



Manufacturing Career Pathways: Successful Models for Aligning K-14

November 4, 2008

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INTRODUCTION

Research Objective

One of the CACT CTE Hub Director's tasks is to help align K-12 and community colleges in creating advanced technology (AT) career pathways. One of the first objectives has been to look for successful programs that achieve this alignment. These programs are benchmarks that others programs may use for help in developing their own classes.

Two of the programs I describe below are focused on the alignment between K-12 and CC. However, I also included a program where the alignment was focused on K-12 and industry (Petaluma High School). In searching for programs, I took a definition of alignment beyond articulation, concurrent enrollment, or advanced placement. I wanted to include other concepts of alignment, such as logistical support, or assistance with networking.

PROCESS

To find successful programs throughout the state and nation, I took the following approaches:

- 1) Talked with people knowledgeable in this field to get their opinions on what are some model programs. These included high school and ROC/P teachers; college deans, educators and administrators; high school administrators; EWD professionals; ROC/P director; and others.
- 2) Researched programs funded by the NSF Advanced Technological Education division.
- 3) Online searches

Online searches yielded few initial hits. While the Internet was useful for getting follow-up information once a program was discovered, there's not much easy-to-find information listing successful alignment models.

RESULTS

Below are three examples of "programs to watch" for increasing alignment within manufacturing and technology career pathways. These are 1) iDesign at Lincoln High School in Roseville, CA; 2) Manufacturing Technology Program at Petaluma High School; and 3) CCSF Engineering 48L concurrent enrollment with Burton and Washington High Schools.

There are a number of other programs out there. Including national programs such as Project Lead The Way (PLTW) and the Infinity Project (similar to PLTW and based in Texas - <http://www.infinity-project.org/>). A non-California program that has some good examples of activities is the [NSF Advanced Technological Education \(ATE\)](#) program at the California University of Pennsylvania.

The three examples chosen are California-based programs – which should have more relevancy to California educators looking for benchmarks.



1) iDesign Program (Lincoln High School – Roseville, CA)

Description:

This is a new program (Fall 2008) at Lincoln covering design and machining. In the course, students learn how to use drafting software, manual milling machines, CNC's, and other equipment in the design and manufacturing of student projects.

Measures of success:

This program has just started. However, there is one important measure of success that can be shown with data – that of creating interest among high school students in a manufacturing program. A couple of different numbers are very exciting.

Last semester the program had 12 high school students pilot the program by coming to school in the morning *before classes started*. Getting kids to roll out of bed early in the morning shows a high level of interest. Another measure was student enrollment: for the official class starting this fall, 192 students signed-up for 82 spots. Forty of those signing up (43%) were girls. While Lincoln High is a relatively large 9th – 12th grade school (over 1500 enrolled), this is a very encouraging number of sign-ups.

Some other notes on the program:

- a. iDesign is a 3-year program. It covers drafting, Solidworks, manual machining, G&M code, MasterCAM, and CNC. The students start on CNC machines early (after just a few weeks of class).
- b. The program received an SB70 grant (\$250k). Money was spent on computers in the lab, software, training, and machines (bought through Sierra College).
- c. There is currently no articulation agreement for the class (this is the first year of the program, and it's still being refined). Articulation will be explored with Chico State in the future. Sierra College does not offer machining, but the skills learned in the class will be useful for the Sierra Mechatronics and Engineering Support Technology programs.
- d. The instructor found that it is very important to give the students projects early in the semester. Students get lots of freedom on what they can design. For instance, rather than “everyone must design widget A,” they “design a part that uses at least 30 straight lines.” The instructor found that many students will push themselves beyond what is required (one student did an AMG logo that had over 400 lines).
- e. Marketing – it was explicitly decided to focus on “design” in the marketing of this class, vs. machining or manufacturing. The general consensus among most of the educators I've talked to is that kids have a negative reaction to these terms. So the class name of iDesign might have a significant impact on the enrollments numbers. Other methods for reaching out to students include:
 - Blog
 - Video
 - Flyers
 - Posters
 - More information on these marketing materials can be found at:
http://www.sierracollegelearning.com/idesign_cnc_machining.php

f. Advisory Board

- Carpenter Advanced Ceramics
- Harris & Bruno International
- Parallax, Inc.
- Sierra Pine
- Selway Machine Tool Company
- CSU Chico – Manufacturing Technology Program
- Sierra College – Mechatronics & Engineering Development Support Programs
- Western Placer Unified School District (<http://www.wpusd.k12.ca.us/>)
- City of Lincoln – Economic Development (<http://www.ci.lincoln.ca.us/index.cfm?page=469800>)

The iDesign program is great example of a “start-up” manufacturing technology program. With numerous schools shutting down machining programs over the last two decades, this shows a promising model for reversing this trend. The logistical support of the Sierra College CACT has enabled a teacher with a passion for the subject to accomplish this. This is a program to watch.

