Tech Prep Student Activities at a Post Secondary Institution

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Abstract

National focus is turning toward keeping the American work force competitive in a global market. The transition of high school students into a university educational environment looms as a major issue in staying competitive. Tech Prep initiatives typically modify high school curriculum to meet certain state standards and facilitate articulation agreements with post secondary institutions. The ideal program should provide a seamless transition for students from high school to the university to industry.

This paper describes interactive, hands-on activities involved in a model Tech Prep collaboration currently under way at the Purdue University Programs Site in Anderson. The program began in the Fall of 1994 with twenty-two freshman students visiting the campus hi-monthly to participate in technology related activities. This fall it will continue with these twenty-two students as sophomores and thirty-seven entering freshmen. The methodology of Purdue's participation is presented and evaluated. Specific student technology projects that were completed are described and discussed. Plans for future activities and expansion of the program are also provided.

INTRODUCTION

The Indiana State Legislature has decreed that all high schools in the State of Indiana will develop and offer to their students a Tech Prep curriculum. In August, 1994, Purdue University Statewide Technology at Anderson began development of a program with Highland High School in Anderson. This program offers university level technology based experiences to the students enrolled in the Tech Prep program. Through meetings between the high school tech prep faculty and the university faculty, a series of visits to the university campus were arranged. At these visits, the high school students were given activities to complete in the areas of electronics, computer applications, mechanical engineering, and leadership. These activities were developed and implemented by the Computer Technology, Electrical Engineering Technology, and Organizational Leadership and Supervision departments of the Anderson Statewide Technology Program, and the Mechanical Engineering Technology department of the Muncie Statewide Technology Program.

UNIVERSITY GOALS

The first step in establishing any new activity is to set goals to measure success. The main goals determined by the Purdue staff and faculty were:

1. Provide a rich and motivational technological environment that would encourage the students to further investigate possibilities in technology studies and careers.

2. Develop a cooperative and involved relationship between the university faculty and the high school teaching staff. As stated in the paper, “Tech Prep: A Comprehensive Approach,” by James C. Wood and Diana M. Walter, Tech Prep programs involving an Associate Degree Institution must be a cooperative approach.1

   a. Previous presentations by university faculty to high school students during career days had been less than effective, and the university staff had decided that part of the problem resulted from lack of involvement of the teachers of the high school students. In one of the career day presentations the high school teachers were heavily involved and the results were very good.
   b. Teamwork is demonstrated to the students when both faculties are involved, and cooperation regarding discipline, student attentiveness, etc., is expected.

3. Introduce students, early in their education, to a positive university classroom experience.

4. Address issues of inadequate student development of skills needed for technology careers. [3]

HIGH SCHOOL TECH PREP GOALS

The high school faculty established objectives for the Highland High School Tech Prep university experience to complement the curriculum requirements, plus meet national competencies and Indiana State Essential Skills. A synopsis of these objectives is as follows:

1. Reduce anxiety for the transition from the high school experience to the university environment.
2. Promote awareness of post-secondary work force expectations.
3. Encourage the application of textbook skills.
4. Develop communication skills for post-secondary work force acceptance and proficiency.
5. Establish a good work ethic and develop a “hunger” to learn and seek new information.
6. Demonstrate how integrating subjects fits into the post secondary education/work force environment.
7. Reinforce the value of education.

METHODOLOGY

Sessions

University faculty determined that a total of four on-campus sessions per school year per high school grade would be offered. When the program is extended to all grades in the high school, freshman through senior, a total of sixteen sessions will occur. When offered over a period of two university semesters of sixteen weeks each, this will result in a session every other week. This is the minimum preparation time the university faculty felt necessary to present quality activities. Each session included two hours of hands-on activity emphasizing different areas of technology and included a follow-up assignment to be completed in the high school classroom. Sessions were designed to emphasize not only current technology, but also the need for education to support the technology in related areas like mathematics and science.

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II-was decided early in the program that multiple, short, hands-on activities would be the most effective approach to match the abilities of the high school tech prep students. "Several researchers and recent national reports have described the need for active learning in the classroom. They indicate that when students are actively involved in learning, they learn more than when they are passive recipients of instructions."[2] Three to four activities per session, each of thirty to forty minutes duration, seem to provide the best mix of challenge and diversity. Activities that required more time to master presented attention span problems for the high school students. They tended to lose interest.

The number of high school students participating in the program required breaking the class into several smaller groups. Laboratory facilities available at the Anderson and Muncie Purdue sites can accommodate ten to twenty students per activity and maintain an acceptably low student to workstation ratio. These smaller groups were rotated through the various activities. Since the students were broken into several groups, a rigid time schedule had to be developed so that all students moved to their next session at the same time. This was extremely important to avoid confusion and ensure that each activity was given adequate time for proper completion. Three groups were used when activities required forty minutes. Four groups were used when activities could be completed in thirty minutes. If activities required fewer than thirty minutes to complete, they were combined with other activities of similar time requirements to create an aggregate thirty minute activity.

