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ABSTRACT

This document compares Tech Prep and School-to-Work initiatives with the Berkeley Biotechnology Education, Inc. (BBEI) community college biotechnology education and training program. The primary goals of the three programs are: (1) Tech Prep links high schools with community colleges; (2) School-to-Work connects school-based learning with work-based learning to prepare students for roles in the workplace and integrate academic and vocational education; and (3) BBEI prepares students for technical positions in bioscience and for postsecondary education. A cohort of 27 BBEI students were studied; five of these students were selected for additional in-depth interviews. Results included: (1) through experiences in the three different settings--high school, community college, and laboratory workplaces--students learned that each setting had different expectations; (2) students had a sense of a range of educational and career options available, and said that they were able to make choices between these options; (3) work-based learning and school-based learning complement each other, but connections between the two settings cannot be assumed, and programs must be designed to make the connections clear; and (4) the expectations of both teachers and supervisors pushed students to make sense of multiple expectations that differed across school and work settings. (Contains 20 references.) (CJW)

Community College Students' Perspectives on Schooling and Scientific Work

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> And they'll get to the house and go, 'Oh look my daughter's working at a café.' My mom goes, 'Well my daughter's working in a laboratory'. Not to make them jealous, but to show them that not only their daughters can do. I'm proving to everybody that just because I have kids and I'm out of my house, that I can do what I need to do. -- Gracia, 1st year community college student

INTRODUCTION

This research focused on a particular point of view—how students (particularly students with little, if any, personal or familial connection to college) define and experience key issues, challenges and opportunities as they made the transition from high school to college while participating in work-based learning experiences in laboratory settings. Helping students see the connections between academic learning and work is increasingly described as one central goal of education. School-to-Work and Tech Prep programs are efforts aimed at preparing students for life after high school—employment and/or college. While school-to-work programs aim to enhance school instruction by adding both a work-based learning component and connecting activities that link the experiences at school and at work, Tech Prep programs focus on linking high schools and community colleges. The underlying assumption in both of these efforts is that high school educational practices have become quite distant and isolated from both college life and work. Reformers note that offering students a broad range of experiences, and increasing a high school's connections to work environments and to colleges, can help to improve the high school curriculum and better prepare students for what they will face in college classes and on

the job (Grubb, Badway, Bell, Kraskouskas 1996; Bragg Puckett, Reger, Thomas, Ortman, Dornsife, 1997; Urquiola et al., 1997).

However, studies of both School-to-Work (Hershey, Hudis, Silverberg, Haimson, 1997; Hershey, Silverberg, Haimson, Hudis, Jackson, 1998; Pedraza, Pauly, Kopp,1997) and Tech Prep programs (Bragg, Layton, Hammons, 1994; Bragg et al., 1997; Grubb et al., 1996) highlight the difficulty of obtaining work-based learning opportunities, integrating academic and vocational education, and meaningfully connecting high school and community college programs. Nonetheless, there are some successful programs. In an effort to highlight the challenges in integrating academic and vocational education and establishing connections across high school, community college and work settings, the research examined a particular point of view, that of the student participants.

In Part 1 of this paper the intentions of Tech Prep and school-to-work initiatives are compared to the Berkeley Biotechnology Education, Inc. (BBEI) community college biotechnology education and training program. Part 2 describes the research methodology used in this study. In Part 3, students' perspectives on schooling and scientific work are discussed. Students discuss issues related to deciding to enter the community college program and their plans for the future, working while going to school, making the transition to college level work, and interacting with adults in school and work settings. Finally, in Part 4 areas for future research are suggested

PART 1: COMPARING TECH PREP, SCHOOL-TO-WORK AND BBEI

Tech Prep Education Act

The 1990 Perkins Act provided federal funding to link secondary and postsecondary educational opportunities. The Perkins Act described 2+2 (or Tech Prep) programs, in which the goal was to join the last two years of high school with two years of study at a community college. Tech Prep programs were designed to create collaborations between high schools and community colleges in order to provide students a coherent sequence of occupationally related programs. In a study of Tech Prep, consortia[1] coordinators were asked to indicate the number of organizations actively participating. During the 1994-95 school year, local consortia typically consisted of 11 secondary schools, two two-year post secondary schools, one four-year post secondary school, 18 businesses, one labor union, four community based organizations, and three student leadership organizations (Bragg et al., 1997). Programs were to lead to placement in employment by providing technical preparation, which it was expected would lead to increased student competence in mathematics, science and communication, and provide students with an associate's degree or 2-year certificate. Local consortia were free to design programs to meet local needs as long as certain essential elements were incorporated into local plans. Essential elements described were formal articulation agreements, a core of required preparatory courses in high school, followed by two years of higher education for technical specialization, curriculum development, training for teachers and counselors, and equal access for special populations (Bragg et al., 1994).

[1] Consortia are groups of institutions (typically secondary schools, community college, and business) that work together to design and implement Tech prep programs.

Like many reform efforts, Tech Prep programs have been described by reformers as serving many worthwhile goals—meeting the needs of students who were not taking college track courses, eliminating general track courses, incorporating cooperative teaching strategies, linking school and work/college, reducing the amount of remediation needed at the college level, and expanding vocational education (Bragg et al., 1994). Tech Prep efforts have resulted in some positive results and have involved community college instructors to some degree. During the 1994-95 school year, most consortia had implemented formal articulation agreements, consortium building activities, and had established a governing or advisory board (Bragg et al., 1997). Community college instructors have participated in some Tech Prep activities including: collaboration, staff development, articulation, and curriculum development. In collaboration and staff development activities, college instructors have described the skills required (particularly in math and English courses) for students to be successful at the college level and to avoid developmental courses. College instructors have been involved in establishing articulation agreements that provide a variety of benefits to students (i.e., giving college credit for classes taken while in high school, waiving prerequisites) (Grubb et al., 1996).

Tech Prep has resulted in few changes at the community college level (Bragg et al., 1994; Bragg et al., 1997; Grubb et al., 1996). Tech Prep can best be described as a secondary school reform, in light of the fact that few changes have occurred at the college level. Upgrading the academic content of courses, integrating academic and vocational education, and incorporating more project-centered teaching approaches have primarily occurred at the high school rather than the community college level (Grubb et al., 1996). In addition, few consortia offered job placement services, apprenticeships spanning secondary and post secondary education or computer tracking

of student progress. While providing work-based learning for students and integrating academic and vocational education was more common, more intensive types of experiences (i.e., work-based learning and integrating academic and vocational education) have not been widely implemented (Bragg et al., 1997; Silverberg and Hershey, 1995).

School-to-Work Opportunities Act

Congress passed the School-to-Work Opportunities Act in response to findings that the earnings of high school graduates have been decreasing, that increased international competition and new technologies have reduced the need for unskilled labor, and that the United States lacks a comprehensive system to help students make the transitions from school to work (H.R. 2884, 1994). Although a small amount of money was allocated for school-to-work programs, this Act was significant in that it expanded federal support of programs making high school relevant to college and employment. The School-to-Work Opportunities Act can be seen as an extension of the Tech Prep Act in that a broader range of components (beyond high school and community college linkages) are identified, especially connections to work.

The School-to-Work Opportunities Act of 1994 established a national framework for the development of school-to-work systems in all states in order to enable students to earn portable credentials, to prepare them for jobs in high skill, high wage careers, and to increase their opportunities for post-secondary education. The Act mandated that 1) students select a career major in the 11th grade; 2) the program include work-based learning, school-based learning, and connecting activities; and 3) the program lead to a skill certificate and post-secondary options (H.R. 2884, 1994). The primary purposes of school-to-work programs include preparing

students for roles in the work force, utilizing partnerships to enhance educational opportunities and integrating academic education and vocational training. Like Tech Prep programs, school-to-work programs have been defined in a number of different ways: keeping options open for going to college or to work, eliminating the general track in high school, and building networks of educators and employers (Urquiola et al., 1997). The School-to-Work Opportunities Act also identified connecting activities that were seen as essential to integrate school-based and work-based learning.

Although the School-to-Work Opportunities Act required creating linkages between secondary and post-secondary institutions, a recent study of 16 school-to-work programs revealed that most programs have not made advances in establishing these linkages (Pedraza et al., 1997). Integrating academic and vocational education is often discussed as an ideal, but few schools have actually been able to implement the ideal in daily practice (Bragg et al. 1997, Hershey et al., 1997; Grubb, 1995). In addition, school-to-work programs have given more attention to soliciting the participation of employers than getting the support of academic educators (Hershey et al., 1997; Stern, Bailey, Merritt, 1996). Schools play the dominant role in developing program components and most companies can not offer intensive work experience for more than four students at a time (Hershey, et al., 1998).

