DOCUMENT RESUME

ED 335 065 JC 910 226

AUTHOR Hata, David M.
TITLE Model 2 + 2 + 2 Tech Prep Program in Engineering Technology.
INSTITUTION Portland Community Coll., Oreg.
SPONS AGENCY Fund for the Improvement of Postsecondary Education (ED), Washington, DC.
PUB DATE 90
CONTRACT G008642085
NOTE 32p.
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Articulation (Education); *College School Cooperation; Community Colleges; Consortia; Curriculum Design; *Curriculum Development; Electronics; *Engineering Technology; Higher Education; High Schools; *Intercollegiate Cooperation; School Business Relationship; *Secondary School Curriculum; Two Year Colleges
IDENTIFIERS 2 Plus 2 Plus 2 Tech Prep Programs

ABSTRACT

In 1986, Portland Community College (PCC) received federal funding to expand its pilot 2 + 2 Tech Prep program in engineering technology to include five local high schools and to link the program to the upper-division engineering technology program at the Oregon Institute of Technology (OIT). Program results included the following: (1) eight high school and three PCC instructors jointly developed a model high school curriculum that could be used as a template for change to standardize the curricula of the five separate high school cluster programs; (2) at the request of the high school instructors, seven 1-day workshops were held, focusing on key elements of the high school curriculum; (3) three formal articulation agreements were signed, specifying the high school courses in analog circuits and digital circuits eligible for college credit; (4) while the content of PCC's and OIT's lower-division programs matched closely, two special interface courses were developed to help prepare PCC students to make the transition to OIT's upper-division program, and relations between PCC and OIT faculty were strengthened by annual meetings; (5) industry has supported the program through equipment donations and provision of cooperative education positions for second-year electronic engineering students; (6) promotional and informational materials were developed and on-site consultations have taken place to bring the program to the attention of other educators and help them replicate it; and (7) while only 31% of the high school students participating in the program earned college credit during its first year, this figure rose to 70% by the program's third year. A completed articulation agreement and sample course sequences from the student guidebook are included. (PAA)

Model 2+2+2 Tech Prep Program in Engineering Technology

Grant No.: G008642085

Starting date: September 1, 1986
Ending Date: August 30, 1989
Number of Months: 36

David M. Hata, Project Director
Department of Engineering & Technology
Portland Community College
12000 S.W. 49th Avenue
P.O. Box 19000
Portland, Oregon 97219-0990
Telephone: (503) 244-6111 Extension 4175

FIPSE Program Officers: Bill Thomson and Sandra Newkirk

Grant Award:	Year 1	$68,116
	Year 2	73,640
	Year 3	59,173
	Total	$200,929

PROJECT SUMMARY

The 2+2+2 Tech Prep Program developed by Portland Community College successfully links five high school electronics cluster programs to community college and upper-division programs in electronic engineering technology. The program provides multiple-entry and multiple-exit points to increase access to post-secondary education and is cost-effective, utilizing the lower tuition of the community college and industry sponsored cooperative education programs. Products of the project include a model curriculum in electronics for high schools, a Tech Prep videotape, and 2+2 Student Guide.

EXECUTIVE SUMMARY

Model 2+2+2 Tech Prep Program in Engineering Technology

Portland Community College
12000 S.W. 49th Avenue
P.O. Box 19000
Portland, OR 97219-0990

David M. Hata, Project Director
(503) 244 - 6111 extension 4175

Project Overview

The project actually began in 1982 with a grassroots effort to link one high school electronics cluster program to the electronics engineering technology program at Portland Community College. Working through the Hillsboro Union High School's Electronics Advisory Committee, David Hata, Advisory Committee Chair, spearheaded an effort to author a "Concept Paper" outlining what we now call a "2+2 Tech Prep" program and gained school board approval for the development of a formal articulation agreement.

Purpose

The purpose of this FIPSE project was to expand the 2+2 pilot 2+2 Tech Prep program with the Hillsboro Union High School District to other high schools in the community college district that offered electronics cluster programs, linking them to PCC's Electronic Engineering Technology progam and Oregon Insitute of Technology's upper-division program. The articulated program would provide multiple-entry and multiple-exit points to maximize access to the program.

Background and Origins

The setting for the project is the Portland metropolitan area in the State of Oregon. Portland Community College, the largest of Oregon's thirteen community colleges, is a multi-campus, public, two-year educational institution. The college offers both lower-division transfer courses and more than 80 vocational/technical programs. Annually, more than 65,000 individuals take courses at PCC, an equivalent of 13,000 FTE (full-time equivalent) students.

The Electronic Engineering Technology Program is one of seven associate degree programs offered by the Department of Engineering & Technology. The program is accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering & Technology. The EET program forms a 2+2 program with Oregon Institute of Technology.

The FIPSE project strengthened the upper-division connection with OIT while adding the high school/community college connection to form a fully articulated 2+2+2 Tech Prep program in engineering technology.

Project Description

The project involved five high schools: a technical high school (Benson Polytechnic High School), an urban high school (Cleveland High School), two suburban high schools (Hillsboro and Glencoe High Schools), and one rural high school (St. Helens High School). This diversity of settings was important to show the adaptability of the program to different settings.

Project activities involved curriculum development, faculty upgrading, laboratory improvement, promotion, articulation agreements, industry involvement, and evaluation.

