



Can Combining Academic and Career-Technical Education Improve High School Outcomes in California?

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By

Patricia Clark, Charles Dayton, David Stern,
Susan Tidyman and Alan Weisberg
University of California, Berkeley

Abstract

One strategy for improving high school outcomes involves combining college-preparatory coursework with career-technical education (CTE) in the high school curriculum. The aim is to make high school more meaningful and motivating for more students, to increase graduation rates, and to prepare graduates for a range of postsecondary options. Preparation for college and career can be combined in various ways. Some high school students manage to complete the academic coursework required for college along with a career-technical sequence. Another approach is to enhance the academic content of CTE classes. A third approach is through “career academies” within comprehensive high schools that organize a multi-year curriculum around a career-related theme, with students at each grade level taking a set of core academic classes together, along with a technical class related to the career theme. This paper reviews the evidence on effects of these approaches for students. Despite the challenges of implementation and the incompleteness of the evidence that these strategies produce the desired effects, the necessity of reconciling universal college aspirations with the realities of labor markets implies that programs combining academic and career-technical curriculum will – and should – continue to develop.

Introduction

“It seems like such an obvious idea. Organize high school to maximize the number of students who graduate ready for college, work, and citizenship.”¹

In this paper we view the high school dropout issue as part of this bigger challenge: reconstructing high schools so that more students will find the experience meaningful and motivating, and so that more have a desirable range of postsecondary options when they graduate. In particular, we focus on programs that attempt to prepare students for work *and* for further education, simultaneously.

During most of the 20th century, vocational education (currently called career-technical education, or CTE) was provided as a separate curriculum in comprehensive high schools, or in specialized vocational high schools. In the 1980s a number of efforts began, with federal backing, to “integrate” academic and vocational education.² For instance, the *High Schools That Work* network was founded, for the purpose of ensuring that high school students complete both college-preparatory coursework and a career-technical sequence providing real preparation for work. Some schools formalized and encouraged this practice by creating career pathways; the 1994-1999 School to Work Opportunities Act promoted career majors; and a number of states are now developing career clusters. Many comprehensive high schools now contain career academies, which organize a multi-year curriculum around a career-related theme (e.g., health occupations, business, information technology); students at each grade

¹ In recent years the Bill and Melinda Gates Foundation has used this as a tag line for their high school reform effort. Of these three goals, the least controversial is preparing students for the responsibilities of civic life – a primary justification for public support of schooling since the days of Adam Smith and Thomas Jefferson. Although there is plenty of room for concern about how well public schools actually do this in practice (e.g., McDonnell et al. 2000), preparation for citizenship is not the focus of this paper.

² Some would say “re-integrate.” See Grubb, 1995.

level take a set of core academic classes together, along with a technical class related to the career theme.

According to the Office of Vocational and Adult Education in the U.S. Department of Education, “Virtually every high school student takes at least one career and technical education course, and one in four students takes three or more courses in a single program area.”³ It is not possible to say precisely how many of these students are in traditional, separate vocational programs, and how many are combining CTE with preparation for college. *High Schools That Work* is involved with more than 1,200 sites,⁴ and it is estimated that two or three thousand career academies now operate in U.S. high schools.⁵ Many students combine college-preparatory coursework with CTE on their own, without any programmatic support.

In Section 1 we will briefly review the rationale for combining academic and career-technical education in high schools. The aim is not only to motivate and enable more students to finish high school, but also to open a wider range of postsecondary options for low-income and minority student populations that have had low college-going rates. In Section 2 we will summarize the evidence on whether existing efforts have achieved their desired effects.

³ <http://www.ed.gov/about/offices/list/ovae/pi/cte/index.html> (retrieved September 14, 2007).

⁴ <http://www.sreb.org/programs/hstw/hstwindex.asp> (retrieved June 19, 2007).

⁵ The largest organized network of career academies is supported by the National Academy Foundation, which serves “over 500 academies in 41 states.” <http://www.naf.org/cps/rde/xchg> (retrieved September 14, 2007). The State of California currently supports 290 academies, and plans to add another 150. Many career academies also operate independently, without any network affiliation or state support. A partial directory of career academies, by state and theme, is available at http://www.wsdg3.com/casn_directory/directory.cfm

The idea of combining preparation for college and work has widespread appeal, and there is some evidence that this kind of combined curriculum leads to improved performance of students in high school and beyond. Still, this is not the conventional way of doing things. In Section 3 we detail some of the practical issues involved in implementing this approach, based on our own experience providing assistance to high schools. Policies to encourage combining academic and career-technical curriculum will have to take these practical matters into account.

That said, in Section 4 we describe several current examples of schools that are successfully implementing a combined college-and-career strategy. We give snapshots of two state-funded career academies in California. We then recount the process of developing a set of new career academies in Seattle, Washington. We briefly describe a regional vocational center in New York State that has embraced college preparation as part of its mission. Section 4 concludes with a profile of High Tech High, a charter school in San Diego, California. These examples illustrate that combining academic and career-technical education is feasible, even in today's policy environment. Section 5 offers some brief concluding remarks.