Berkeley Biotechnology Education, Inc., (BBEI)

This study focused on a cohort of 27 students at a local community college who participate in a biotechnology education and training program. The program, as implemented, reflects elements of both School-to-Work and Tech Prep program models. The program is coordinated by a non-

profit organization, Berkeley Biotechnology Education, Inc. (BBEI) which seeks to "build interest in science and technology careers, among populations typically under-represented in the sciences, through classroom experiences and exposure to the world-of-work" (BBEI Mission Statement, 1997). BBEI was founded in 1992 as a result of a public/private partnership between Bayer Corporation and the City of Berkeley. Two high schools, one community college and 55 industrial partners work in partnership with BBEI to create opportunities for students to become prepared for the world of work in the biotechnology industry. The participating high schools are Fremont High School in Oakland, California and Berkeley High School in Berkeley, California. The community college component takes place at Laney College in Oakland, California. BBEI assists students making the transition to community college in a variety of ways.

The BBEI program includes on nine components. (1) A high school program for 11th and 12th graders that includes hands-on laboratory experiences, a laboratory skills-based curriculum, small classes, and competency-based grading. Students complete four semesters of specialized lab-based courses in biotechnology (in conjunction with a full 4-year high school program). Students use the tools and techniques from the bioscience industry to prepare media, grow and maintain cell cultures and conduct experiments in molecular biology and biochemistry. (2) High school students work in paid summer internships in scientific settings in the summer between their junior and senior years. (3) A community college bioscience certificate program emphasizes more advanced laboratory training. Students complete four college level science courses: Introduction to biology, microbiology, inorganic chemistry, and organic/biochemistry. (4) Students work in paid year-long co-op jobs in laboratory settings while taking college level science courses. (5) Teacher training that includes paid teacher internships in industry,

classroom training, and joint high school and community college instructor retreats and workshops. (6) Job placement assistance is provided to help program graduates find employment. (7) Industry outreach efforts designed to attract companies to partner with BBEI, and ensure education/industry collaboration in training and placement of students and graduates. Over 50 companies have offered summer internships or year-round co-op jobs to students or have hired program graduates. (8) Support services to help students maximize their potential for successful program completion and include: scholarships, mentoring, tutoring, career guidance, college counseling, and leadership opportunities. (9) Program evaluation, which includes collection and analysis of data and assessment outcomes.

Comparing Tech Prep, School-to-Work and the BBEI Program

As summarized in Table 1, BBEI exhibits elements of both Tech Prep and School-to-Work initiatives. Like Tech Prep, the BBEI program links two high schools and one community college. Like School-to Work, the BBEI program links school-based learning and work-based learning through connecting activities.

Like Tech Prep initiatives, the BBEI program offers core science courses in high school and teacher training. Unlike Tech Prep, the BBEI community college program is not a full two year associate degree, but rather a one year certificate program which qualifies students for entry level skilled-technical positions and provides 17 of the 20 science units required for an A.S. degree[2]. Where many Teach Prep programs have had difficulty implementing work-based learning

[2] Skilled technical positions typically require some college level science courses as a minimum requirement. Since most biotechnology companies have extensive educational reimbursement programs, where the company pays for employee schooling, the BBEI program was designed as a one year certificate to provide students access to entry level skilled technical positions and opportunities to fund higher education while working in industry.

components (Bragg et al., 1994; Bragg et al., 1997) and successfully transitioning high school students to the community college partner (Grubb et al., 1996), each year BBEI provides approximately 60 internships to high school students, 30 co-op jobs to community college students, and job placement services to graduates. In addition, over 50% of 12th graders in the BBEI program matriculate to the community college partner and over 90% continue on to some form of postsecondary education.

Like School-to-Work initiatives, the BBEI program begins when students select biotechnology as a career major in the 11th grade. Students receive specialized training and work in an internship and co-op job in industry. BBEI coordinates a variety of connecting activities including: student seminars to discuss workplace experiences, teacher visits to each student at the job site, teacher and industry supervisor training, information to teachers and employers about student progress in both settings, and opportunities for students to speak about their experiences in school and at work sites. As suggested by the school-to-work initiative, students receive a skill certificate at the end of both the high school and the community college programs.

BBEI students experience a coherent sequence of career development activities. Individual students participate in school-based learning activities at both the high school and community college level, and at least two different work based learning opportunities including a paid internship as a high school student and a paid co-op job as a community college student. Consistent with findings of other School-to-Work programs, only one business partner (Bayer Corporation) offered co-op job placements to more than four students during the 1999-99 school year. Research indicates that most students participating in school-to-work programs experience

occasional and unconnected career development activities. Only 2% of students experienced "a variety of career development activities, school-based career majors, and work place activities linked to the high school curriculum" (Hershey et al., 1997). A study of 16 programs found sites struggling to find a balance between scale or offering opportunities to larger numbers of students and intensity or providing individual students with a coherent sequence of experiences (Pedraza et al., 1997). As discussed in relation to Tech Prep programs, school-to-work reformers have put lower priority on developing linkages between high schools and post secondary institutions. To compound the problem, students often do not take advantage of formal linkages that have been established (Pedraza et al., 1997).

Table 1: Elements of Tech Prep, School-to-Work and the BBEI Program

	Tech Prep	School-to-Work Opportunities Act	BBEI Program
Primary Goal	Linking high schools and community colleges	Connecting school-based learning with work-based learning to prepare students for roles in the workplace and integrate academic and vocational education	Prepare students for technical positions in bioscience and for post secondary education
Essential Components **Education**	Core preparatory courses in high school Two years of technical specialization at the post secondary level leading to an associate degree or 2-year certificate	School-based learning Career major in 11th grade Post secondary options Skill certificate	11th and 12th grade high school program One-year Community College Bioscience Certificate Program
Work		Work-based learning	Paid summer internships Paid co-op jobs
Linking	Training for teachers and counselors Articulation agreements Job placement	Connecting activities that link experiences in schools and in workplaces	Teacher training Job placement Industry outreach Support services Program evaluation
Target Population	Not specified, legislation referred to high school dropout rates of 50%, majority of state coordinators identified students as coming from the 25th to 75th percentile.	All students	Students typically under-represented in the sciences
Consortia or Partnership Membership	11 secondary schools 2 2-year colleges 1 4-year college 18 businesses 1 labor union 4 community organizations 3 student organizations	School districts High schools Businesses (Unions and colleges are less involved.)	2 high schools 1 community college 26 industrial partners 2 community organizations 1 4-year college
Challenges	Integrating academic and vocational education Establishing work-based learning components and post secondary connections	Integrating academic and vocational education Establishing work-based learning components and post secondary connections	Presented later in this paper through students descriptions of their experiences.

As suggested by the comparison in Table 1, the research site reflects elements of both Tech Prep and School-to-Work initiatives. Students are enrolled in college courses (with a designated community college partner) after completing a two-year high school program. In addition, all 27 students in the cohort worked in co-op jobs in laboratory settings. Studying this cohort of students can help to determine what role work-based learning plays in students' transition to college.

PART 2: RESEARCH METHODOLOGY

Qualitative Methodology

Bogdan and Biklen (1998) stated that methodology is the general logic or theoretical perspective that informs research, emphasizing that theoretical assumptions orient thinking and research. Researchers have rarely studied how work-based learning experiences enhance or inhibit academic and occupational development of students or how students experience work-based learning (Stasz and Kaganoff, 1997). Erickson (1986) noted the importance of the "immediate and local meanings of actions, as defined from the actors' point of view." From this perspective, students are important actors with unique points of view. This research focused on a particular point of view—how students (particularly students with little, if any, personal or familial connection to college) define and experience key issues, challenges and opportunities as they made the transition from high school to college while participating in work-based learning experiences in laboratory settings. McGinn and Roth (1999) described the need for students to realize that scientific discovery is embedded in webs of social relations among scientists, technicians, politicians, journalists, granting agencies, tools and equipment. Like McGinn and Roth, this study explored how students experience and understand the webs of connections

among high school, college and scientific work. Studying the details of a particular site, from a particular perspective, through interviews, observations, and analysis of written work, allows consideration of how students make sense of their experiences in work-based learning while making the transition to college.

Student perspectives may be very different from that of educators and employers. Bragg (1997) asked students, employers, and educators to sort statements about desired Tech Prep outcomes. She found that students sorted the outcome statements very differently than educators and employers. Students attributed greater value to educational outcomes (e.g., graduating from high school, advancing to college) and work skills (e.g., personal initiative, using technology and information), rather than academic outcomes, especially in math and science.