Project Results

Curriculum Planning and Development. Connecting five separate high cluster programs required standardization. Beginning with a "blank slate", eight high school instructors and three community college instructors work side-by-side to develop a model high school curriculum. This model curriculum served as a template for change toward a common, yet unique, curriculum in each high school. Key results in this process include:

- A perception of ownership in a jointly-developed curriculum and program on the part of both high school and community college instructors.
- A support network of high school and community college faculty that fostered the sharing of ideas, instructional materials, and surplus supplies.
- A clarification of curriculum goals, content, concepts, and terminology so that each instructor developed a common vision for the program.
- A broader view of technical education and how programs at different educational level fit together.

Staff Development. An unexpected outcome of the curriculum development process was a request for inservice workshops. This request was initiated by the high school instructors. Seven one-day workshops have been held, each workshop focusing on one key element of the high school curriculum.

Articulation Agreements. Three formal articulation agreements are in operation. These three agreements cover electronics cluster programs

at five high schools. Each agreement specifies high school courses eligible for college credit, responsible parties for executing the agreement, and time lines for program operation.

Upper-Division Interface. The interface between PCC and OIT has been strengthened through annual meetings between faculty at each institution. In addition, PCC's Electronic Engineering Technology program was reaccredited by TAC/ABET, the same agency that accredits OIT's Electronic Engineering Technology program. The establishment of OIT's Metro Center has placed the entire 2+2+2 program in Portland.

Industry Support. Industry has supported the program in two ways. First, the project received a major donation of oscilloscopes from Tektronix, Inc. These instruments are being used to improve laboratory facilties at participating high schools. Second, local high tech companies provide cooperative education positions so that second year EET students can gain real-world experience before they graduate.

Promotion of the Tech Prep Program. In conjunction with the Portland Area Vocational Technical Education Consortium (PAVTEC), a number of promotional materials have been produced. These materials include a Tech Prep Videotape, 2+2 Student Guide, and brochure.

Dissemination and Replication. Project results have been disseminated at conferences and professional meetings. However, replication of this successful program can be enhanced through on-site consultancies. A pilot consultancy to Delgado Community College in New Orleans during the last year of FIPSE funding proved very successful.

Student Participation. Over 200 high school students have participated in the 2+2+2 program. The success rate for the earning college credit has increased from 31% during Year 1 to approximately 70% in Year 3 of the project. Of these students, eighteen have requested the college credit.

Summary and Conclusions

The FIPSE grant provided funding at a critical stage in the program development cycle and provided the needed release time and extended contract days for high school and community faculty to work on this project. The result has been the implementation of a working 2+2+2 Tech Prep program that serves as model for other programs around the country. The best strategy for replication seems to be on-site consultancies, similar to the consultancy visit to Delgado Community College during the final year of the project.

FINAL REPORT

2+2+2 Tech Prep Project in Engineering Technology

Project Overview

The project actually began in 1982. At that time, David Hata, Instructional Coordinator for PCC's Electronic Engineering Technology program and Chair of the Hillsboro Union High School District's Electronics Advisory Committee, approached Mr. Al Miller, Director of Career, Vocational and Community Education for the Hillsboro Union High School District, with the concept of formally linking the two high school electronics cluster programs offered within the Hillsboro District with Portland Community College's Electronic Engineering Technology program.

The goal of this grassroots effort was to develop a 2+2 model program linking the two educational levels so that students could transition from one level of schooling to another with the successive and systematic building of concepts and skills without duplication of coursework. And by involving the community college, the implementation of the concept would produce a cost-effective, multiple-entry, multiple-exit program that could be extended to the baccalaureate degree.

The Electronics Advisory Committee under the leadership of David Hata then developed a "Concept Paper" outlining the structure and goals of what we now call our "2+2 Tech Prep program." This concept paper was endorsed and adopted by the Hillsboro District's School Board and formally began the development of a formal articulation agreement between Portland Community College and the Hillsboro Union

High School District.

Purpose

The initial purpose of the project was to provide students with a high-quality, articulated program of study beginning in the early years of a student's high school education, if not before, and leading eventually to a baccalaureate degree. The program would provide multiple-entry, multiple-exit points and be affordable to the student, a key feature in this day of escalating costs for post-secondary education.

However, as the project developed, it became evident that that the problem was more global in scope. It was not enough to link two curricula. The effort needed to encompass the entire high school community and a new culture needed to develop in high schools.

Dr. Dale Parnell in his book, The Neglected Majority clearly identified the problem. How could we reach those students that were neither part of the "college prep" culture nor the "vocational" culture in the high school, a majority of students? How could we establish a "Tech Prep" culture?

Using funds provided by the Carl Perkins Act, the College embarked on a parallel effort that eventually would involve vocational/technical programs from automotive technology to veterinary technology. By creating a broad-based effort at both the high school and community college, this new culture could germinate in high schools throughout the community college district. This broadbased effort is coordinated by the Portland Area Vocational Technical Education Consortium or PAVTEC, for short.

This report is more than a report on one FIPSE-sponsored project.

It summarizes a broad-based effort by Portland Community College, high schools, business, and community groups to develop this "Tech Prep" culture that we hope will become an institution within educational system in the State of Oregon.

Background and Origins

Portland Community College, the largest of Oregon's thirteen community colleges, is a multi-campus, public, two-year educational institution serving the metropolitan area. The college offers both lower-division transfer courses and more than 80 vocational/technical programs throughout its 1500 square mile district. Annually, more than 65,000 individuals take courses at PCC, an equivalent of 13,000 FTE (full-time equivalent) students.

The Department of Engineering & Technology has 24 full-time faculty members and currently serves a total of 410 day students and 370 evening students in the following disciplines: General Engineering, Electronic Engineering Technology, Software Engineering Technology, Mechanical and Civil Engineering Technology, and Industrial and Architectural Drafting.