1. Why combine academic and career-technical education in high school?

Much controversy has arisen over whether high schools should try to prepare all students for both college and careers, as opposed to separating one group of students into an academic course of study and placing other students in vocational programs, i.e., "tracking." In the U.S., an energetic debate on this issue started around the turn of the twentieth century (Lazerson and Grubb 1974, Oakes 1985). The debate continues even now. Although fewer people now openly advocate "tracking," some still argue that career-technical education

should not be concerned with preparing students for college – at least not for colleges that award bachelor’s degrees.⁶

For example, California’s current Governor ,Arnold Schwarzenegger, has proposed increased funding for career-technical education. On March 13, 2007 he hosted a “summit” meeting on career-technical education, and said in his welcoming remarks,

“...we see students dropping out – in some schools up to 50 percent of the high school students are dropping out.... And I think that it’s very clear that a lot of students are dropping out because we don’t offer them alternatives. We only offer them one thing, and that is a four-year college, but there is nothing else for them to shoot towards.

“...[C]areer tech education, we know, addresses two very important issues; it fulfills the needs of the workforce and also it fulfills the needs of the students by giving them multiple pathways to success. A lot of students, it’s very clear, have said that they are dropping out because they don’t find anything interesting in school, or they have no interest in going to a four-year college. So, because they don’t have an alternative, they are discouraged and they drop out. By expanding career tech education we are giving them options, options to become mechanics, or become nurses, or carpenters, electricians, to become welders, or chefs, or lab technicians, computer technicians, and the list goes on and on and on. Those are all very important professions.”⁷

In this paper we focus on high school programs that attempt to *combine* college preparation with career-technical education, rather than seeing them as alternatives. The rationale for this approach rests on three observations.⁸ First,

⁶ The term “four-year college” is often used to refer to one that awards bachelor’s degrees, but this term is not strictly accurate, since many students take more than four years, and some take fewer, to earn bachelor’s degrees.

⁷ <http://gov.ca.gov/index.php?/speech/5622/> (retrieved June 20, 2007)

⁸ For a more detailed statement of this rationale, with supporting evidence and citations, see Stern and Stearns (2007). A simpler rationale for combining college preparation with career preparation is that the knowledge and skills required for success in the labor

the great majority of high school students say they aspire to get bachelor's degrees, at least. According to the National Center for Education Statistics, 79 percent of 10th graders in 2002 said they aspired to earn a bachelor's or postgraduate degree – up from 60 percent in 1990, and 41 percent in 1980.⁹ Parents also affirm these aspirations. Students and parents therefore tend to avoid high school programs that do not lead toward bachelor's degrees. Second, from the beginning of federal support for vocational education in 1917, it was defined as preparation for occupations that do not require a bachelor's degree.¹⁰ Vocational courses and programs were therefore less academically rigorous. Students assigned to vocational programs tended to be less affluent, less likely to have parents who attended college, and more likely to belong to racial, ethnic, or linguistic minorities who have been under-represented in higher education (e.g., see Oakes 1985/2005). This came to be widely regarded as unfair, and also wasteful because students in these classes are given less challenge and opportunity to develop their intellectual and academic capabilities. Third, despite the almost universal desire of students to obtain bachelor's degrees, only about one out of three 25-34 year-olds in the U.S. currently accomplishes that

market are becoming similar to those required for college. However, while the kinds of competence demanded at work may be growing more similar to what is required for successful entry to higher education, available evidence suggests that they are not (yet) the same (Barton 2006, Education Week 2007).

⁹ Indicator 18 of *Youth Indicators, 2005*,

<http://nces.ed.gov/programs/youthindicators/Indicators.asp?PubPageNumber=18&ShowTablePage=TablesHTML/18.asp> (retrieved September 14, 2007)

¹⁰ The original Smith-Hughes Act of 1917, which provided the first federal grants for vocational education, repeatedly stipulated that the “purpose of such education shall be to fit for useful employment; that such education shall be of less than college grade....” Successive reauthorizations of the federal law continued to distinguish vocational education from preparation for college. The 1998 Perkins Act included such a statement in defining vocational and technical education as “a sequence of courses that provides individuals with the academic and technical knowledge and skills the individuals need to prepare for further education and for careers (other than careers requiring a baccalaureate, master's, or doctoral degree)....” The 2006 reauthorization of the Perkins Act finally removed this restriction, opening the possibility for creating more programs that combine CTE with preparation for college.

goal;¹¹ the other two-thirds enter the workforce without a bachelor's degree. If they can learn something in high school that helps them in the labor market, that would be a benefit. Gaining work-related competence in high school also can help students pay for college.

In short, combining academic and career-technical education in high school can keep students' options open. This integrated strategy can encourage students to pursue their college aspirations while providing skills that could be useful if they attend college or if they leave school without a bachelor's degree.