Researcher Role

In the course of data collection I had access to many documents and interviewed many different people. For the past five years I have worked as BBEI's Education Director, and I have been a Co-op Education Instructor (at the community college) for the past three years. My professional role as a BBEI employee is to find work-based placements for students, to monitor students' progress at school and on the job, and to assist teachers. Students are accustomed to talking to me about their progress in school and at work (I have known each of these students for over three years); thus, my formal role is consistent with my research questions.

Researchers debate the tradeoffs of being a participant in the research setting. Being a researcher/practitioner can make it difficult to see what is being taken for granted and/or can

allow for long-term participation and understanding of the setting. Bogdan and Biklen (1998) suggested that researchers should not be directly involved in research settings since it is difficult to change thinking patterns and see what is being taken for granted. Erickson (1986) noted that fieldwork involves long-term participation and that an individual involved in the setting can be an "unusually observant participant who deliberates inside the scene of action." Erickson noted that the reflectiveness of qualitative research "make(s) the familiar strange." As a participant in the action, I had a dual role as both researcher and participant. Peshkin (1988) alerted researchers to be aware of the multiple "I's" one brings to a research setting. During this study I found that my "Program Planner-I" was evaluating outcomes in relation to objectives stated in foundation grants, my "Teacher-I" was focused on interactions I observed in classrooms and at work places, my "Scientist-I" was thinking about scientific content and skills, and finally my "Researcher-I" was looking to see how my work at BBEI fit in with all the research reports I have read.

For this research I relied solely on taped interviews with five focal students, taped discussions of three teacher meetings, and written documents as data sources. However, my full knowledge of the program helped me to make connections that another researcher might not have made. For example, because I am intimately aware of each student's involvement with the program, I was able to construct a table (Table 2) of student program participation.

Participants

The students who entered the community college portion of BBEI's nine-part program in Fall 1998 were in an ideal situation to reflect upon their personal transitions to college, since they

completed a two-year high school program and began taking college courses while working in laboratory settings. This was the first cohort in which students from both of BBEI's partner high schools were represented. The cohort included students who either left the program or completed both, some, or no science courses in the fall semester. In addition, the students worked as laboratory assistants in 13 different locations.

- Of the cohort of 27 students who started at the community college in Fall 1998, 12 (44%) of the students came from Berkeley High School and 15 (56%) came from Fremont High School.
- Students took two science courses (inorganic chemistry and biology) during the Fall semester. Five students (19%) dropped out of the program, two (7%) passed no science courses, but did not leave the program, eight (30%) passed one of two science courses, 12 (44%) passed both science courses.
- Ten (37%) of the students are male and 17 (63%) are female.
- Thirteen (48%) of the students are African American, eight (30%) are Mexican American, four (15%) are Asian/Pacific Islander and two (7%) are White.
- Five instructors and two instructional assistants work with this cohort of students at Laney College. All of the staff are women, six (86%) of the seven are White and one (14%) of the seven is Asian.

Table 2 lists the high school attended, sex, ethnicity, grades in Fall 1998 courses, Spring 1999 course plans, and location of co-op position for each student.

Table 2
Laney College Bioscience Career Institute Students 1998-1999

Focal students appear in bold. Pseudonyms were given to focal students.

Student (n=27)	High School Attended	Sex	Ethnicity	Fall 1998 Grades		Spring 1999 Plans (courses)	Co-op Position
				Bio 10	Chem 30A		
1	B	M	White	B	C	two	Bayer Corporation (summer) Laney College
2	F	F	African American	W	C	two	EBMUD
3	F	F	Mexican American	A	A	two	Alta Bates
4	F	F	African American	W	W	left program (had a baby girl)	BBEI
5	B	F	Asian	B	B	two	Bayer Corporation
6	F	F	African American	W	W	one (Bio)	Bayer Corporation
7 Terry (TB)	**F**	**F**	**African American**	**A**	**B**	**two**	**Bayer Corporation**
8	B	F	African American	W	W	left program (in community college, working at the GAP)	Americans for Non-Smokers Rights
9	F	M	Mexican American	C	C	two	Bayer Corporation (summer) Fremont High School
10	B	F	African American	C	C	two	Department of Justice
11	F	M	Mexican American	C	B	two	Cortex Biochem
12 Gracia (GH)	**B**	**F**	**Mexican American**	**C**	**W**	**three**	**Bayer Corporation**
13	B	M	Asian	A	A	two	Bayer Corporation
14	F	M	Mexican American	B	C	two	DNA Plant Technology
15	B	M	African American	B	W	three	Temp. Lab Support
16	F	F	Asian	C	W	two (30A &Micro)	Bayer Corporation
17 Kenisha (KM)	**F**	**F**	**African American**	**C**	**W**	**two (30A &Micro)**	**Lawrence Berkeley National Laboratory (LBNL)**
18 Ethan (EM)	**B**	**M**	**White**	**A**	**A**	**two**	**EBMUD (summer) Berkeley High School**
19	F	M	Mexican American	B	C	two	National Food Lab (NFL)
20 Victoria (VN)	**F**	**F**	**Mexican American**	**A**	**A**	**two**	**DNA Plant Technology**
21	F	M	African American	C	W	two	LBNL
22	B	F	African American	Micro	30 B	left program (working at Sugen)	LBNL
23	F	M	African American	W	W	left program (working at NFL)	National Food Lab (NFL)
24	B	F	African American	W	W	one (Bio)	Bayer Corporation
25	F	F	Asian	C	W	one (30A)	Bayer Corporation
26	B	F	Mexican American	W	B	two	LBNL
27	B	F	African American	Micro	30 B	left program (temping in lab positions)	Bayer Corporation

Selecting Focal Students

While there were 27 students in the cohort, five students were selected for in depth interviews. In selecting the five focal students to interview, students with a variety of characteristics were chosen—those who had passed only some courses, those who passed all their courses, students working in different laboratory locations, and students of different ethnic backgrounds. Four female students and one male student were interviewed. Two of the students are African American, two are Mexican American, and one is White. Three students completed both of the fall courses and two students completed only one of the two fall courses. The pseudonyms of selected focal students were: Victoria, Ethan, Gracia, Kenisha, and Terry.

Both Victoria and Ethan received A's in both of their science courses, and both informally tutored other students. Victoria attended Fremont High, Ethan attended Berkeley High. Victoria worked at DNA Plant Technology and Ethan worked at East Bay Municipal Utility District (EBMUD) during the summer and as the Lab Assistant at Berkeley High during the school year. Ethan's co-op position as a tutor/lab assistant in the high school biotech courses had potential for interesting points of comparison between high school and college. Terry attended Fremont High School and worked at Bayer Corporation. She and Victoria were study buddies.

Gracia and Kenisha both failed to pass one class. Gracia has two sons aged four and two. She planned to take three science courses during Spring 1999, microbiology and organic chemistry, plus the inorganic chemistry class she did not pass the previous semester, while also working at Bayer Corporation. Kenisha worked at Lawrence Berkeley National Laboratory. Although BBEI co-op jobs are typically one year, she was asked to stay in her job (for as long as she was interested). Her supervisor was willing to employ her in the lab as long as she is taking college

courses. She planned to take the microbiology class and to repeat the inorganic chemistry class that she did not pass the first semester. Both Gracia and Kenisha took the inorganic chemistry class from a non-biotech program instructor[3]. This experience had potential for revealing an interesting point of comparison when describing college level courses.

Data Collection Procedures

Data was collected from February to April 1999. Eight hours were spent collecting documents on BBEI and the students. Student documents, in files in the BBEI office, have been collected over the course of the students' participation in the program. Documents were photocopied from all 27 student files (a study skill questionnaire and written papers in which students reflect on their co-op job placements and their ability to meet learning objectives).

A total of five hours was spent interviewing the students. Three hours were spent taping teacher meetings. These recorded discussions were turned into data (text) to be analyzed. Eight hours were spent listening to the tapes and correcting transcripts. A transcriber did the initial transcription of each tape, then her work was checked by listening to the tapes again. Additions/corrections and speaker identification was written on a hard copy of the draft transcript. This procedure ensured that the tapes were listened to twice to make sure that the transcripts reflected my accuracy standards (especially with scientific terms).

[3] Biotechnology students are co-enrolled in two science courses each semester. Since biotech instructors teach different courses in the fall and the spring, students that do not pass fall biotech courses retake these courses from the general Laney College science offerings, thus they do not have the benefit of a cohort structure.

In addition to these formal research activities I continued to work for BBEI 30 hours per week. Data collection activities are summarized in Table 3 in the form of a timeline.