Instituted in 1965 and accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering & Technology since 1985, then Electronic Engineering Technology Program plays a vital role in the economic development of the area. During the 1988-89 academic year, enrollent in the EET program averaged over 100 day students and 120 evening students. Of these 220 students, the average age is 31.9 years, 13% are female, 17.9% are Asian, and 2.4% are Black or Hispanic. Program graduates are employed by Intel Corporation, Hewlett Packard, Mentor Graphics Corporation, and

Tektronix, Inc.

The EET program forms a 2+2 program with upper-division programs offered by Oregon Institute of Technology leading to the baccalaureate degrees in electronic engineering technology, computer engineering technology, and industrial management. The creation of OIT's Metro Center in Portland has made upper-division programs available to many of our graduates that are place-bound due to employment.

The FIPSE project strengthened the upper-division connection with OIT while adding the high school/community college connection to form a fully articulated 2+2+2 Tech Prep program in engineering technology.

Project Description

The project's main demonstration project involved PCC's Electronic Engineering Technology program and electronics cluster programs at five high schools: Benson and Cleveland High Schools in the Portland Public School system, Hillsboro and Glencoe High Schools in the Hillsboro Union High School District, and St. Helens High School. These five high schools include a technical high school (Benson), urban high school (Cleveland), suburban high schools (Hillsboro and Glencoe), and a small rural high school (St. Helens). This diverse groups of high schools was important in order to show the transportability of the model to any high school setting.

Active participation by the high school and community college instructors was essential to project activities that included curriculum development, staff development, facility upgrading, evaluation of student performance, and student advising. Grant activities were planned to produce a cohesive group of instructors that shared a

common vision for what the program could do for their students.

Figure 1 shows the model for the 2+2+2 Tech Prep program. At the top are the high schools. A key assumption here was that the curriculum at each of these high schools could be standardized so that the students coming to the community college from each of these high schools would have a common skill set and many of them would be eligible for credit for first term electronics courses. Second, it was assumed that the high school instructors would have the skills to teach the material required at the appropriate level in order to prepare their students to transition to the community college. It was also assumed that the high school curriculum, in a rapidly evolving industry, would not be able to prepare the student for entry-level technician position in our local high tech industry and hence, the student would have to go on to the community college for additional education and training.

Hence, the community college curriculum component in the model had two missions. First, the student needed to acquire the skills required by industry for entry-level positions. This would be the first exit point in the program.

Second, the community college needed to provide the lower-division credits so that students could progress to an upper-division program in engineering technology, thereby getting the education to advance in their careers.

And finally, Oregon Institute of Technology would provide the final two years leading to a baccalaureate degree in engineering technology. It was assumed that many of our students would continue to go to work in full-time positions and continue their education