Can an integrated academic and career-technical curriculum motivate more students to complete the academic coursework required to graduate from high school, as Governor Schwarzenegger claims career-tech by itself can? The original Philadelphia Academies (see discussion of career academies below) were designed originally for this purpose: to reduce the number of students who drop out of high school (Stern, Raby, and Dayton 1992). A review of research on motivating high school students, conducted for the National Research Council (2003), included a chapter on "education through theme-based learning communities," which focused on high school programs that combine academic curriculum with occupational themes. "These programs are different from traditional, terminal vocational education programs designed previously for students not bound for college. The emphasis on 'college *and* careers' conveys a range of options that is broader than is typically found in traditional vocational education...." (p. 169, emphasis in original).

¹¹ As of March 2005, the Current Population Survey found only 30.3 percent of 25-34 year olds had completed bachelor's or advanced degrees, 9.0 percent had completed associate but not bachelor's degrees, and an additional 18.7 percent had some college but no degree (Statistical Abstract of the US 2007, Table 216).

The National Research Council chapter describes six conditions considered more likely to exist in these combined programs, which should be expected to enhance students' motivation. Programs combining academic and career-technical education are often organized as small learning communities—career academies being a prime example. These allow students to form closer relationships with teachers and other adults. They may further strengthen students' motivation by fostering greater autonomy, through offering choice of which program to join, and through greater use of project-based and work-based learning. High academic expectations, a clear purpose related to possible future careers, and more obvious connections between school and work, should contribute to students' motivation. The use of workshops and work-based learning, in addition to regular classrooms, also may help motivate students by providing multiple paths to acquire and demonstrate competence.

But is there actual evidence that combining academic and career-technical education in high school actually does lead more students to succeed academically? We will review the research in the next section of this paper. Overall, results to date are probably not strong enough to change the mind of someone who did not already believe that integrating academic and career-technical education is a good idea.

2. Evidence on effects of combining academic and career-technical coursework

The effect of combining academic and career-technical coursework in high school has been studied in various ways. Unfortunately, most of the research does not support strong inferences about cause and effect. We will pay particular attention to studies with stronger designs. We will also refer to other recent reviews of research on this topic, and will avoid duplicating what has already been published elsewhere. Here we will focus on (1) studies using high school transcript data from national surveys; (2) a study on academically

enriched career-technical education, using random assignment at the classroom level; (3) research on *High Schools That Work*, a large reform network dedicated to combining college-preparatory academic coursework with rigorous career-technical education; and (4) evaluations of career academies.¹² The studies we review will generally include larger than average proportions of students from low-income families, whose parents have not attended college, and who belong to racial or ethnic groups traditionally under-represented in higher education, because these are the students who have been disproportionately included in high school vocational or career-technical education. The studies reviewed here will include a range of academic and labor market outcomes; we will especially highlight results pertaining to high school completion.

Our general conclusion is similar to that reached by the National Research Council (2003) in its review of research on high school students' motivation. After explaining why combining academic and career-technical education should be expected to motivate students, the review summarizes reports from students and teachers in these programs, who frequently do express enthusiasm. However, "this kind of evidence is always suspect. Teachers and students may feel positive about reforms without improvement in their performance, learning, persistence, or understanding." (p. 179) After reviewing evidence pertaining to these outcomes,¹³ the chapter concludes,

¹² The Talent Development High School (TDHS) model calls for grouping all students and teachers into career academies in grades 10-12. However, methodologically strong evaluation of TDHS so far has covered only grade 9, so the effects of career academies in TDHS have not yet been measured (see Kemple, Herlihy, and Smith 2005). We therefore do not review the TDHS results here.

¹³ This chapter of the National Research Council report covered the research on career academies up to 2003, but not *High Schools That Work*. The subsequent chapter reviewed comprehensive high school reform designs collectively, and briefly described *High Schools That Work* but did not review the evidence critically. The study we review on academically enhanced career-technical education was done after the National Research Council review.

“The good news is that the kinds of negative effects academically oriented critics might expect of schools with occupational themes have not been found. There is no evidence of lower grades, lower test scores, or lower rates of college-going. A judicious summary might be that there are no obvious problems in theme-based education in the contexts in which they have been studied and there is the potential for substantial improvements in school climate, motivation, and other outcomes.” (p. 186)

Studies of high school transcripts from national surveys. Starting in the 1980s, researchers have analyzed data from longitudinal surveys such as High School and Beyond (HSB) and the National Educational Longitudinal Survey (NELS), to determine whether course-taking patterns are correlated with subsequent success in postsecondary education or work. Several studies found that students who combined a sufficient number of courses to qualify for college with a sequence of career-technical courses had more success in postsecondary education and work than students who completed neither the college-prep nor the career-tech sequence.¹⁴ Studies differed in whether students who took this combined curriculum were found to do better than, the same as, or worse than students who took the college-prep but not the career-tech courses.