2) Manufacturing Technology Program (Petaluma High School)

Description:

The Petaluma High School Manufacturing Technology Program is a four-year program (from 9th to 12th grade) run by Dan Sunia. The students learn welding, fabrication, casting forging, machining, sheet metal, design, metal art, process planning, CNC programming and machining. The instructor is well-known and highly-respected in the ITE community and has put together a modern machine shop. He started teaching the program six years ago. Prior to that he was in industry.

Measures of success:

One of the strengths of his program is the alignment with industry and the production of real products. This involves working with the Downtown Petaluma Project – contracting with the city to make metal benches and other products for downtown. This project was the recipient of the 2007 Jack London Award for Educational Innovation. The award is given annually to an outstanding, innovative K-12 public school program.

The school is also a Haas Technical Education Center (Haas is a large machine tool manufacturer based in Southern California) and many of the students are taking the National Institute of Metalworking Skills (NIMS) certification. In addition, the program is applying for NIMS accreditation. Students who have earned NIMS Credentials are being placed in local machine shops and in-turn are being sponsored by their employers to become machinist apprentices. The formal apprenticeship is an 8000 hour on-the-job training program with 576 hours of related instruction (post-secondary education). Other NIMS students are currently attending California universities and studying engineering.

Some other notes on the program:

- a. They have installed 3 new lathes as part of a Prop. 1D grant.
- b. The instructor also runs a Federal and State approved precision machining apprenticeship program.
- c. Marketing
 - All 8th graders take a tour of the high school programs in February. The instructor gives them lessons and demos. The same evening, 8th grade parents come to see the programs. Reaching out to parents is especially important.
 - They're developing a video to educate people.
- d. Advisory Board
 - Members from industry, city and state government, education, students and parents meet at least bi-annually.
- e. Partnerships
 - NIMS—National Institute for Metalworking Skills
 - California Tooling and Machining Apprenticeship Association (CTMAA)
 - Machinist Union– Local lodge 1596
 - Santa Rosa Junior College
 - Sonoma County Office of Education / ROP
 - City of Petaluma
 - Chevron Research, Richmond CA
 - PAX Scientific, Novato, CA
 - Agilent Technologies, Santa Rosa CA
 - Haas Automation, Oxnard, CA
 - Union City HFO, a Division of Selway Machine Tool, Union City CA
 - Regency Centers / East Washington Place, Petaluma, CA
 - Paula Lane Project, Petaluma, CA
- f. Other
 - 1) Enrollment is approximately 75 high school students in 3 classes (not full). There are 35 students in the apprenticeship program.
 - 2) The program is based at Petaluma high school. Casa Grande students can also enroll (3.5 miles away, 10 minutes by car – no bus available). Only had a couple of students from Casa Grande.
 - 3) The teacher is a SkillsUSA Advisor and students participate in regional and state competitions annually.

3) Concurrent Enrollment in Engineering Lab Course at CCSF

Description:

CCSF [Engineering 48L](#) is a project-oriented, hands-on course to introduce students to the practices and methodologies used in Engineering and Technology. Professor Kevin Mueller is the instructor. Work is in five areas: electronics, computer aided drafting, mechanical construction and fabrication, applied technical mathematics and exploring internship possibilities. Students get into the lab and build things.



Students involved in engineering programs at two different San Francisco high schools (Burton and Washington) can enroll in the class.

Measures of success:

One encouraging sign is the number of enrollments and the number of females taking the course. Out of a total of 31 students, thirteen are from high school (twelve from Burton and one from Washington). Almost half (six) of these enrollments are young women.

It's important to note that this class meets after normal school hours (4-7 pm) – indicating a certain level of interest in the topic from the students. One student when asked reported that he “loves the class”.

I also spoke with Professor Mueller to get his feedback on how the high school students are doing. He's been very happy with their progress and noted that they are hard workers.

Some other notes on the program:

This will be an excellent program to track, since it's the first year and we can explore any growing pains with the start of a new program.

There are certainly other community college engineering classes across the state that have this type of concurrent enrollment. One goal we have is to continue to gather information about these classes to create a database of benchmark programs.