2+2+2 TECH PREP PROGRAM MODEL

Electronic Engineering Technology

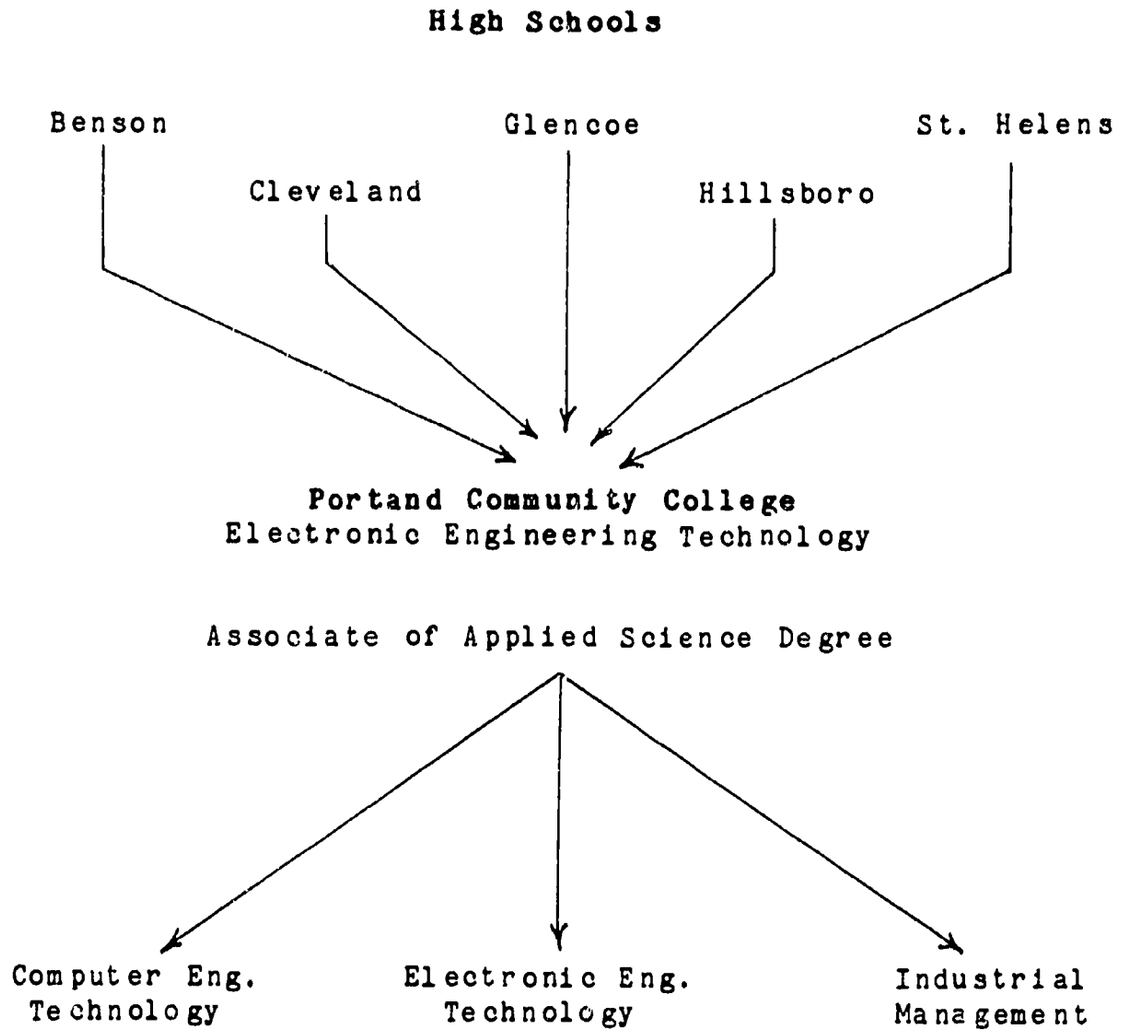

FIGURE 1.

through OIT on a part-time basis, using company sponsored educational benefits programs to fund their continued education.

Project Results

Curriculum Planning and Development

Curriculum planning and development has been a major focus of the 2+2+2 Tech Prep project. Unlike typical 2+2 programs that link a single high school program and a community college program having similar courses of study, the 2+2+2 project links many high school program to a single instructional program at Portland Community College.

In order the improve the success rate of high school students entering the community college program, each student needed to bring a common, basic skill set. This meant that each high school program's curriculum had to have common attributes. The driving force for moving high school curricula toward a "model or standard" curriculum was the curriculum planning and development effort.

The Process. The curriculum development process used was also unique. Rather than starting with either the high school or the community college curriculum, the development process started with a "blank slate." The curriculum was then built, concept by concept and objective by objective. High school and community college instructors participated equally in this process. This was essential to the success of the FIPSE project and produced key results in addition to the success of the creation of a standard curriculum. These key results included the following:

(1) A perception of ownership in a jointly-developed curriculum and program on the part of both high school and community college instructors.

(2) A support network of high school and community college instructors that fostered the sharing of ideas, instructional materials, and surplus electronic components.

(3) A clarification of curriculum goals, content, concepts, and terminology so that each instructor developed the same vision for the high school curriculum and community college curricula.

(4) A broader view of technical education, how a certain program fit into the 2+2+2 model and the role it was to play in preparing the student to transition to the next level.

Essentially, the curriculum addressed two areas: analog circuits and digital circuits. Analog circuits was placed in the junior year of the high school curriculum. During this year, all of the objectives needed to satisfy the requirements of EET 111 Electronic Circuits & Devices I, the first circuits course in PCC's Electronic Engineering Technology program, would be covered.

Digital circuits would then follow in the senior year of high school. During this year, all of the objectives required in EET 112 Digital Systems I would be covered.

In addition, the recommended high school curriculum included specific mathematics courses so that students articulating to the community college would meet the mathematics entry requirements for the EET program. Failure to meet program entry requirements would make advanced placement and the awarding of credit for EET courses a mute point.

Staff Development and Inservice Workshops. An unexpected outcome of the curriculum development process was a request from the high school instructors for inservice workshops. Obviously, these instructors had the freedom to admit that they needed help to teach the material to

PORTLAND COMMUNITY COLLEGE

12000 S W 49th Avenue
Portland, Oregon 97219
Telephone 503/244-6111

LETTER OF AGREEMENT
PORTLAND COMMUNITY COLLEGE AND HILLSBORO HIGH SCHOOL DISTRICT
ARTICULATION PROJECT IN ELECTRONIC ENGINEERING TECHNOLOGY

This Letter of Agreement has been enacted to facilitate the continuation of students from the Electronics program at Hillsboro High School District to Electronic Engineering Technology at Portland Community College. This agreement is intended to establish a 2 + 2 tech prep/associate degree program between the two institutions. High school students will need to apply for admission to the PCC Electronic Engineering Technology program and to meet program entry requirements. This agreement will be evaluated and renewed annually.

1. Articulated Courses

This agreement enables the high school student to receive PCC credits and advanced placement in the PCC Electronics Engineering Technology program. The following high school and PCC courses are identified as equivalent:

Hillsboro High School District Equivalent Course	Portland Community College Course
Electronics II (1 unit)	EET 111 Electronic Cir./Dev. (4 credits)
Electronics III (1 unit)	EET 112 Digital Systems (4 credits)

The following additional articulated courses pertaining to the Electronic Engineering Technology program are included under separate agreements:

Hillsboro High School District Equivalent Course	Portland Community College Course
Technical Math (1 unit)	Math 100 Intermediate Algebra (4 credits)
Analysis (1 unit)	Math 101 College Algebra (4 credits)
	Math 102 College Trigonometry (4 credits)

FIGURE 2 (a).

2. Instructional Representatives

The following instructional representatives are responsible for implementing the provisions and procedures of this agreement as well as maintaining liaison between the high schools and PCC.

Lloyd Gooding, Faculty
Glencoe High School

Chuck Thurber, Department Chair
Glencoe High School

Don Domes, Faculty
Hillsboro High School

Dave Turnbull, Department Chair
Hillsboro High School

Dave Hata, Faculty
Portland Community College

Bob Dixon, Department Chair
Portland Community College

3. Administration

A. Credit via exams:

PCC will provide Course Content Guides which list topics covered in articulated courses. Information about test dates will be agreed upon by the PCC instructional representatives and the Hillsboro instructional representatives.