Since the 1980s, a growing percentage of high school students have been taking a combined academic and career-technical curriculum (Silverberg et al. 2004). However, it is not possible to infer from the correlational studies whether enrolling students in additional college-prep or career-tech courses actually makes any difference. Students may self-select, or be directed by teachers or counselors, into certain sets of courses because of unmeasured characteristics such as ambition, energy, drive, self-discipline, or awareness of what it takes to do well in the world. These qualities might enable them to succeed just as well without a combined academic and career-technical curriculum.

¹⁴ For more detail, and citations, see Stern and Stearns (2007).

One study of transcripts is particularly noteworthy here because it focuses on high school completion. Plank (2001) used NELS transcript data to compute the ratio of career-technical credits to academic course credits earned by each student while in high school. He found that a higher ratio was associated with a lower probability of dropping out of high school.¹⁵ Extrapolating this result to its logical conclusion would imply that replacing all academic classes with career-technical courses would minimize the dropout rate. To preclude this inference, Plank added the square of the career-tech/academic credit ratio to the equation, producing a curvilinear relationship. The results then imply that a ratio of three career-technical to four academic credits would minimize the chances of dropping out, on average.

However, Plank's results do not necessarily imply that scheduling more students to take a combined curriculum would reduce the dropout rate. Plank's study has the same limitation as the other transcript studies: students who took a combined curriculum might have more energy, ambition, self-discipline, or other unmeasured qualities that would make them more likely to finish high school even if they had not taken career-technical along with academic courses. There is also an additional issue that pertains to high school completion and career-technical coursework. Many students leave high school in grades nine and 10; but most career-technical course credits are earned in grades 11 and 12. Many dropouts are simply not in school long enough to take a high ratio of career-technical to academic classes.

¹⁵ The logistic regression controlled for gender, race/ethnicity, socioeconomic status, eighth grade test scores, and high school GPA.

Academically enhanced career-technical classes.¹⁶ A recent study by Stone and others (2005) produced results that are much more clear-cut. It used random assignment to test the effects of combining academic instruction with career-technical education. Instead of analyzing students' entire high school course-taking pattern, the Stone study focused on individual career-technical classes as settings in which to improve students' performance in one academic subject, namely, mathematics. A total of 134 career-technical teachers took part in the study: 60 were randomly assigned to the experimental group, and the remaining 74 were the control group. Each career-technical teacher in the experiment partnered with a math teacher from the same high school. The treatment consisted of bringing together the career-technical teachers in each of five disciplines – agriculture, auto technology, business/marketing, health, and information technology – along with their math teacher partners, to identify mathematical content embedded in the career-technical discipline, and develop lesson plans to teach the math within the occupational context.

All students in the experimental and control classrooms were given pre- and post-tests in math. After one year, students in the experimental classrooms scored significantly higher on TerraNova and Accuplacer math tests, though there was no significant difference in performance on the math portion of WorkKeys, which is less advanced. These findings demonstrate that it is possible to provide professional development for teachers that leads to improved math achievement by students in career-technical classrooms.

The Stone study is especially important in an era of test-based accountability. School leaders are increasingly reluctant to adopt any curriculum or teaching strategy that does not improve students' test scores. This study is the

¹⁶ The following two paragraphs are from Stern and Stearns (2007).

first to demonstrate that combining academic with career-technical instruction can do that.

On the other hand, if the objective is to increase math test scores, career-technical education – even academically enhanced – may not be the most cost-effective method. Instead of investing in professional development to enhance the math content of career-technical classes, an alternative would be to spend the same amount of money on improving math instruction in non-career-technical classes. On a larger scale, it is conceivable that student achievement in math and other academic content areas would improve if all the resources currently devoted to career-technical education in high school were spent instead on academic instruction. The Stone study was not designed to address such comparisons; but it did convincingly demonstrate that it is possible to increase math scores of students in career-technical classes.

High Schools That Work. In 1987 the Southern Regional Education Board (SREB) and an initial group of state partners launched *High Schools That Work* (HSTW). The goal was “to prepare students for careers and further education by improving curriculum and instruction in high schools.”¹⁷ According to the web site, “More than 1,200 HSTW sites in 32 states are using the framework of HSTW Goals and Key Practices to raise student achievement.” HSTW is probably the biggest high school reform network in the country, and is certainly the largest initiative aiming to combine academic with career-technical education. This is explicit in HSTW’s 10 key practices, two of which are:

“**Academic studies** – Teach more students the essential concepts of the college-preparatory curriculum by encouraging them to apply academic

¹⁷ <http://www.sreb.org/programs/hstw/hstwindex.asp> (retrieved June 19, 2007). SREB now also sponsors related initiatives involving middle schools, urban schools, and comprehensive school reform.

content and skills to real-world problems and projects.

“Career/technical studies – Provide more students access to intellectually challenging career/technical studies in high-demand fields that emphasize the higher-level mathematics, science, literacy and problem-solving skills needed in the workplace and in further education.”¹⁸

From its inception, *HSTW* has stressed the importance of using data to monitor its work in schools. Another of the 10 key practices is:

“Culture of continuous improvement – Use student assessment and program evaluation data to continuously improve school culture, organization, management, curriculum and instruction to advance student learning.”