Table 3: Data Collection Timeline

Data Collected	February	March	April
Documents (Inventory of one student's file)	X		
Documents (BBEI mission statement, educational flow chart, list of company partners, 9-part model program description, skill certificates)	X		
Taped Discussions of Meetings (student support discussion during partnership meetings with high school teachers and community college instructors)		X	
Documents (Fall semester grades, spring enrollment status, co-op education papers for summer 1998 and fall 1998)		X	
Taped Event (Bioethics Symposium panel on ethical issues faced on the job)		X	
Taped Interviews (Interviews with 5 focal students)		X	X

Data Analysis Procedures

Twenty-three hours were spent reading documents, coding chunks of text and writing a first draft of the findings section. Four phases of data analysis lead to the development and evolution of codes as presented in Table 4.

Table 4: Development of Codes

Phase 1 **Initial Codes** Co-op Papers	**Phase 2** **Places of Learning** **(8 Codes)** Interview Transcripts	**Phase 3** **Consolidating** **(5 codes)** Interview Transcripts	**Phase 4** **Writing up Findings** **(4 comparisons)**
Future Plans	High School Student College Student Future	Student Future Plans	Reasons for Entering and Future Plans
Learning Objectives Efficiency/Time Paperwork	Work	Descriptions of Work	Comparing School and Work
Efficiency/Time	High School College	What is School Like	Comparing College and High School
How Trained	High School Teacher College Instructor	Role of Adults	Access to Adults

Phase 1: Initial Codes

Focal students' final co-op education papers from the Summer and Fall semesters were read and initial codes were noted in the margins. Initial codes were related to the organization of the papers and were focused on descriptions of job duties and training procedures, rather than on school-based learning.

Phase 2: Places of Learning

After coding the co-op papers, interview transcripts were coded according to the three places of learning (high school, community college, and work). Eight codes were used to categorize the interview data—comments about being a high school student, high school teacher, high school, community college student, community college teacher, community college, work and future. When moving text, an effort was made to maintain clumps of speech where the interaction between the student and myself remains visible to the reader. This was done in an effort to make my role in the interaction visible.

Phase 3: Consolidating

The eight codes were consolidated into five—student, role of adults (teachers and supervisors), what is school like, descriptions of work, and future.

Phase 4: Writing up Findings

Four headings organized the writing process—reasons for entering the program and future plans, comparing college and high school, comparing school and work, and access to adults (supervisors and teachers). Student quotes were used as headings for subcategories within the four sections. Interview segments that were good examples of the ideas that the five students identified in the interviews were selected.

PART 3: FINDINGS

Four comparisons are presented in this section in order to highlight BBEI students' experiences in different settings. First, students' reasons for deciding to enter the college program and their plans for the future are presented. In describing reasons for entering the community college program and their future plans, students discussed the importance of education to career goals and a sense of self. Second, students' experiences at work and school are compared. In comparing work and school, students noted that at work scientific knowledge is applied in the laboratory and in school the focus is on theory and scientific details. Third, students' experiences in making the transition to college level work are discussed. In discussing what it means to be in college and to be a college student, students described college as a "serious" place (compared to high school) where much material was covered at a fast pace, thus much study time was required. Fourth, students' comments about interactions with adults in school and work settings is described. In describing interactions, students revealed that work supervisors and

teachers shared expectations for certain things, but that expectations varied across school and work settings.

Reasons for Entering the Program and Future Plans

While Grubb et al. (1996) found that Tech Prep partnerships had difficulty transitioning high school students to the community college partner, the five focal students described different reasons for entering the community college biotechnology program. Three of the students were considering entering a four-year college and two of the students were considering working in full-time jobs after graduating from high school. Table 5 presents the students' comments about why they entered the community college program and their goals for the future.

Table 5: Focal Students Reasons for Entering the College Program and Goals for the Future

Student (n=5)	Why Entered Laney Program	Future Goals: Five Years
Terry (TB)	TB1 - Well I could have went to a university if I wanted to but since the Biotech program is so direct and you know exactly what it's doing, I just said ok, I'll do the Laney thing and if that doesn't go well I have a Biotech certificate behind my name which could still put me at an advantage and then I could still transfer to a university.	TB8 - I hope that I will have done my B.S. already by then and starting my career (forensic researcher). What we're doing now is like the foundation for us to venture off to our career. I'll probably still be in school and working and doing what I'm doing now. But I probably would be in university somewhere.
Gracia (GH)	GH4 - Well, from graduating from high school I'll get a fun job, just work full-time making the minimum wage. But then I thought about it, if I go to school, and just get prepared, and get my requirements to work in a place where I can make more than the minimum wage, and still be working and going to school. I was thinking about making my boyfriend work. I would have stayed home, sleep all day. But no, my education was more important to me and it's something to show my kids.	GH11 - Working at Bayer, supervising, QA, QC. Still going to school, going for my B.A. Um, five more kids. I'm just kidding. GH12 - Maybe one but no, I'm not sure yet. Maybe after I'm real settled, I want a girl. Just to see if she will look like me or not. Well, hopefully have work and make good money or at least something to get, I guess a house, I could have a house where my kids would be ok. GH12 - Probably try to travel to Hawaii or Mexico.
Kenisha (KM)	KM2 - Because I had talked to like three different counselors before I really graduated. Two of them were telling me that I should start off at a J.C. So I just took that and thought about it. KM3 – If I would have went straight to a university the class would be so big and you would just be lost. And then they were saying like a J.C. is a little bit easier.	KM6 - Probably at a university or a state college. I thought about like San Francisco State and probably Cal State Hayward. I wanted to stay with the job and they said that I would have to go to a UC that was close in the area. I was thinking about taking up pathology but I'm not that sure about that.
Ethan (EM)	EM - Senior year I was a Taco Bell shift manager with opportunities to move up. I was debating between Laney and the manager job. Taco Bell didn't seem like the best line of work. I've done more.	EM4 - Five years I hope to be in graduate school with a Bachelor's degree in Biochemistry. That's where I hope to be in five years. My plans have changed drastically in the last five years that I have lived, I don't know if that's gonna come true but... Next year I envision being at Laney working on my Bachelor's.
Victoria (VN)	VN1 - I was gonna go to a four year or go to a community college, so I decided to come to Laney because I was gonna have to take the science courses anyway, and at a community college it's a lot cheaper and it would prepare me better for when I do transfer. And it, one thing coming to the Laney program gave me was experience in lab work.	VN8 - Five years from now, well, I think I'll still be in school. Probably. Next thirty years. I already told my mom. I'll probably barely be graduating from like a four-year university for my BS and, if I can, get a job that at least has to do with what it is I'm dealing with at school, like I am now.

Reasons for entering the community college program varied amongst students. However, there were common themes, including useful applications for education, a choice of a community college versus a 4-year college, and the contribution that education can make to establish a sense of self.

As seen in Table 5, students described the benefits of college and linked experience to future use. School is seen in a useful light, and this can contribute to new educational goals. Gracia noted, "But then I thought about it, if I go to school, and just get prepared, and get my requirements to work in a place where I can make more than the minimum wage (GH4)." Like Gracia, Ethan was considering taking a full-time job after high school. His comments suggested that he felt that college would allow him to do more, "Taco Bell didn't seem like the best line of work. I've done more."(EM1) Terry described college as a foundation for things to come in the future, "What we're doing now is like the foundation for us to venture off to our career." (TB8)

Students also revealed reasons for choosing a community college over a four-year college. Kenisha identified the size of the classes as a factor, "If I would have went straight to a university the class would be so big and you would just be lost." (KM3). Victoria noted the low price of community college classes, "I was gonna have to take the science courses anyway and at a community college it's a lot cheaper." (VN1) Terry identified having a clearer understanding of what the community college was offering, "since the Biotech program is so direct and you know exactly what it's doing." (TB1)

Students also described the importance of education to a sense of self. Gracia noted the importance of education in her role as a mother, "My education was more important to me and

it's something to show my kids." (GH4) She went on to say, "Well, hopefully have work and make good money or at least something to get, I guess a house, I could have a house where my kids would be ok." (GH11) Ethan's comment, "I've done more." highlighted his understanding of school requiring something more of him than work at Taco Bell. All five students stated that they hoped to earn bachelors degrees in the next five years, suggesting that they were aware of a range of options beyond community college and entry level positions in bioscience industry.

Comparing School and Work

Offering students a broad range of experiences, and increasing a high school's connections to work environments and to colleges, can help improve the high school curriculum and better prepare students for what they will face in college classes and on the job. School and business partnerships have potential to increase the rigor of the typically fragmented high school offerings, but simply placing students in work-based learning experiences will not increase learning (Hamilton and Hamilton, 1997). Work-based learning settings can be evaluated for authenticity or meaning to student, academic rigor and the use of discipline specific methods of inquiry, and applied learning involving problem-solving, teamwork, and organization (Stasz and Kaganoff, 1997; Urquiola et al., 1997). In addition, work-based learning settings can be evaluated for active exploration or investigation through a variety of methods, adult connections and making adult roles visible, and assessment practices including frequent feedback, self-assessment, and clear benchmarks (Urquiola et al., 1997).