At the end of the school year, no later than April 20, the high school instructional representatives will submit to the Hillsboro District Office a list of students, grouped according to the course exam they desire to take, 10 school days before the agreed upon test date.

Students taking the exam will pay the exam fee (presently $10) through the Hillsboro District Office. The District Office will forward the fees along with the list of Hillsboro students who desire to take the exams to the Department Chair at Sylvania Campus. This $10 fee will cover all courses a student transcripts to PCC during a given year.

The PCC instructional representative will send the appropriate exams to the Hillsboro instructional representative who will administer the exams. The exams will be returned by the Hillsboro instructional representatives to the PCC instructional representatives for evaluation.

The PCC representative will evaluate the exams and send to the Hillsboro instructional representatives a list of the students who successfully complete them.

FIGURE 2 (b)

Students who wish to have credits transcripted by PCC must fill out a PAVTEC registration form, which will be forwarded by the Hillsboro instructional representative to the Department Chair at the Sylvania Campus.

The PCC Department Chair will send to Student Records a completed grade roster (listing the courses, names, social security numbers, and grades of students who have earned credit), the PAVTEC registration forms, and the $10 fees.

Hillsboro will include information regarding the exam process for Electronic Engineering Technology in the curriculum handbooks given to counselors, students, and parents.

B. Enrolling Students in Appropriate Courses:

Portland Community College, Electronic Engineering Technology Department, will provide copies of the PCC catalog and handouts on certificate and degree programs to the instructional representatives at the Hillsboro High School District.

Hillsboro High School District will identify students, if possible, who will be attending PCC in order to assist those students in the transition period. Hillsboro will refer students who wish information about Electronics Engineering Technology to instructors at the Sylvania Campus.

C. Instructors from both institutions agree to evaluate the process and materials at least once a year for revision and updating.

Submitted by:

PORTLAND COMMUNITY COLLEGE

PRINCIPAL, GLENCOE HIGH SCHOOL

PORTLAND COMMUNITY COLLEGE

PRINCIPAL, HILLSBORO HIGH SCHOOL

PORTLAND COMMUNITY COLLEGE

HILLSBORO HIGH SCHOOL DISTRICT

6-18-87
Date

7/14/87
Date

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FIGURE 2 (c)

the level required by the community college program. They requested that several one-day workshops be developed to provide the updating they required and identified the priority topics to be covered. Seven workshops have been held over the past two years.

Articulation Agreements. For PCC's Electronic Engineering Technology program, three formal articulation agreements have been signed and are in operation. These three agreements cover electronics cluster programs at five high schools. A sample agreement is shown in Figure 2. Each agreement specifies the schools involved, the course equivalents, the people responsible for executing the agreement, and the procedures and timelines for student evaluation and the transcripting of credit.

Upper-Division Interface. The PCC/OIT interface has been strengthened over the past three years. First, indepth comparisons of lower-division programs at Portland Community College and Oregon Institute of Technology have revealed a very close match in program content except for two minor areas. Two special interface courses, one in advanced circuit analysis techniques and the other in field effect device technology, have been developed to prepare students for transition to OIT's upper-division programs.

The establishment of OIT's Metro Center in Portland has made OIT's upper-division programs much more accessible to PCC graduates that are place-bound due to professional and personal reasons.

Furthermore, the compatibility of the PCC and the OIT programs was further strengthened when PCC's Electronic Engineering Technology was accredited by the Technology Accreditation Commission of the

Accreditation Board for Engineering and Technology. By meeting TAC/ABET accreditation criteria, PCC's Electronic Engineering Technology program meets the same requirements for faculty, curriculum, facilities, and program administration as does OIT's program and improves the credibility of the 2+2+2 program.

Building on the work sponsored by the FIPSE grant, annual meetings with OIT faculty and administrators have been established. These meetings provide faculty and administrators with the opportunity to disseminate information of program changes and explore ways to strengthen the articulation of programs. The meetings are generally two-day length, providing ample time for indepth discussion to occur.

Laboratory Improvement. To establish and implement articulation agreements, two essential ingredients are required. First, the instructors must have the knowledge to teach the breadth of subject matter at the appropriate level. Second, adequate laboratory facilities are required to support the implementation of the curriculum.

To get the training job done, technology definitely has to be included yet most high schools lacked the resources to purchase them and lacked the clout with industry to trigger donations. Where feasible, cooperative equipment planning and acquisition makes good dollars and sense.

The FIPSE project has demonstrated that this cooperation can be achieved with profitable results, especially for the student. In support of the electronics articulation project, Tektronix, Inc., and Portland Community College are placing brand-new, dual-trace oscilloscopes in high schools that have formal articulation agreements

in electronics engineering technology with the college. The cost to Tektronix, Inc., was $10,000, to PCC $10,000, and $0 to the participating high schools.

Industry Involvement Industry involvement goes beyond donations of equipment. A key element at the community college level in the 2+2+2 Tech Prep program are internships or cooperative education positions. PCC has developed a very successful cooperative education program where second year students are employed on a part-time basis in industry. Typically, cooperative education students work twenty hours a week in an approved position while carrying twelve academic credits.

It is recommended, when geographically practical, that cooperative education programs be run in parallel with the academic program rather than having student leave the educational institution to participate in cooperative education of a full time basis for a semester or quarter and then return to full-time study.