The core of *HSTW*'s continuous improvement system is the *HSTW* Assessment, a set of achievement tests based the National Assessment of Educational Progress, in the subjects of reading, mathematics, and science.¹⁹ All *HSTW* sites are required to administer the tests in even-numbered years. Surveys of students and teachers, measuring implementation of *HSTW*'s 10 key practices, are also part of the assessment in high schools.

When *HSTW* started, the achievement tests were administered only to “vocational completers,” seniors who had completed a sequence of four or more units in a particular career-technical specialty. In the late 1990s, *HSTW* began offering schools the option of testing all seniors, or a random sample of all seniors. For the 2006 Assessment, *HSTW* offered schools the following options:²⁰

¹⁸ <http://www.sreb.org/programs/hstw/background/keypractices.asp> (retrieved June 19, 2007).

¹⁹ <http://www.sreb.org/programs/hstw/Assessment/assessindex.asp> (retrieved June 19, 2007)

²⁰ <http://www.sreb.org/programs/hstw/Assessment/2006/WhatIsAssessment.asp> (retrieved June 19, 2007)

- “1. Test all seniors completing four units (or their equivalent) in a career/technical area.
2. Test a random sample of 60 seniors completing four units (or their equivalent) in a career/technical area.
3. Test a random sample of 60 or more seniors. This sample is intended to be representative of all seniors.
4. Test ALL seniors. This option is used most frequently by schools with fewer than 60 seniors.
5. Test all senior career/technical completers and a random sample of the remaining seniors.
6. *Comprehensive School Reform (CSR)* schools should assess all seniors or a random sample of 100 seniors at large schools or 60 seniors at small schools. (Refer to your CSR contract for this information.)”

This sampling strategy makes it difficult to draw conclusions about the effects of *HSTW* on student achievement. If the average test scores of a school’s career-technical completers this year are higher than those of the career-technical completers two years ago, the explanation could be that this year’s career-technical completers were a higher-achieving group to begin with. Upgrading career-technical courses may be keeping out lower-achieving students who previously took those courses – but those students’ scores may not be improving, and the average performance of *all* seniors may not have improved at all. Limiting the assessment to career-technical completers, or over-sampling this group, makes it impossible to determine whether any change is due to career-technical courses simply enrolling more students who were already achieving at higher levels.

Another difficulty is the lack of comparison groups. Even if the *HSTW* Assessment sample consisted of all seniors, or a random sample of all seniors, a

school may show improvement over time for reasons unrelated to the *HSTW* intervention. Given increased state and federal pressure to raise test scores, some states have reported rising trends. To determine how much *HSTW* contributed, it would be necessary to compare with similar non-*HSTW* schools in the same states.

For these reasons, the jury is still out on whether *HSTW* actually causes gains in student achievement. This is unfortunate, and ironic, given *HSTW*'s genuine commitment to using data for continuous improvement. *HSTW* has published hundreds of reports, case studies, research briefs, and other publications.²¹ Many of these include results from the *HSTW* Assessment. But two separate meta-analyses of the *HSTW* evidence have both concluded that the data are simply insufficient to make a judgment. Borman and associates (2003) included *HSTW* in their review of 29 different comprehensive school reform models. Based on the meta-analysis, they classified models into groups according to whether the evidence of effectiveness was strong, highly promising, or promising. *HSTW*, however, was placed in the category of those with "greatest need for additional research," with the following summary:

"[T]he High Schools That Work model has a large research base, composed almost entirely of one-group pre-post evaluations performed by its developer. The magnitude of the effect size from these studies, $d = .30$, is relatively large, but the effect size from the one comparison-group study of High Schools That Work actually revealed a statistically significant negative effect of the model, $d = -.06$. This model has been widely replicated and studied and, in many ways, appears to be a promising high school intervention. That the model has been replicated with such success, has been so well supported by the developer and accumulated a large number of one-group pre-post evaluations is, indeed, laudable. For many schools, this type of evidence may be sufficient to convince decision makers that the model is worthy of adoption. However,

²¹ <http://www.sreb.org/programs/hstw/publications/pubindex.asp>

more research using control groups is needed to help clearly establish the model's apparent benefits." (p. 157)

A review by the Comprehensive School Reform Quality Center (2006) reached a similar conclusion:

"The CSRQ Center reviewed 48 quantitative studies for effects of HSTW on student achievement at the middle and high school levels. Of these studies, none met the CSRQ Center's standards for rigor of research design. Therefore, the overall rating in this subcategory is zero. (Appendix G reports on the 48 studies that were reviewed but did not meet the CSRQ Center's standards.)" (p. 104)