Best results were achieved when group size was between seven and ten students. This number allowed individual attention from the university faculty during the activities. Given the challenge level of these activities, individual assistance is essential to mastery. The small group size prevents a student from falling into the background. All students are involved and directly participate in the activities. The smaller groups also aid in disciplinary monitoring.

The high school faculty must assist in the planning and be actively involved in the delivery of each session. They are instrumental in determining group makeup. A blend of leaders and followers is essential and personality issues must also be considered. The high school faculty, through their close association with the students, can assemble groups that will perform well. The presence of high school faculty rotating with the groups also helps to reduce discipline problems. Students accept the university experience as an extension of the high school classroom if the high school faculty is present and active. Without the high school faculty presence, many students view the session as a field trip.

Activities

All activities were designed to highlight an area of technology and demonstrate the skills and educational background necessary for a career in that area. Activity planners made an active effort to include a wide range of technology fields and to ensure that no single field received more coverage than other fields.

When possible, activities in different technology fields were coordinated. Occasionally, the results of an activity were maintained for use in a future session. Frequently data collected in one activity became the data used in a subsequent activity within the same session. However, use of data from a previous activity does present a special situation that must be addressed. The first group to perform the activity that uses data from another activity will not have that data. The rotation of groups through the different activities forces one group into the data usage activity before they have performed the data collection activity. This situation was handled by providing the first data usage activity a set of calculated or theoretical data to use.

The degree of challenge each activity presented was an area requiring considerable planning and design. 'Activities that are too difficult for the high school students to master cause frustration and loss of interest. Projects that are too easy to offer any degree of challenge will quickly become boring. Activities weredesigned to give each student a hands-on experience. All activities were designed so that each student had a separate workstation or separate tasks to perform if the workstation was shared. Students learn and retain better if they are active in the learning mechanism.[2] In a shared workstation situation, the leaders tend to do the bulk of the work, while the followers stand and watch. Individually assigned workstations and tasks eliminate this problem.

Since a large number of high school students were involved in each session, meticulous activity and time planning were required to achieve the maximum benefit to the students. The planning started with a selection of activities which could be completed in a 30-minute to 40-minute time period. Activity selection involved multiple meetings between university and high school faculty to ensure that each activity was within the skill levels of the students, and that each activity's delivery was complete and accurate. All activities underwent laboratory testing to verify that all equipment, programming, instruction packets, data collection sheets, etc. functioned as expected. Freshman projects included:

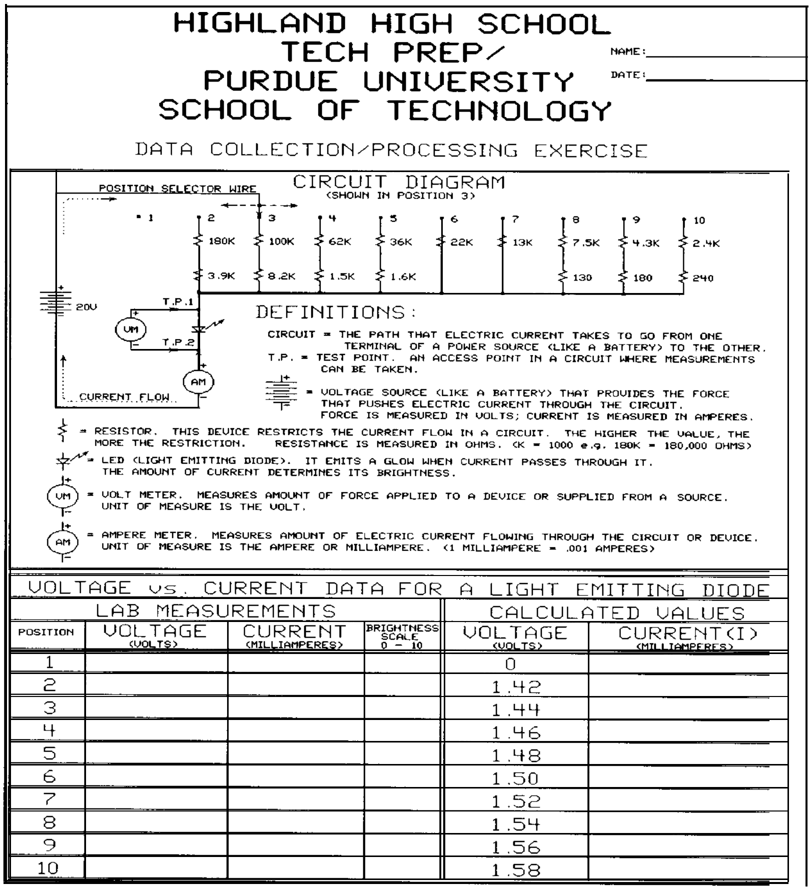
1. Entering data entry into a spreadsheet.
2. Measuring temperature effects on metal properties.
2. Comprehending decision making techniques.
3. Exploring digital electronic circuits and binary math.
4. Utilizing electronic fabrication techniques (soldering & resoldering).
5. Investigating light emitting diode circuits.
6. Using Autocad for a room layout.
7. Evaluating electronic systems & sensors.