It is also assumed that participation in cooperative education programs will provide the incentive for students to remain in school and complete their academic programs. Note that conversion from cooperative education status to full-time employee is contingent upon completion of the associate of applied science degree.

Promotion of the Tech Prep Program. In conjunction with PAVTEC, several promotional materials have been developed. A pilot project in the Hillsboro Union High School District has produced a "2+2 Tech Prep Student Guide". The electronic engineering technology section of the student guide is shown in Figure 3. The high school and community college curricula are listed side-by-side, enabling the reader to see the connection and continuity in the program of study. Furthermore,

2 + 2 TECH PREP ASSOCIATE DEGREE
ELECTRONIC ENGINEERING TECHNOLOGY

A 2 + 2 Tech Prep Associate Degree program ties together grades 11-14 in a continuous succession of courses. The associate degree is typically earned by completing 2 years of designated college courses after graduating from high school. By participating in the 2 + 2 Tech Prep Program, the student is not only certain to have met all of the community college's prerequisites, but may also be able to challenge and earn some of the associate degree credits while still in high school.

Challenge Credits - High school courses which may be taken to challenge and earn associate degree credits are shown below in bold type. The related college courses are also in bold type. High school students should consult with their counselor or teacher to find out how to earn challenge credits.

Required Courses - The 11th &12th grade required courses to earn a high school diploma are the same for every student.

Elective Courses - The elective high school courses for this 2 + 2 Tech Prep program are recommended for providing the student with the best technical preparation for the given associate degree program. Students may choose to exceed or differ from what is recommended.

Changing or Exiting the Program - Flexibility and individual choice is guaranteed and easy to attain with the 2 + 2 Tech Prep Associate's Degree program. Students may enter, exit, or change programs at any time. For many programs there are 3 possible "termination" exit points which will prepare the student with some entry-level job skills and credentials: 1) grade 12 - high school diploma; 2) grade 13 - Vocational Certificate; 3) grade 14 - Associate Degree. See the following page for more information.

2 YEARS.....PLUS.....2 YEARS

HIGH SCHOOL

GRADE 11

Semester 1

Required Course	Credit
English	.5
U.S. History	.5
Personal Finance	.5

Elective Course	Credit
Tech. Math	.5
Electronics II	.5
Princ.Tech./Physics	.5

Semester 2

Required Course	Credit
English	.5
U.S. History	.5
Health	.5

Elective Course	Credit
Tech. Math	.5
Electronics II	.5
Princ.Tech./Physics	.5
TOTAL	6.0

GRADE 12

Required Course	Credit
English	.5
Economics	.5

Elective Course	Credit
Analysis	.5
Electronics III	.5
PASCAL I	.5
Mech. Drafting II	.5

Required Course	Credit
English	.5
Social Studies	.5

Elective Course	Credit
Analysis	.5
Electronics III	.5
PASCAL II	.5
Mech. Drafting II	.5
TOTAL	6.0

COMMUNITY COLLEGE

GRADE 13

First Term

Course #	Title	Cr.
EET 110	Progr. for Elect.	3
EET 111	Elect.Cir/Dev.	4
EET 112	Digital Sys. I	4
MTH 101	Coll. Algebra	4
WR 121	English Comp.	3
	TOTAL	18

Second Term

EET 121	Elect. Cir/Dev.	4
EET 122	Digital Sys. II	4
MTH 102	Trigonometry	4
WR 122	English Comp.	3
	General Educ.	3
	TOTAL	18

Third Term

EET 131	Elec.Cir/Dev III	4
EET 132	Digital Sys. III	4
EET 133	Calculus for Elec.	4
CST 2.211	Struc. Progr. I	4
WR 227	Tech. Writing I	3
	TOTAL	19

GRADE 14

Fourth Term

Course #	Title	Cr.
EET 241	Microcom.Sys I	4
EET 242	Linear Sys. I	4
EET 243	RF Comm. Sys.	4
EET 244	Seminar I	1
	Elective	4
	TOTAL	17

Fifth Term

EET 251	Microcom.Sys II	4
EET 252	Linear Sys. II	4
EET 254	Seminar II	1
PHY 201	Gen. Physics	4
	Elective	4
	TOTAL	17

Sixth Term

EET 261	Microcom.Sys.III	4
EET 262	Power Electr.	4
CST 2.666	Unix and C	4
PHY 202	General Physics	4
	TOTAL	16

Figure 1. The Hillsboro/PCC 2+2 Tech Prep Program in Electronic Engineering Technology. Reprinted with permission from the "Hillsboro * Glencoe High School and Portland Community College 2+2 Tech Prep Guide".

the courses eligible for college credit are shown in bold type, in this case EET 111, EET 112, and Math 101.

The student guide is distributed to high schools students and their parents along with the forcasting material used to prepare the a schedule of study for the next year of high school. After perusing the student guide, the student can plan a course of study that will prepare him/her for post-secondary programs at the community college.

The important point is preparation. The goal is to get the student to think two, four, or more years ahead in their educational plan. Preparing for post-secondary study, especially in technical areas, requires that the student take the right mathematics and science courses at the right point in their high school study.

A sure way to catch the attention of a young audience is through a lively video! PAVTEC entered the world of video program with a 2+2 Tech Prep Video Program for the student audience. Twelve minutes in length, the program depicts high school students discussing their future and the new avenues for getting from here to there through 2+2 Tech Prep/Associate Degree Programs. The real message is that traditional college prep and a four-year college is not the only option for a bright future. Securing a job with only a high school diploma is becoming no option at all. A Tech Prep program and community college associate degree could be the ticket to a rewarding career.