A more recent study by Bottoms, Han, and Presson (2007) does provide some clearer evidence. They used 2002 and 2004 data from schools that tested all seniors or a random sample of all seniors, thus obviating concerns about whether the kinds of students selected for testing might have changed over time. The study also compared two sets of schools, 50 *HSTW* schools that received extra support, and 50 *HSTW* schools that did not. The two sets of schools were very similar in their overall student composition, as measured by race and parents' education. The extra support included a three-day technical assistance visit (like an accreditation visit), a site development workshop for the entire faculty, up to 20 days of on-site coaching by a consultant from *HSTW*, site-specific professional development, support for attending national *HSTW* meetings, and leadership team development. The schools that received this extra support showed statistically significant gains in students' mean scores in math and science, while the non-supported schools did not.²² Neither set of schools showed significant change in reading (Table 3). Among the supported schools, the study also found significant associations between average test scores in 2004 and the degree to

²² In the supported schools, the gain was 5 points in science and 3 points in math, on a 500 point scale, but with more than 3,000 students tested these gains were statistically significant.

which schools implemented *HSTW* practices. The authors conclude, “While these findings do not prove a causal relationship between a school’s support and its achievement and implementation levels, the connections are plausible.” (p. 18). They also note that the cost of doing a study with random assignment of schools would be greater than the cost of providing the services directly to the schools.

Career academies. We coined the term “career academy” for the title of a book (Stern, Raby, and Dayton 1992) describing a strategy that began in Philadelphia in 1969 and spread to California and New York City during the 1980s. The original impetus for this strategy was to motivate more students to complete high school, by creating a small school-within-a-school (what would currently be called a “small learning community”), in which a team of teachers worked with the same group of students during grades 10-12 or 9-12. Students at each grade level were scheduled as a cohort to take a core set of academic classes and a technical class related to the theme of the academy, e.g., business, electronics, or health. Internships, mentorships, field trips, and other experiences linked the school curriculum to the world of adult work. The initial focus on dropout reduction was expanded in the 1980s to include completion of coursework that would qualify graduates for admission to bachelor’s degree programs. The academy model is therefore a clear example of the “college and career” approach for high schools.

During the 1980s and 1990s, several different researcher teams conducted quantitative evaluations of career academies. We have recently reviewed this research elsewhere (Stern et al. 2007; also National Research Council 2003, chapter 6), so we will summarize it only briefly here. Some studies were quasi-experimental, comparing students in career academies with matched groups of similar students at the same high schools. Other studies used regression to

estimate differences in outcomes between academy and all non-academy students at the same schools, controlling for individual students' demographic characteristics and prior achievement. Measured outcomes included indicators of success in high school such as attendance, credits, grades, and – of particular interest here – actual graduation. Some studies also measured postsecondary outcomes including college attendance, bachelor's degree completion, employment, and earnings. No study found academy students performed better on all these measures, but every study found academy students did better on some of them, and none of the evaluations found academy students did worse.

A recent study of the state-funded California Partnership Academies also found positive differences between academy students and other California high school students. Information on academy students' performance was submitted by academy teachers in required annual accountability reports to the California Department of Education; there may be some positive bias in these self-reports. Two findings are particularly relevant to high school completion. One is the percentage of students who pass the California High School Exit Examination, both sections of which students must pass in order to graduate. Students first take the exam in grade 10. The pass rate among 10th graders on the English Language Arts section was 84 percent for academy students, compared with 76 percent statewide. On the math section, it was 80 percent for academy students and 74 percent statewide (Bradby et al. 2007, p. 16). Differences were consistently in favor of academy students when disaggregated by gender or by racial/ethnic classification, except for Asians in math. The second finding related to high school completion is that the number of academy students who graduated at the end of the year was 96 percent of the academy students enrolled in 12th grade at the beginning of the year; the comparable statewide figure was 87 percent (Bradby et al. 2007, p. 18). This difference is in favor of academy

students when disaggregated by gender or by racial/ethnic group, without exception.

These results are encouraging, though not conclusive. The big unanswered question is about student selection or self-selection. Since students usually enroll in career academies by choice, it is possible that students who choose academies are more motivated or better organized, or have other unmeasured characteristics that would cause them to be more successful whether or not they enroll in academies. Teachers also may tend to recruit such students, even if, as in California's state-funded academies, they have to draw from populations of students deemed "at risk."

Enter MDRC. Founded in 1974 as the Manpower Demonstration Research Corporation and renamed in 2003, MDRC had established a strong track record of conducting random-assignment field experiments on job training, welfare-to-work, and other labor market programs. They had not found any program that was effective for young high school dropouts, so they became interested in whether anything could be done to prevent students from dropping out in the first place. Given the encouraging results on career academies, they decided to do an experimental evaluation.

The MDRC evaluation studied nine²³ career academies, each of which was the only one in its host high school, so there was a clear contrast between academy and non-academy students. For the evaluation, each academy recruited more applicants than it could accommodate. From among the pool of applicants, MDRC randomly assigned some students to participate in the academy, and the others became the control group. As is often the case in field

²³ Originally 10, but one program folded.

experiments, some who were assigned to the program did not actually participate. Twelve percent of the students assigned to academies never enrolled in one; another 22 percent left the academies while staying in high school (Kemple and Snipes 2000, p. 34). Adhering to strict experimental protocol, MDRC's analysis included all students assigned to academies in the treatment group, whether or not they actually started or stayed in an academy. Nevertheless, surveys of students during the high school years found significant differences. In particular, students assigned to academies were more likely to combine academic and career-technical coursework, and had substantially more exposure to career development activities, including work experiences connected with school (Kemple 1997). These results confirmed that the academies did, in fact, provide a curriculum that combined academic with career-technical preparation.