Description of the Light Emitting Diode Circuit project

As discussed earlier, each student activity time on campus was broken into three or four segments. Students participated in activities during the year that involved welding, strain gauge measurements, Autocad, robotics, electronics and decision-making techniques. One of the early projects was an integrated electronics/computer-utilization activity spread over two one-half hour segments. This project had three main objectives:

1. Provide data taking experience on a live electronic circuit.
2. Familiarize the students with practical soldering and resoldering techniques.
3. Use the computer as a tool to present and compare data to calculated values.

This was accomplished by designing a circuit and data sheet for the students to use in the laboratory. Based on all the previously stated goals and guidelines, a great deal of effort was put forth to keep the circuits and forms simple and easy to use. Shown in Figure 1 is the activity sheet provided for each of the students to complete in the laboratory. About one-third of the electronic segment of this activity was allocated to explanation of the circuit, its function, instrumentation and data taking techniques. Additional work stations were set up in the lab for hands-on experiences in soldering and resoldering techniques. In this segment of the electronic lab experience the students soldered discrete electronic components into proto boards and resoldered components from a defective circuit board. These additional stations provided sufficient opportunities to keep all students actively engaged for the entire segment. This is extremely critical as the attention span for students at this level can be short. Bored, disinterested students turn any project into a disaster. Sufficient faculty support was recruited to provide a student to faculty ratio of less than four to one which works well.



HIGHLAND HIGH SCHOOL
TECH PREP/
PURDUE UNIVERSITY
SCHOOL OF TECHNOLOGY

NAME:
DATE:

DATA COLLECTION/PROCESSING EXERCISE

CIRCUIT DIAGRAM
(SHOWN IN POSITION 3)

POSITION SELECTOR WIRE
1 2 3 4 5 6 7 8 9 10
180K 100K 62K 36K 22K 13K 7.5K 4.3K 2.4K
3.9K 8.2K 1.5K 1.6K 130 180 240
20V
T.P.1
T.P.2
VM
AM
CURRENT FLOW

DEFINITIONS:

CIRCUIT = THE PATH THAT ELECTRIC CURRENT TAKES TO GO FROM ONE TERMINAL OF A POWER SOURCE (LIKE A BATTERY) TO THE OTHER.
T.P. = TEST POINT. AN ACCESS POINT IN A CIRCUIT WHERE MEASUREMENTS CAN BE TAKEN.
= VOLTAGE SOURCE (LIKE A BATTERY) THAT PROVIDES THE FORCE THAT PUSHES ELECTRIC CURRENT THROUGH THE CIRCUIT. FORCE IS MEASURED IN VOLTS; CURRENT IS MEASURED IN AMPERES.
= RESISTOR. THIS DEVICE RESTRICTS THE CURRENT FLOW IN A CIRCUIT. THE HIGHER THE VALUE, THE MORE THE RESTRICTION. RESISTANCE IS MEASURED IN OHMS. (K = 1000 e.g. 180K = 180,000 OHMS)
= LED (LIGHT EMITTING DIODE). IT EMITS A GLOW WHEN CURRENT PASSES THROUGH IT. THE AMOUNT OF CURRENT DETERMINES ITS BRIGHTNESS.
VM = VOLT METER. MEASURES AMOUNT OF FORCE APPLIED TO A DEVICE OR SUPPLIED FROM A SOURCE. UNIT OF MEASURE IS THE VOLT.
AM = AMPERE METER. MEASURES AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH THE CIRCUIT OR DEVICE. UNIT OF MEASURE IS THE AMPERE OR MILLIAMPERE. (1 MILLIAMPERE = .001 AMPERES)

VOLTAGE vs. CURRENT DATA FOR A LIGHT EMITTING DIODE

	LAB MEASUREMENTS			CALCULATED VALUES	
POSITION	VOLTAGE (VOLTS)	CURRENT (MILLIAMPERES)	BRIGHTNESS SCALE 0 - 10	VOLTAGE (VOLTS)	CURRENT (I) (MILLIAMPERES)
1				0	
2				1.42	
3				1.44	
4				1.46	
5				1.48	
6				1.50	
7				1.52	
8				1.54	
9				1.56	
10				1.58	

Figure 1 Sample Student Data Sheet

Concepts introduced on the worksheet are intended to promote understanding of the function of the activity and establish a base line vocabulary of electronic terms for future use. Data taken using standard laboratory equipment (voltage & current measurements) was entered into the appropriate columns, and the students were asked to estimate the brightness of the LED at various voltages (decision making). Student groups rotated from the electronics laboratory to the computer laboratory where they entered their data into the Microsoft Excel spreadsheet template illustrated in Figure 2.