Three issues that are related to comparing school and work are presented in this section. First, students identified work as experience, rather than as just a job. The students referred to their co-op positions as "work experience" (KM5) or "experience in lab work" (VN1). In addition, the

students noted that their experiences were unique for people their age--"it put me in the type of job, types of jobs that most young people don't have . . ." (EM3). Second, work was described as a place where the theories learned in school are applied—"They teach us how to make them here, and what happens, and the reactions but at work is where we have to make them. Like the molar solutions." (VN9). And third, the nature of learning at school meant being a traditional student—"Mmm, well, you sit in class and listen." (VN4), while the nature of learning at work meant fulfilling responsibilities and asking questions—". . . I ask a lot of questions. If I see somebody doing a different experiment I ask, "What is that?" (KM7)

"Job Opportunities That Most Teenagers Wouldn't Have"

Students referred to their co-op jobs as unique opportunities to gain experience in lab work. The five students recognized that few young people have access to work-based learning activities that are directly related to their studies in school. Students recognized that exposure to the world of work was an opportunity--"It's sort of a transition from going from a child to an adult, it helped because it put me in the type of job, types of jobs that most young people don't have the opportunity to experience. I think that had an impact on my mind" (EM3). College instructors also described the program as an opportunity, "So I think what this does is it really just opens the door and gives them an opportunity" (Community college Instructor).

In the following excerpt from an interview with Victoria, she described how having the opportunity to gain laboratory experience at DNA Plant Technology (DNAP) was a factor in her decision to go to community college. She also noted that the other students working in the same DNAP laboratory were upper division four-year college students, not community college

students. She explained that the Laney program, "gave me experience in lab work" (VN1). When asked whether she got lab experience from school or work, she said at work—at DNAP.

Example 1.1

VN1 - Well I was, I either had two choices - I was gonna go to a four year or go to a community college, so I decided to come to Laney because I was gonna have to take the science courses anyway, and at a community college it's a lot cheaper and it would prepare me better for when I do transfer. One thing coming to the Laney program gave me was experience in lab work, and if I would have applied to a four year, I don't think I could have been able to work in a lab like my first year. Usually they accept like juniors and seniors to work in the labs.

AR1 - So when you say lab work, are you talking about your work at Laney or your work at DNAP or both?

VN1 - My work at DNAP.

AR2 - You think you wouldn't have had that as a first year college student?

VN2 - No, I don't.

AR2 - How come?

VN2 - Well, for the most part, from what I've noticed at work, the students that do work there are from four year colleges they're not freshmen, they're juniors and seniors and I don't think they'd give us the opportunity, I don't think they feel we're prepared. And I think we're lucky because we went through the Biotech program in high school and that gave us a lot of training. It took a lot of time off of their hands in teaching us how to use little things like the pipettes and the centrifuges and that sort of thing.

While Victoria noted that she was in a unique situation (she is a first year community college student working in an agricultural biotechnology laboratory), she also described her high school preparation and how it played a role in her work at DNAP. She clearly saw that her supervisors didn't need to spend as much time training her since she already had experience using basic laboratory tools and equipment. All five students interviewed said that college courses covered theory and details, and that work provided opportunities for application of theory and use of tools and equipment. Victoria suggested that the high school setting also provided exposure to basic laboratory equipment, and that this exposure reduces on the job training time.

"You Learn Theories in the Class But You Apply Them in the Lab at Work"

Work-based learning experiences can help students gain technical competence (Hamilton and Hamilton, 1997). All five students described work as a place of application of theories learned in school. Each student noted that the major similarity between the two settings is the laboratory work, especially using basic tools and equipment. Victoria noted the similarities in the previous interview excerpt (Example 1.1). Gracia also noted the similarities, "We do the same, use the same equipment, like the pipettes and the pH's and the chemicals, and the math, and like you have to be there on time every day and if you're not you have to call in" (GH14). In the following interview excerpt, Kenisha noted that at work she performed procedures or techniques, but at school she learned the background of these laboratory techniques. Kenisha reported gaining technical competence through a combination of work-based and school-based learning.

Example 1.2

AR6 - How is learning at work similar and different to learning at school, because you were talking about wanting to stay with the job?

KM6 - It's similar because a lot of things I do at work I do here at school, especially in our labs. I learned the majority of the stuff that we do in the microbiology class from my job. I had already learned it. So it's similar because we do the same things in the lab.

AR6 - What kind of things have you done, like what's something you've done at work and...

KM6 - That I did here? It's like gram staining and identifying microorganisms, streaking plates, counting colonies, it's a lot of things. We learn more at school, I mean, we learn more details at school than at work. Like when doing the gram staining here, they told us more of the purpose for why we do gram staining and everything about what happened to the cell. And at work she just gave me the procedures and I just did a gram stain.

AR7 - Without that background information.

KM7 - Yeah.

AR7 - You said when you got to micro you've pretty much done everything already. So do you think that that's helped you in micro just the fact that you've done the procedure before or not?

KM7 - It helped me some but I wouldn't say, I wouldn't really say it helped me because doing the labs that's not really what counts, she likes the lab write-ups and the exams. Maybe it kinda helped because I was like 'Oh, I understand this' and I knew some of the names that she was saying.

Kenisha's statements detailed that at work she performed procedures, "I just did a gram stain," while at school she learned the procedural background, "purpose for why we do gram staining and everything about what happened to the cell." She also suggested that there was a difference between the forms of evaluation at school and at work. She noted that at work doing the procedure was what mattered, but in school "lab write-ups and the exams" were what counted. Terry echoed her comments, "I mean it's just the test and the quizzes, I don't think a lot of us is really used to that - taking a lot of tests quizzes every week like that" (TB2). The combination of school and work provided students with the opportunity to learn both scientific theory and laboratory skills. Work-based learning settings provide students with an opportunity to apply what they are learning in school. In addition, the job experiences give students concrete techniques, and basic scientific vocabulary, which they can then relate to theories presented in laboratory courses in school.

"At Work You're Figuring Things Out for Your Own Self"

As seen in Example 1.2, students suggested that at work the focus was on doing tasks and applying knowledge, while at school the focus was on theory and details. The next section of this paper reveals how students view college instructional interactions, ". . . you sit in class and listen." (VN4), "I mean, your hands would be tired of writing from lecture notes, six or seven pages of lecture notes that you have to go over, front and back of lecture notes." (TB3).

Cazden (1988) describes the types of social interactions within classrooms as very restricted. She notes that most classroom discourse takes the form IRE. I, the teacher initiates a question; R, the student responds; E, the teacher evaluates. Thus students and teachers have set roles—the teacher dictates what topics are discussed and evaluates, while the students simply respond.

Of importance here is the striking difference between the descriptions of the students' learning activities in the BBEI community college classes and at work. Students described the rush to cover material in school in contrast to focusing on particular laboratory procedures at work.

Gracia described a situation at school in which she didn't know how to ask for help, because she was not able to identify what she needed help with.

> GH18 - I just kind of think if I went to them I would hardly know what subject to help me because I don't even know where I am.
>
> AR18 - Where ...
>
> GH18 - I know what I've been doing but I don't know how to tell them I need help on this.

Gracia's description of this school situation is a sharp contrast to Kenisha's description of how she learned about acid digestion at work by asking questions.

> AR7 - Do you think you learn at work?
>
> KM7 - I learn a lot at work.
>
> AR7 - About?
>
> KM7 - About everything we do, or other people are doing, because I ask a lot of questions and I see somebody doing like a different experiment I ask "What is that?" I just learned about acid digestion. So we are learning, my supervisor used to be a professor so he is always explaining things, he give us problems to do.

In contrast to Kenisha, Terry compared learning at school and work by suggesting that at school students enlist other studnets to help figure things out, but at work "you're off on your own." Interestingly, she also noted that at work the tasks at hand were clearly defined, but at school it was not always clear what was expected—"When we go to the class you have a procedure and it's missing things and not making a lot of sense, it's not explaining in details exactly what you have to do, it's different, and it's more harder to adapt to that because when you're at work, you

have everything laid out exactly how it should be" (TB9). Terry highlighted the different roles that she had at work and at school. At work she had responsibilities, and clearly defined procedures, at school she could rely on other students when procedures were unclear.

> TB9 - At work, you go your first day there and they train you for a couple of weeks or whatever and then you're off on your own. I mean, I hardly ever seen my supervisor. You're just, you're off on your own and you're just doing everything. But at school, I guess you kinda rely on it more, you can say "Hey, come over here help me." And you take advantage of that because at work you're figuring things out for your own self. And so it's really really different, it's different at work, you can't really depend too much on someone to help you and in school you have like all these people surrounding you that's there to help you at any time that you need help.