Interesting results emerged on dropout prevention. A survey conducted in the spring of senior year found 10 percent of students assigned to academies had dropped out, compared to 12 percent of the control group – not a statistically significant difference (Kemple and Snipes 2000, p. 71). However, a significant difference did appear when the academy and non-academy students were each divided into subgroups: one quarter designated as “high risk,” one quarter as “low risk,” and the remaining half as “medium risk.”²⁴ Among the high-risk group, the dropout rate for academy students was 21 percent, compared to 32 percent for the non-academy students – a highly significant difference, even with a fairly small sample (185 academy and 160 non-academy students in the high-

²⁴ These designations were based on students' characteristics before the experiment began, as revealed by the intake surveys and school records. Characteristics were combined into an index of the likelihood of dropping out, using weights computed by a logistic regression estimated among the non-academy group. Students in both the academy and non-academy groups were then ranked according to this index.

risk group; Kemple and Snipes 2000, p. 48).²⁵ Academy students in the high-risk group also outperformed their non-academy counterparts, with significantly better attendance, more credits earned in both academic and career-technical courses, fewer arrests, and more steps taken toward applying to college. As measured in spring of senior year, impacts of career academies were significant for students at greatest risk of not completing high school.

The picture changed a year later. MDRC conducted a follow-up survey 14 months after students' scheduled graduation from high school. Among the high-risk subgroup, 56 percent of academy students turned out to have graduated on time, compared to 50 percent of non-academy students – not a significant difference. An additional 21 percent of academy students, and 23 percent of non-academy students had either graduated late or obtained a GED, so the total numbers who had obtained a diploma or GED were 77 percent of academy and 73 percent of non-academy students – also not a significant difference (Kemple 2001, p. 31). There were also no academy/non-academy differences in on-time graduation or total high school completion rates among the low- or medium-risk subgroups. In sum, MDRC found no impact of career academies on completion of a high school diploma or GED.

Four years after students' scheduled graduation from high school, MDRC conducted another follow-up survey (Kemple 2004). Again comparing the group originally assigned to academies with the control group, there was generally no difference in postsecondary educational attainment. On the other hand, the former academy students now reported significantly higher earnings than the control group. Separated by gender, the difference was significant among males but not among females. This result is plausibly attributed to academy students

²⁵ Dropout rates did not differ significantly between academy and non-academy students in the low- or medium-risk subgroups.

having more career-technical courses, work experience, and other career development activities while they were in high school. Career academies evidently improved students' preparation for work, while neither improving nor diminishing postsecondary education outcomes.

In explaining the absence of impact on high school completion or postsecondary education, the MDRC researchers point out that both the academy students and the control group went farther in school than students from comparable high schools, according to NELS data (Kemple and Snipes 2000; Kemple 2001 and 2004). Students who applied to the academies had relatively high educational attainment whether MDRC assigned them to academies or to the control group. This supports the conjecture that students who apply to some career academies – including the academies studied by MDRC – have unobserved characteristics that make them more likely to succeed whether or not they enroll in a career academy. An evaluation might try to avoid this issue by assigning students to the program without asking them to apply first. But this would change the nature of the program itself, because participation in a career academy is usually voluntary on the part of students.

Some career academies are more effective than others. A quasi-experimental evaluation in the late 1980s discovered marked differences among academies in their apparent dropout-prevention effect (Stern et al. 1989). In a more recent study, we used multi-level modeling to try to relate the apparent effectiveness of individual academies to certain implementation variables, especially the degree to which academy students were scheduled to take classes together, as prescribed by the academy design (Stern et al. 2007). No significant relationship emerged, but the number of academies studied was small and the implementation measures were very limited. MDRC did some investigation of differences among career academies in their study, and found that the *contrast*

between conditions in the academy and in the host high school, particularly in the level of teacher and peer support students reported receiving, was associated with a stronger dropout-prevention effect (to the end of grade 12) among the medium-risk subgroup (Kemple and Snipes 2000). Further research on differences among career academies would be useful, but would require a larger number of sites.

3. What is so hard about combining preparation for college and careers?

Lack of definitive evidence that an integrated curriculum is more effective for students, and persistence of traditional beliefs that high schools should prepare some students for college and others for work, make it difficult to enact the seemingly obvious idea that high school should prepare all students to graduate ready for college and careers. But even if there were a strong consensus in favor of this idea, it would still not be easy to implement. At a minimum, it would mean ensuring that all students have the opportunity to complete academic course requirements for admission to bachelor's degree programs (as most students aspire to do), plus a sequence of career-technical classes that provide real preparation for work. Even this is no small challenge, especially given the large number of students who move from one high school to another, and the necessity of evaluating individual transcripts to determine whether incoming transfers are on pace to meet these requirements.

