:4 (15.4%)
1974:4 (15.4%)	
8. Degree Goal?

B.S. - 18 (72.0%)
M.S. - 6 (24.0%)
Doctoral - 1 (4.0%)
9. Number of hours accumulated: (Range) 6 - 213
(Mean) 104.52
10. Number of hours at Institute: (Range) 6 - 118
(Mean) 50.88
Percent of Total - 48.66%

11. Institute made easier?

Yes: 26 (100%)
No: 0 (0%)

12. If so, how?

a) No need to travel to UT	13 (50.0%)
b) Less time involved	9 (34.6%)
c) More individual attention	1 (3.9%)
d) Better pupil/teacher relationship	1 (3.9%)
e) Classes with people own age	1 (3.9%)
f) Better equipment	1 (3.9%)
g) No activities fee	1 (3.9%)
h) Other	3 (11.5%)*

13. Would have taken courses if no Institute?

Yes: 7 (26.9%)
No: 19 (73.1%)

14. Why?

A. Yes: Need courses	5 (100%)
B. No: Too inconvenient	5 (26.3%)
Too time consuming	5 (26.3%)
No encouragement to continue	3 (15.8%)
Wouldn't know what needed	2 (10.5%)
UT classes too large	1 (5.3%)*

15. Courses would like to see added:

English	9 (34.6%)
All necessary for degree	6 (23.1%)
Humanities	8 (30.8%)
History	7 (26.9%)
Economics	5 (19.2%)
Botany, Zoology	3 (11.5%)
Sciences	3 (11.5%)
Math	2 (7.7%)
Electrical Courses	1 (3.9%)
Magnetic Attraction & Repulsion	1 (3.9%)
More technical	1 (3.9%)
Education Courses	1 (3.9%)
Health	1 (3.9%)
Psychology	1 (3.9%)*

*Adds to more than 100% because of multiple responses

proposed

and revised

course syllabi

appendix

f

A PROPOSED INDUSTRIAL EDUCATION 500 LEVEL COURSE

- I. I. E. 3_____ Physical Testing Technology (3,3,3)
- II. Course Description This course is designed for the Vocational-Technical teacher to become proficient in the physical testing field and to learn the skills and techniques involved in radiography, metallography, tensile and compression testing, and other destructive and nondestructive testing methods.
- III. Purpose and Competencies
1. To develop an understanding of the importance and relationship of destructive and nondestructive physical testing technology to industry and production control.
 2. To develop skill in the use of the more destructive and nondestructive physical testing equipment.
 3. To develop a full understanding of the technical knowledge of physical testing processes, principles, and procedures.
 4. To develop judgements to ascertain the proper physical testing procedures to follow for specified conditions.
- IV. Topics Covered in the Course
1. Importance of industrial physical testing procedures.
 2. Visual
 3. Tensile
 4. Drift
 5. Crush (compression)
 6. Free bend

PHYSICAL TESTING TECHNOLOGY

1. Physical Testing Technology 3040 (3 hours credit)

Catalog Description:

Physical Testing (3040) concerns materials, processing, evaluations, their properties, uses, and common defects as an introduction to Physical Testing Methods.

2. Physical Testing Technology 3041 (3 hours credit)

Catalog Description:

Physical Testing (3041) concerns liquid penetrant and magnetic particle inspection methods. The surface condition of materials and products as well as the thermal, electrical, and magnetic aspects of the field of Physical Testing.

3. Physical Testing Technology 3042 (3 hours credit)

Catalog Description:

Physical Testing (3042) concerns mechanical and physical properties of materials, their strength, hardness, machinability, ductility, elasticity, impact, and density.

4. Physical Testing Metallography 4040 (3 hours credit)

Basic metallography will encounter techniques in specimen preparation and producing microphotography. Grain structure and grain size of materials will be studied.

5. Physical Testing Ultrasonics I 4041 (3 hours credit)

Basic introduction to ultrasonic testing.

6. Physical Testing Ultrasonics II 4042 (3 hours credit)

Continuation course of Ultrasonics I with emphasis on the application of ultrasonic equipment to the inspection of metallic and nonmetallic materials.

7. Technical Physical Testing Radiography I 4043 (3 hours credit)

Basic theory of radiography inspection on metallic and nonmetallic materials.

8. Technical Physical Testing Radiography 11 4044 (3 hours credit)

Continuation of Radiography I with emphasis on production of radiography and film interpretation.

9. Technical Physical Testing Metallography 11 4045 (3 hours credit)

Heat treatment and properties of iron and steel. Phase diagrams and related microstructures of ferrous and nonferrous alloys.

UNIVERSITY COURSES OF INDUSTRIAL EDUCATION 1964

Course Description

Industrial Education 39-0 is an introduction to Physical Testing. The course will introduce the theory and basic laboratory procedures in Mechanical Properties, Metallography, Ultrasonics, and Radiography as applied in a modern industry.

The concept of the course is to instill in the student a basic understanding of the above mentioned field of Physical Testing of metallic and nonmetallic materials.

Course Organization

The course is an upper level undergraduate course. It consists of lecture and laboratory practice, in that order. The students observe and carry out the various manipulative skills demonstrated by the instructors. The student will be evaluated, based upon two examinations, a mid-term and a final, and the degree of proficiency attained in the laboratory. Classroom attendance and student participation in discussion will also be a determining factor in student evaluation.

Specific Objectives

The student, upon completion of the course, should be able to:

1. Explain the difference between the various areas of Physical Testing.
2. Differentiate between macro and micro in Metallography.
3. Know the crystalline nature of metals.
4. Identify the following: slip planes, twinning and worked structure, and recrystallization; with respect to polycrystalline metal.
5. Define the following: alloy, continuous crystallization, dendrite, metal grain, and grain boundary.
6. Explain cold and hot working of metals.
7. Define roentgen, RAD, REM, and curie.
8. List the genetic effects of the various forms of radiation.
9. Compare the different types of monitoring devices used in Radiography.