These interview excerpts described learning in school as listening to lectures, taking notes, having access to other students for help, and not always knowing how to define and explain what is not understood. "The roll is not really taken in college, I mean if you don't go to your lecture class, you don't go to your lecture class, that's just 7 pages you missed" (TB10). In sum, students' perspectives were that learning at work required asking questions, reading procedures, and figuring things out on one's own.

Comparing High School and College

Tech Prep reforms have resulted in few changes at the community college level, especially in terms of integrating academic and vocational education and incorporating more project-centered teaching approaches. Rosenbaum (1998) describes poor linkages between high schools and community colleges. He suggests that students look at community colleges as second chance institutions, not recognizing that a lack of preparation is likely to lead to unrealistic expectations about college, and therefore reduce students' chances for success at the college level. Rosenbaum notes that community colleges need to make requirements clear to high school students and counselors by providing information to prospective students about college degree completion as related

to student high school grades and/or test scores. He also suggests that Tech Prep programs may help students understand how high school courses are related to college courses.

All five students described college as a serious place where a large amount of material was covered at a fast pace, thus a lot of study time was required. Ethan described the progression from high school to college as a transition, "I think the main thing for me is you've just gotta realize the importance of that transition from high school to college. It's a lot like the same transition of going from adolescent to adult." (EM4) All of the students recognized that they had changed their study habits. "I swear, I tell you, I don't really think, I mean I studied in high school but not, I don't even think half, it's not half as much as I study now" (TB3). "But it, with college you have to study every week or else you get swamped with too much work, and you get like really behind and you can't remember all that stuff, too much" (TB3).

During teacher planning meetings, high school teachers noted that some students have unrealistic expectations about college level work. An instructor at Berkeley High School recognized that students needed to adjust to new expectations at college, "Plus I think they do have an unrealistic idea of what Laney is like, I think they think like 'Oh, I'll go to Laney and it's just'. . . I don't think they understand that it's hardcore science classes that they're taking there. They don't take Laney seriously so much" (High School Teacher 1).

"It's Time to Stop Playing Around and Focus and Be Serious"

Students described the college atmosphere as being serious. In interviews, the students offered advice for new program entrants, "I would probably tell them that when they get here it's different from high school, that it's time to stop playing around and focus and be serious, cuz it's not the same as high school" (KM1). "I'd tell them to be ready to work hard, that they might have gotten away with a lot of things in high school but you can't pull a lot of those things off in college. . . just little things, like cheating on tests or asking questions or trying to do things at the last minute" (VN1).

In the following interview excerpt Terry, described high school as a place where students were "just acting crazy" and college as a place where students "seem more mature" and did homework or studying.

Example 2.1

AR4 - Ok. What about similarities between high school and college? Are they similar in any way?

TB4 - I would say that Laney is a little similar because a lot of the people that go there I have known in youth, in high school, junior high, or elementary. That's the only reason why I would say that they're similar, but the atmosphere is really different. I wouldn't really say that they're similar, I mean as for knowing a lot of the people that go there, that's the only reason why I would say they are similar, kind of reminds me, 'Oh, I knew you when I was in the 5th grade!', you see old faces or whatever. But as in like how the school is ran and things like that, it's different, it's a different atmosphere altogether so it's not too similar.

AR4 - So when you say atmosphere is different, what do you mean?

TB4 - I guess the people's, kids personalities and their behavior it just is not the same. They don't have the mind mentality of the high school. So they may have, they seem more mature, I suppose to say. So they seem, some of them seem more mature acting, their behavior is a little bit more serious like it kinda should be.

AR4 - Ok. What does a more mature student look like? If I watched them in high school and I saw them in college, how would I know, what would I see?

TB4 - Like at Fremont High School, I suppose you'd see people running around and people pushing people and, 'Oh, gimme back my hat' and just acting crazy. So you don't really see that at Laney. I mean at lunchtime people are just sitting up there talking. You see people over in the corner doing their homework, you see people studying. I guess that's the reason why it's different. I mean I think they seem

that they act more mature because you don't see people running around taking people's hats or taking people's purses or anything of that kind, so that's the reason why.

Terry described high school and college as two very different places. College was "a different atmosphere altogether." In both places familiar faces can be found, but in college people took their responsibilities as students seriously. In seeing students behave more maturely in college, Terry interpreted college as a more serious place than high school. Terry also noted that there were differences between college and work, with work being more formal than college as far as language was concerned. "When I'm at work I'm more serious, I really don't be like laughy laughy, jokey jokey all the time. At school there's more a relaxed mode, not too relaxed, but relaxed enough there, you don't have to be, 'Oh, ok, yes' and, even your grammar and the way that you talk is different. They're not the same. You can't address your supervisors like, 'What's up?' You can't do that. So it's like the tone and the everything is even different because it's a different atmosphere and different people" (TB10).

College instructors agreed that giving students access to the college environment was an important program element. An instructional assistant explained, "I mean, we're gonna see some of them that do want to go in the sciences. That's really great but, giving them the opportunity to be in, around a college atmosphere and to know what college work is like, that to me, today, is enough" (Community College Tutor).

As these comments suggest, experience with the college environment, not just information about college outcomes, helps students understand the demands of college. It is important for programs to focus on actually getting high school students into the college environment, which, so far, has been a weakness of most Tech Prep and School-to-Work programs.

"You Get Swamped With Too Much Work, You Can't Remember All That Stuff"

The students interviewed described college as a place where a large amount of material was covered at a fast pace. They clearly saw that their high school study behaviors were not adequate to keep up with the demands of the community college program, "The advice that I would give a senior that's starting the Laney program is that you cannot slack off, because if you slack off you really will be, will get behind in school, and the classes move extremely fast, so you have to always be on top of the ball rolling with everything" (TB1). "And then when the exam comes, you won't be able to remember like three chapters like in two days" (GH6). In the example below, Victoria described college as requiring more work and effort than high school.

Example 2.2

AR2 – All right, you talked a little bit about this but what are some of the differences between high school and college?

VN2 - Some of the differences, well a lot of the same classes you take in high school you take over in college but in college they're in much more depth, you cover more detail. And as you progress during the years as you go on and take more classes and more years pass by, the classes become harder and more detailed.

AR3 - Can you think of a specific example or some couple examples of like something that you remember doing in high school, and then something you did in more depth when you got here to Laney?

VN3 - Like cells, studying cell structure and cell function.

AR3 - So how was it in high school and how was it in college?

VN3 - In high school they just tell you what cells are. Basically they make tissue in your body or plants, they have a nucleus inside, the nucleus is what tells or controls the cells. I've learned what different kinds of cells there are and that's what I learned here in college. There are different kinds of cells and that they contain organelles and what each of their functions are. Like bacteria. Like in school they tell us that bacteria's bad. In high school, it's bad. But in microbiology I'm learning that not all bacteria are bad, some are good for you. Yesterday we learned the difference between a bacteria that doesn't cause disease and one that does.

College instructors also acknowledged the push to cover a large amount of material. Below, acollege instructional assistant described the tension between breaking the material down for the students versus making the students do it for themselves.

> And I also think that it's really important to model the way of organizing material. I beat my head up against a wall to try to get them to do it. I think it's because they don't know how and I don't feel equipped to really break it down, because then I feel like the more I break it down, the less time we're spending on the material. So I feel really torn. Yes, it would be easier, it's easier for me to do it the way I'm doing it which is to organize things myself and present it to them. I know it's harder to get them to make the note cards, and get them to rewrite their notes and do all of that, and that's constantly the battle that I feel like I'm facing. Because there's not enough time to get the material covered and get them successful, get them up to speed, where they can do it on their own. So I just think that modeling that behavior is the best that I can do at this point. (Community College Instructional Assistant 2).

The focal students, all of whom completed the community college program, realized new requirements and expectations, paid attention to details, and kept up with course material. "And then we did more stuff in college, more labs, difficult ones. There's more work in one, more learning, more equipment and just more, we're using more chemicals" (GH8). The college instructors set the pace and expected students to keep up; this had not been the students' experiences with teachers in high school. As one student noted, "I think in high school they have a schedule that they kind of need to be on but not so demanding. And so whenever we finish this chapter we finish, but in college you have to finish things at a certain amount of time by the end of the semester" (TB3). "Oh yeah, because in school they'll stay on it maybe a little longer, especially if there are people not understanding it. But in, at college they move on. They can't stop just because you don't know it" (TB4).