Each high school student was provided a copy of the template. This spreadsheet template allowed them to create a line graph illustrating current versus voltage for the LED circuit. The spreadsheet shown in Figure 2 compares actual measured values with those calculated by equations entered into the spreadsheet. Students were split into several different groups that rotated through mechanical, electrical and computer experience. The first group to plot or calculate data in the computer experience was provided with sufficient information to create calculated data for their spreadsheets. This concept is critical to the planning of any activity since every session has a first group at the computer area with no experimental data.

Feedback from the students in the form of written reports assigned as the last part of the project indicated that the primary goals of the project were met. They said their visit was well planned, interesting and educational. The experience of seeing solder melt and flow gave them new respect for the word “hot.” Comments in their reports indicated that the instructors at Purdue were very helpful and they were looking forward to their next visit.

Position	*Lab* Voltage (volts)	*Measurements* Current (ma)	Brightness (0 to 10)	*Calculated* Voltage (volts)	*Values* Current (ma)
1	0.30	0.000	0	0.00	0.000
2	1.42	0. 095	0	1.42	0.118
3	1.44	0.155	0	1.44	0.186
4	1.44	0.281	1	1.46	0.295
5	1.48	0.461	2	1.48	0.468
6	1.51	0.808	3	1.50	0.741
7	1.53	1.390	4	1.52	1.173
8	1.55	2.350	6	1.54	1.859
9	1.55	4.080	8	1.56	2.944
10	1.59	6.720	10	1.58	4.664

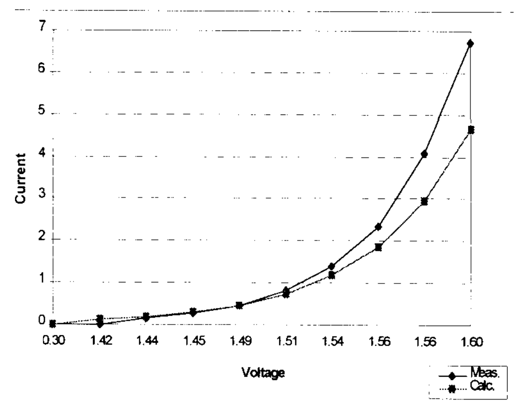


Figure 2 - Sample Student Spreadsheet

RESULTS AND FUTURE PLANS

Twenty-two students started the program and twenty-one of them are continuing in the program in their second year. Thirty-eight percent of the second year group is female compared to forty percent of the entering class. Retaining a high percentage of female students is an indicator of the success of the program, since engineering technology education typically has a very low percentage of female and minority students.

Thirty-seven freshman students entered the program this fall, and the retention of these students in the program is a prime goal. Thirty-eight percent of this class is female and/or minority.

Since over one third of the high school population will eventually be involved in the tech prep program, the high school/university collective effort should see significant growth. The program has allowed the university to present modern technology and its rewards to high school students before it is too late for them to register for courses which will qualify them for university level education. Thus the program can also be viewed as a long range university recruiting effort.

CONCLUSION

In the final assessment (conducted by both faculties and based on student “feedback”) the program was deemed successful enough to continue as the students matriculate to each succeeding grade level. Each new freshman class will continue to be introduced into the cycle. The early intervention and the richness of diversity in the high school student body combine to provide a “win/win” environment for the students and the university.

The Highland faculty indicated that the teachers and students have experienced a paradigm shift: students are the ones engaged in doing the work, while teachers have become facilitators and coaches in the later stages of the learning process. Students do not feel the need to ask, “Why are we learning or doing this?” They are able to understand the relevancy of the experiences and connect them via the application process.

REFERENCES

1. Wood, James C., & Walter, Diana M. (199 1). Tech Prep: A Comprehensive Approach. ASEE Annual Conference (pp. 555-561).

2. Mehta, Sudhir (1995). A Method for Instant Assessment and Active Learning. Journal of Engineering Education. July, (pp. 295-8).

Ercolano, Vincent (1 995). Seeing is Achieving. American Society for Engineering Education Prism, 5, (pp. 29-31).

4. Cullop, A., Dennis, D., Lowery, R., Chase, V., Teeters, K., (1996) Tech Prep Initiatives in a Co-Op Environment between a University Technology Program and a High School Tech Prep Class. IN/ILL ASEE Annual Conference Proceedings.

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