Participation

Participation in the 2+2+2 Tech Prep Program at the high school level has grown from 3 students who applied for college credit during Year 2 of the project to eighteen students applying for college

credit during Year 3. This may seem like a small number but in the three year project, it represents a significant achievement to develop, implement, and actually get twenty one students to earn college credit.

The success rate on the qualification test given at the end of each academic year to high school students seeking college credit for high school courses has risen from 31% in Year 1 of the grant, prior to implementing the model curriculum in electronics to over 70% during Year 3.

Despite the apparent success of these statistics, almost all of the credits were in the analog circuits portion of the curriculum. Very few students applied for credit for the digital circuits portion of the high school curriculum. This indicates a reticence on the part of the high school instructors to have their students take the digital circuits exam. Clearly, additional work must be done to get to the point that high school faculty feel comfortable with their knowledge of digital circuits and their ability to teach it effectively.

Looking across the programs supported by PAVTEC, the numbers are even more impressive. Table 1 shows the growth in interest and active participation in the 2+2 Tech Prep program across college programs. In 1989, 31[illegible] students successfully applied for a total of 2,580 credits.

Dissemination of Results

The dissemination of project results have involved the following activities: papers presented at major conferences, the sharing of program products, visits by faculty and administrators from interested colleges, and consultancies to colleges starting their own 2+2 Tech Prep programs.

PAVTEC

PAVTEC
Articulation Credit Awards Summary
8/24/89

PARTICIPATION	1986-87	1987-88	1988-89	1988-89 % INCREASE FROM 1987-88
Districts	9	10	12	20%
High Schools	12	20	24	20%
Programs	6	7	15	114%
Courses*	---	---	45	---
Students	81	147	315	114%
Grades Issued	131	262	758	189%
Credits Earned	315	783	2,580	230%
Credit Value (PCC)	$7,402	$18,401	$60,630	230%

*Different courses involved (added 1988-89)

PAVTEC\SUM-89

TABLE 1.

Conference papers have been presented at the following conferences:

- 1986 American Society for Engineering Education (ASEE) Conference, Reno, Nevada
- 1987 FIPSE Project Director's Meeting, Washington, D.C.
- 1987 American Association for Community and Junior Colleges (AACJC) Conference, Dallas, Texas
- 1989 American Society for Engineering Education (ASEE) Conference, Lincoln, Nebraska
- 1989 California Industrial & Technology Association 60th Annual State Conference, Oakland, California
- 1989 Engineering Technology Leadership Conference, Norfolk, Virginia
- 1989 FIPSE Project Director's Meeting Washington, D.C.

In addition, over fifty information packets have been requested by other colleges around the country. Each information packet included a copy of the 2+2 Tech Prep Student Guide, Tech Prep videotape, copies of conference papers, Tech Prep brochure, and annual reports.

However, these efforts in themselves do not insure replication or lasting impact of our successful FIPSE project. Hence, a pilot effort to provide consultancies to other colleges was carried out during the final year of the project.

At the request of Delgado Community College in New Orleans, Lousianna, an initial visit was made during February of 1989 by David Hata, Project Director. This initial visit consisted of general presentations to both college staff at Delgado Community College and faculty and staff from local high school parishes. The purpose of the

initial visit was to create a vision for 2+2 Tech Prep programs in the minds of key college and high school personnel and to determine the merit of a follow-up consultancy visit by a team from Portland Community College.

A follow-up consultancy visit was made in April of 1989. The visitation team was composed for five individuals that played key roles in the development of PCC's district-wide Tech Prep program. These five individuals were: Dr. Donald Johnson, Chair of PAVTEC; Sherry Robinson, Special Needs Coordinator for PAVTEC; Dolores Turville, Coordinator of PAVTEC Operations; David Hata, FIPSE Project Director; and Al Miller, Director of Career, Vocational and Community Education. The consultancy team focused on the process and the pitfalls of developing a program and the development of resource materials to support the program.

It is our conclusion, based on the evaluations for the Delgado visit, that consultancies provide the type and quality of assistance that promotes replication of successful programs, FIPSE sponsored or otherwise.

Continuation and Institutionalization of the Project

The continuation of this project is insured by the establishment of the Portland Area Vocational Technical Education Consortium. PAVTEC began in 1986 as a regional cooperative association between Portland Community College and high school districts within the college district. The catalyst for creating the association was the Division of Vocational Education of the Oregon Department of Education. The PCC District was designated as one of eighteen regions in the State to receive vocational education seed money for

cooperative planning and delivery of quality vocational/technical education.

PAVTEC's 2+2 efforts are unique in four different ways:

- The effort targeted an extremely large, 1500 square-mile area which includes rural, suburban, and urban high schools. Thus, the results can be replicated in a variety of settings.
- The effort brought together, in a working partnership, a wide variety of organizations and agencies beyond the educational institution, all of which have strong interests in technical education.
- The number and variety of programs articulated is unusually large. Such a broad-based effort allows students with interests in vastly different fields to profit from the 2+2 program.
- Articulation went beyond program content to include student-oriented materials to promote participation in articulated programs and assist in making an appropriate choice of career and of program.

During its first two formative years, PAVTEC has forged strong partnerships between the thirteen school districts, representing twenty-seven high schools and Portland Community in Region IX of the state program. In addition, the consortium has associate members which include the Private Industry Council, the Oregon Alliance for Program Improvement, the Northwest Regional Educational Laboratory, the Division of Vocational Education of the Oregon Department of Education, and industry members, Tektronix, Inc., and IBM.