Students' conceptions of college as a serious place were related to experiencing a different atmosphere and expectations. The students realized that they had to take more active roles as college students than they had to in high school.

"You Have to Really Take Hours Out and Sit Down and Study"

All five students emphasized that college required much more studying than high school. Each student noted that they seldom studied in high school, and if they studied, it was only right before a test. In describing college demands, Victoria stated, "Oh, I've listened to science all day, I don't want to look at it, but you have to pull yourself to do it, to do your homework and read and study. Even on the weekends" (VN4). Terry emphasized Victoria's point—you have to push your self to do it—"Well, with high school, you don't have as many tests and you basically only have to buckle down and make yourself study. In college you *have* to take the time out and study because if you don't study, then it's gonna show. I mean, you can't just scan through the book like you did in high school, oh ok. No, you have to really take hours out and sit down and study and it's hard to get used to, you have been just with just scanning books and just looking through things for four years, I mean now in college you have to sit down and buckle down and study" (TB2). In the following excerpt from an interview with Kenisha, she suggested that she "didn't have any homework" in high school, and if she was assigned homework, she would have spent 30 minutes to an hour completing the assignment. In college, she "spend(s) all day and night trying to do it."

Example 2.3

AR1 - Do you think there's any other differences? You said the teachers were easier at Fremont than Laney, and that Laney seems more serious. Are there any other differences between high school and college?

KM1 - No, not really. More work.

AR1 - Could you give me a comparison to high school?

KM2 - Well Biotech II [high school] we really, we didn't have any homework there, we rarely had any homework. And here we have homework that you have to do.

AR2 - If you think back to high school could you give an estimate about how much time you spent doing homework in high school versus here? Is there a difference?

KM2 - Yeah it is a difference because in high school I barely did homework and here I'm always doing

my homework, I have to. Like, in high school, I probably spend like 30 minutes to an hour for each class, for whatever class I had homework in. And here I spend all day and night trying to do it, whenever I have the chance.

AR2 - All day and night really?

KM2 - I mean when I have time, when I'm not working or don't have any classes.

AR2 - So all your free time is study time?

KM2 - Except for Friday.

Kenisha's comments highlighted the fact that the students felt that all of their time was taken up with either scientific work or studying. Victoria expressed a similar sentiment, "Well it's hard. You, um, you work and you go to, well we go to school at night and sometimes you get home and you're tired and you're like, Oh, I've listened to science all day, I don't want to look at it" (VN4).

Students recognized that college required more studying than was required in high school. In addition, college instructors recognized that students could be overwhelmed with the amount of time they had to devote to studying science in college. One instructor suggested that a love of science wass essential to being willing to study, "Some people it's writing, it's art, it's business, but science is a unique area, and because I was always enthralled with science as a child, I'm here now. But how many of these people are interested in science? Because this is what we're shoving down their throats frankly—math, chemistry, biology - and you have to really have a love affair with science to really want to do well in these classes. And so I'm wondering if there is that element that's being brought in, how many of you, not just to get a job, really are turned on by the science?" (Community College Instructor 3). As noted previously, students suggested that their experiences on the job increase their interest in science.

"She Does Everything, She's Always There, She's Always Answering Questions"

In contrast to a love of science, students' descriptions of a successful student focused on either particular study habits or completing goals. Successful students were described as having characteristics such as; good study and classroom habits, finishing the program, or achieving personal goals. In an interview, Gracia identified good organizational habits as a key to passing classes. "Well, like I did a separate notebook for each class, and I also did a spreadsheet in Excel to graph out the homework that I have to remember that I can turn in. The first semester I found a way of doing that cuz there was documents where I didn't know what I'd turned in or I didn't, and where my notes were. I think that's why I didn't pass the class" (GH1).

In Example 2.4, Ethan noted that successful students did the work, participated in class, and helped others.

Example 2.4

AR1 - How do you think your Laney College teachers would describe a successful student?

EM1 - I'd say they'd describe it much in the same way I did, basically handling your responsibilities, getting the work done, I think helping others if you can. And, I failed to mention before, but punctuality also, that's very important and attendance.

AR1 - Do you think that high school teachers would have the same description of a successful student?

EM1 - Punctual and responsible.

AR1 - Ok, and how about a student that you think isn't successful in the Laney program?

EM2 - I'd say that would be just the opposite - don't come on class time, or if you do you're late, not getting your homework in, failing to participate in class, failing to help others even if you can, that's like a horrible student. But unsuccessful students...

AR2 - Do you think there are any unsuccessful students in the Laney program?

EM2 - Oh yeah. There's always, people who are really unsucc... no I don't think there are any students who are really, really unsuccessful. I believe there's one or two that can do a lot more but don't. I mean, even myself I can do a whole lot more and I fail to live up to all my responsibilities as a student.

Gracia's description of an unsuccessful student was very close to Ethan's description of a "horrible student", "Never there, be there late, have paper wrinkled, homework all wrinkled and they're not even finished, will make, distract other students and always sit in the back in the corner, or sleep, or getting smart with the teacher" (GH10). Victoria, like Gracia, described a successful student and agreed with the college instructor that successful students, "have to enjoy what they're doing" (VN5).

Rather than detailing specific study habits, Kenisha suggested that successful students finished the program, "If they finish, if they stick to what they started and they finish" (KM4). In contrast, Terry noted that success wass different for each student. "Somebody may think that they're successful by investing their money in buying a brand new car or somebody, somebody may think that they're successful in getting their degree" (TB5). She also suggested that attempting the program was an important step. "Well, at least you gave it a try. And that's ok, if you didn't proceed on, because maybe it wasn't for you, or maybe something in your life was happening to you where you couldn't continue on" (TB5).

In each of the students descriptions, being a college student meant taking some kind of active role. These comments add a new dimension to the earlier discussion of school being a more passive environment than work. In response to questions about success, students suggested that being a college student meant having to be more active outside the classroom. The students adjusted to new expectations and changed their study and classroom habits in order to meet the demands of college. For example, Victoria highlighted the transition that students faced in the following statement, "And I think a lot of those people haven't accepted, I don't know, that they're growing up and they just want to have fun, because that is the only reason people don't

do good. It's not that they're not smart because nobody's stupid" (VN6). To summarize, the students' college experiences helped them recognize that being a college student means making different choices than the choices made in high school.

Students learned that taking academic study more seriously and making studying a priority was related to their success in college. This finding highlights the difficulty in helping high school students recognize and prepare for the demands of college prior to reaching the college environment.

Access to Adults: Teachers and Supervisors

Hamilton and Hamilton (1997) suggest that there are a variety of roles for adults in work-based learning programs—coordinator, manager, coach and mentor. Students interviewed noted that at both school (community college) and at work they had access to adults who had expectations and were a source of support. Students' comments suggested that they sense that there were many sources of assistance. "Help is all around us" (VN6). "There's lots, there's more teachers, if I can't get her help, I can get it from somewhere else, like another classroom" (GH16). College instructors also acknowledged the importance of students having access to help, "I think what I see really being beneficial is a mentorship type of thing or just somebody being there" (Community College Instructional Assistant 2).

In addition, teachers and supervisors shared expectations for certain behaviors. The students were aware of these expectations and adjusted their behavior accordingly, Kenisha said, "I basically be the same way around the teachers and the supervisors. I mean cuz it's like the same thing, you might as well say my supervisor is almost my teacher, that's like he acts sometimes"

(KM8). Gracia described things that were important at both work and at school, "Well, safety and that it gets done and well done. You have to get, keep records of what you do" (GH14). Terry described feeling pushed by expectations, "So I mean she just expects a lot, a lot out of us, a lot. And sometimes I cannot always meet up to her standards of what she wants me to be, I have to do what I want to do. But that's good, that you have someone there pushing you like that, because sometimes it's really easy just to fall and don't get up for awhile, and you don't get up, things roll past you, things get left behind, tumble" (TB12). The expectations of teachers and supervisors pushed students to make sense of multiple expectations that differed across school and work settings.

"I Think Students Just Need to Take More Responsibility on Themselves"

In describing the expectations of high school teachers and community college instructors, students suggested that they themselves had to take on different roles as college students. They also noted that students had more choice about their activities in college classes. "They just seem different because at college you're more free to do whatever, and high school is like you were stuck in that class. We couldn't just get up and leave and go to the bathroom if we wanted, we couldn't like ask this person anything, like the teacher like, 'Stop talking', always on you. Not really stuck, but I mean it's like you have to always report to the teacher whenever you want to do anything" (KM4).

In Example 3.1 Gracia provided a description of a contrast between high school teachers, college instructors that teach in the biotechnology program, and other community college science instructors. Since Gracia did not pass inorganic chemistry the first semester, she took two sciences courses in the biotechnology program (microbiology and organic/biochemistry) and one

science course outside the program (inorganic chemistry). Gracia noted that a non-program college instructor was not as persistent as the biotechnology program instructors were, she said, he "mentioned he'd like everybody to be here on time so you can hear the end of the lesson, he won't be like 'Where were you yesterday?' or 'Where were you on Monday?'"

Example 3.1

AR3 - When you think back to last semester having chemistry 30A with the biotech teacher, how does it compare to your classes now?

GH3 - We had a lot of help in biotech, more than with this teacher. I mean on the exams we could ask questions and she would try to help us. When I asked this teacher and he'd just say, 'Oh, tough one.' And then this teacher is going over everything, the biotech teacher skips parts that she didn't really think was important to show us. And this teacher's going everything - there's things that I've never heard of.

AR3 - Any other differences you see between the two?

GH3 - For this teacher we have our labs, not our lab book. In biotech chemistry we had a lab book. And with him we have lab reports, so we don't have any protocols.

AR3 - And you think that's good, bad?

GH3 - That's easy. We don't write protocols, which is good for experiments in writing the data down and turning it in.

Gracia highlighted some of the differences between biotech and non-biotech science courses. In the non-biotech chemistry course, protocols were not emphasized and the instructor covered all the material in the textbook, "this teacher is going over everything." In contrast, the biotech instructor was selective about course material and concentrated on certain relevant topics, the instructor "skips parts that she didn't think was important to show us." In addition, the biotech instructor required a lab book and gave assistance on exams. While Gracia saw the biotechnology program requirements of a lab book and written protocols as requiring more work than lab reports, the biotech instructor did not feel that she had extensive requirements. In an instructor planning meeting the instructor noted, "And so maybe if the high school teachers

would just see what we do and what we ask, which isn't that much, I'm not asking that much from the labs, except to write out a lab" (Community College Instructor 4).

Later in the interview Gracia talked more about community college expectations that differ from those in high school. Gracia noted that high school teachers "check if you're there or not, call your parents." She went on to state that biotech teachers in high school and at Laney have the same expectations for attendance.

> GH7 - I guess being there on time. It's just, college teachers don't care what time you come in and what time you leave or if you're there so it's up to you to be there. And in high school they would be checking if you're there or not, call your parents.
>
> AR7 - So you said teachers don't care if you're late or if you're there or if you leave early but high school teachers communicate differently about that and one of the things you said is they call your parents. Are there other things that high school teachers did to communicate 'Hey, you need to be here' or that college teachers do to communicate 'You need to be here or you don't'?
>
> GH7 - They would talk to you and tell you, 'You're messing up, you need to be here more, you need to get here on time, you're disrupting class.'
>
> AR7 - And does that happen in college?
>
> GH7 - Well, just in the BBEI. In the Chem 30A class he has mentioned he'd like everybody to be here on time so you can hear the end of the lesson, but he won't be like 'Where were you yesterday?' or 'Where were you on Monday?'
>
> AR7 - So, was that the same as high school or do you think there's a difference between high school and your BBEI classes in high school and your BBEI classes in Laney?
>
> GH7 - They're the same.

Gracia's comments incorporated the complexity of understanding what the expectations were in different settings. There were expectations about attendance, "College teachers don't care what time you come in and what time you leave or if you are there." There were expectations about how lab work was completed, "And with him we have lab reports, so we don't have any protocols." And there were expectations about content covered, "And then this teacher is going over everything so the biotech teacher skips parts that weren't really, that she didn't really think

was important to show us. And this teacher's going everything - there's things that I've never heard of."

College instructors also recognized that students faced different expectations in different settings. The college biotech chemistry instructor stated, "And I'm sure that the high school labs are actually more biotech oriented than our labs. I mean, I understand that. I'm just saying that what is a culture shock for the students is that the work presentation is not the same, and there should be that follow-through" (Community College Instructor 4). In summary, students dealt with multiple expectations as they transitioned from high school to college, took biotech and non-biotech courses, and worked in laboratory settings. Students took on new roles as they made the transition to college.

"You Might as Well Say My Supervisor is Almost My Teacher"

Consistent with Hamilton and Hamilton (1998), students suggested that both community college instructors and supervisors can play a variety of teaching roles. Students noted that being able to talk to both community college instructors and supervisors was important in enabling them to feel comfortable in different settings. One student noted that this familiarity made it easier to talk about goals. "But it makes it easier when you have a teacher you could talk to about, 'Well I didn't have a good weekend this weekend because this and this happened and I was really upset about it.' You can talk to them about things that happened and you can talk to them about your goals and your dreams and all that stuff just fine to let them know you" (TB11). In Example 3.2 Kenisha described a way in which a supervisor was "almost my teacher"—he assigned math problems to her and another co-op student.

Example 3.2

KM7 - My supervisor used to be a professor so he is always explaining things, he give us problems to do.

AR7 - What kind of problems?

KM8 - Like, when we first started, we was kind of having troubles with our math. And he gave us like a list of problems that we have to do, we have to go down to the office and work them out. We couldn't ask nobody for help because he wanted to see what you know, what we didn't know. Then he helped us with what we didn't know.

AR8 - Do you remember what were some of the things that you did know and some of the things that you didn't?

KM8 - Yeah like how to get a one millimolar solution. It was just problems like that.

When co-op supervisors assign math problems in the work setting, they tap into a strategy that teachers use in school, and students recognized this. However, identifying a supervisor's teacher-like qualities suggests that supervisor interactions are not usually school-like. In the comment below, Terry noted that there were certain expectations for interactions with supervisors.

TB11 - I think that's important that you try to have a close relationship with your co-workers and your supervisors. Not too close with your supervisors, because your supervisor is your supervisor and you have to have a professional attitude and professionalism, but close enough where you can talk to her. And sit and talk with her and have a conversation with her because, my supervisor always talks with me when I do see her, she talks about school, she talks about her sons, we talk about normal things. It's not all about, 'Oh this must be done right and I need to be uptight.' No, you can relax and she's a human just like you are and she's your supervisor and she is supposed to give you instructions and direct you to do different things and you're supposed to do different things for her and the things that she expects from you. She's your supervisor, but you don't have to be so uptight and nervous in front of her.

Students described optimal arrangements, both at work and at school, as having access to a variety of adults, having open communication with instructors and supervisors about both scientific content and personal goals, and getting assistance with scientific concepts they did not understand. Students realized that having access to a variety of adults resulted in a variety of expectations.

To re-cap, the expectations of teachers and supervisors has pushed students to make sense of multiple expectations that differed across school and work settings. Those differences entailed expectations about attendance and punctuality, written forms for presenting experimental data, appropriate language use, and varying emphasis on scientific content.

PART 4: SUMMARY AND DISCUSSION

This pilot study supports research findings that work-based learning and school-based learning support each other, but connections between the two settings cannot be assumed, and programs must be designed to make the connections clear. The findings of this study have clarified how students in BBEI's program view their experiences in high school, college, and laboratory work settings. In interviews, the five focal students described issues related to deciding to enter the college program and their plans for the future, working and going to school, making the transition to college level work, and interacting with adults in school and work settings.

Prior research on work-based learning suggests that work is an authentic environment that motivates students to learn complex material. In comparing work and school, students interviewed noted that at work scientific knowledge was applied in the laboratory, and at school the focus was on theory and scientific details. In addition, work was described as a way to learn lab techniques, which were then elaborated on in school. In making the transition to college, and experiencing the college environment, students learned that college was a serious place (compared to high school). In discussing what it meant to be a college student, students described college as a learning environment where much material is covered at a fast pace, thus a lot of study time was required. In this study, students described college as an authentic place that demanded more work and study than high school. In addition, students described high school

experiences as important precursors for community college and work, but did not see high school as authentic or demanding as either college or work.

In describing interactions with adults at school and at work, students noted that work supervisors and teachers shared expectations for certain behaviors and activities, but that the types of expectations varied across school and work settings. Through experiences in the three different settings—high school, community college, and laboratory workplaces—students learned that each setting had different expectations. They described different expectations for the processes of completing tasks, the form of presenting final products, and using different language/speech patterns. Researchers need to keep in mind that simple conceptions of greater expectations or lower expectations in one setting versus another will not capture the complexity of experiences across a variety of settings.

Finally, although harder to measure, students had a sense of a range of educational and career options available, and said that they were able to make choices between these options. All five focal students described success as being more than the admission to a community college program and entry level biotechnology positions.

The strength of this study is that it adds student perspectives to the research about connecting schools and workplaces by revealing what students define as important experiences and opportunities. Students play a key role in school and work experiences by utilizing resources to enable their own progression, thus students are crucial to the success of work-based programs.

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