The FIPSE sponsored project will continue as one of PAVTEC's 2+2 Tech Prep programs. PAVTEC funding has been requested and received for continued faculty inservice workshops. One of the priorities for the coming year will be the review of the analog and digital circuits curricula in light of the widespread use of PC-based tools for design, analysis, and simulation of electronic circuits and mirrors similar

reviews being conducted at the community college and upper-division educational levels of the 2+2+2 program.

Summary and Conclusions

The FIPSE grant has provided funding at a critical stage in our 2+2+2 program development and has enabled the college to fully implement a model program in engineering technology. Funds were used to provide release time for high school and community college faculty during the academic year and for extended contract days during the summer.

The program has been implemented in a variety of high school settings and student interest and success in the program has grown steadily over the last three years.

Quality promotional materials in the form of brochures, student guides, and videotapes have been produced and are being widely disseminated to students, parents, and faculty.

Industry has supported the project through the contribution of equipment.

Project results have been disseminated through conference presentations and workshops. However, replication of the program is best accomplished through consultancies, as demonstrated through a pilot consultancy during the third year of the project.

Tremendous insight has also been gained through faculty and administrators from secondary and post-secondary educational institutions working together. The project has effectively broken down barriers that often block the development and implementation of 2+2 agreements. An important key in this process has been the mutual respect given each participant during the formative stages of the

project and the high level of assistance given to the high schools by the community college.

The project's initial focus was very narrow, encompassing only engineering technology programs but the parallel establishment of PAVTEC clearly demonstrated that a broad-based effort was essential to institutionalizing the 2+2 concept within the college district.

The project also demonstated the need for acceptance within the high school community from students to faculty to administrators. Establishing a Tech Prep culture became a goal of the entire educational community and even spread to community groups like the Private Industry Council.

For those practicioners who are interested in beginning a similar program, our advice is to seek out successful programs. Many schools and colleges have begun their own 2+2 Tech Prep programs and have a wealth of experience to share. I would encourage interested schools to request consultancy visits as the most efficient way of getting started and keeping the development process moving toward a fully functioning program.

APPENDIX

Assistance from FIPSE

As Project Director, I was very disappointed in the level of interest shown by FIPSE staff in this project and the level of support provided for the project. Despite what is written in the RFP guidelines, articulation and Tech Prep in particular is not a real interest to FIPSE staff or FIPSE project directors. The two sessions devoted to 2+2 programs at the annual Project Director's Meeting were very poorly attended. Even the FIPSE staff member responsible for developing the panel session chose not to attend.

As a result, I felt that the FIPSE staff did not fully comprehend the significance of the project or the results that were produced. Hence, it was not surprising that a new proposal to foster replication of this successful project through FIPSE-supported consultancies was not funded.

Nevertheless, the response of the educational community in general has been very positive. Numerous requests for information have been received and it is hoped that a number of these request will result in future requests for assistance, possibly even consultancies.

It gratifying to see that the Tech Prep concept has gained a high level of visibility at the State and National levels and is the focus of a number of legislative bills. In Oregon, the Workforce 2000 Bill that was recently passed allocated several million dollars to funding the Tech Prep efforts in Oregon. At the national level, I have been able to work through the American Society for Engineering Education to encourage the inclusion of Tech Prep funding in the vocational education bill before Congress.

And finally, FIPSE staff should give more attention to the role of community colleges in meeting FIPSE's goals for access to quality post-secondary programs and for cost-effectiveness. With projections by the Bureau of Labor that a majority of the new jobs will require post-secondary education, the community college is a key player in providing the needed human resources of business and industry. Access requires preparation and Tech Prep programs get students, other than the traditional college prep student, thinking about life after high school.

And on the issue of cost-effectiveness, consider the following scenario. A student, early in his/her high school career decides to take one of the many Tech Prep programs that are available, e.g. electronics. The suggested high school courses are taken and some of these courses qualify the student for college credit. The transition from high school to the community college goes smoothly.

Because of earned credits for high school work, the student can take a reduced academic load, again easing the transition to the post-secondary level. This encourages a higher success rate. After one year, the student enters a cooperative education program and works for one of our high tech companies. During this time, the student gains valuable work experience, earns a modest salary, qualifies for educational benefits that pay for tuition, books and fees.

Upon graduation with an associate of applied science degree, the student enters the workforce, usually with the company that he/she worked for as a cooperative education student. Now the student or worker is earning a full-time salary.

But the education does not stop here. The credits earned during

the associate degree program qualify the worker for entry into an upper-division program. Most likely, the worker will continue his/her education on a part-time basis, supported by company educational benefits. Eventually, the worker earns a baccalaureate degree, a necessary qualification for advancement to professional level jobs.

The benefits are obvious. The total cost of the above scenario, approximately $1,000, the cost of attending a community college for one year. The student gains experience, earns a salary, an important feature since many community college students are older and have family responsibilities, and charts a clearly defined and well articulated program of study.

I am convinced that this model will serve our nation well in meeting other objectives. For example, this mo'el will work in getting women and minorities into careers with a future. The 2+2+2 model has entry points beyond high school but the key is getting business and industry involved in the development of our human resource pool. It is clearly a win-win situation for all those involved.

The FIPSE project has been a tremendously rewarding process for me, as Project Director. I have worked with a dedicated group of educators at all three levels and without their creative efforts and support, the success of this project would not have been possible.