Beyond completing college-preparatory and career-technical course sequences, integrating the academic and career-technical curriculum would include the use of lessons, projects, or entire courses that actually bridge the academic and career-technical content. Building these bridges may involve partnerships among teachers, and scheduling students so that they take at least some of their classes together. If teachers are to work in teams, they have to be given time for collaborative planning. All of this requires vision and support

from school and district administrators, who are currently facing intense pressure to raise students' test scores. Here we discuss these challenges in more detail. In the next section we will profile several programs that are meeting these challenges.

Unlike the preceding section which reviewed published research, the discussion in this section is based on our own direct observations in the field, where we have been providing direct assistance to career academies and other high school reform efforts over the past 30 years. We have engaged in on-site coaching and technical assistance to teachers and administrators in several hundred schools, located in more than 20 states. In the past few years we have also documented the experience of 25 high schools that received federal grants to create small learning communities, many of which are modeled on career academies. We draw from these experiences to describe the challenges involved in creating and sustaining career academies, and more generally in preparing high school students for both college and careers.

Demands on teachers. Combining academic and career-technical education in a career academy or similar program requires a team of teachers to work together, so that a career-related theme such as health occupations, business and finance, or information technology is woven throughout the curriculum. Most high school teachers specialize in a particular academic subject, e.g., mathematics, biology, history, English, etc. Asking academic teachers to find ways to integrate their subject with CTE may challenge the most fundamental mission they view themselves as having: enabling students to meet state standards for their particular discipline. State departments of education now have extensive sets of standards in core academic fields; some states also have developed standards in career-technical fields. Learning to teach the standards, and enabling students to reach "proficiency" on tests in their subjects, has become the main imperative for

high school teachers. They may see combining academic and career-technical curriculum as an unwelcome distraction.

Even if academic and career-technical teachers are willing to work together to create an integrated curriculum, forming such a team is itself a substantial task, and raises many questions. How should the team be constituted? Should it be done by an administrator? Should teachers self-select, finding colleagues in other departments with whom they would like to work? How will the strength of teams be balanced so that all students have access to quality teaching? Who should determine or oversee the process? Schools may have difficulty working their way through these questions successfully, and teacher teams may need some assistance learning how to work collaboratively.

The traditional separation between CTE and college-preparatory education poses particular problems. Academic teachers may view career-technical classes as less rigorous, and career-technical teachers may view academic values as elitist. Textbooks are less central in career-technical classes, and they may appear less substantial than the heavy texts in core academic subjects. Career-technical classes traditionally have not counted toward meeting college admission requirements, though this is changing in some places. The traditional status conflict may be reinforced by differences in credentialing requirements: while academic teachers must have bachelor's degrees at least, career-technical teachers in many states need only a high school diploma or GED, plus experience in the field.²⁶

²⁶ The Association for Career and Technical Education will produce a set of state profiles over the next year which will include detailed information about several dimensions of career-technical education, including teacher certification requirements.

Successful teams of academic and career-technical teachers must get past the conventional stereotypes and treat each other as equals. Even then, institutional differences may interfere. Career-technical teachers may be paid by a regional center or other separate program with its own funding sources. They may be contracted to teach in a particular school based on the number of periods taught, much like a part-time band teacher or other specialist. Depending on the size of a school and students' interests, a school may offer only one or two sections of a career-technical course, so the teacher's time is split between two or more schools, making it more difficult for that teacher to be part of an integrated team at any one of the schools.

Once a team of academic and career-technical teachers has been formed, the challenge is how to integrate instruction across disciplines so that students can see how academic skills and concepts are relevant to a particular field of work. This requires teachers to depart from standard textbooks, to find or develop projects that bridge an academic subject, such as history, with a technical subject, such as business and finance. Teachers may find this exciting and interesting, but most of them have little or no experience in creating or choosing curriculum, and they are already stressed for time. Resources are increasingly available, so teachers may be able to find curricular ideas and materials that have already been developed, but accessing these resources also takes time and sometimes money.²⁷

²⁷ Web-accessible resources include the Association for Career and Technical Education (ACTE)'s Lesson Plan Library (http://www.acteonline.org/resource_center/lpl/index.cfm); ConnectEd: The California Center for College and Career (<http://www.connectedcalifornia.org>); Edutopia Online, the George Lucas Educational Foundation site (<http://www.gleef.org>); What Kids Can Do (<http://www.whatkidscando.org>); Project Lead the Way (<http://www.pltw.org/index.html>); and others listed on the CASN web site (http://casn.berkeley.edu/resources/tl_resources.html). Some schools, academies, and programs include examples of their integrated units and projects on their websites. For example, see High Tech High (<http://www.hightechhigh.org>); Digital Safari Academy

In addition to finding or developing integrated curriculum, teachers in career academies and similar programs take on other responsibilities that are different from those working in traditional high school structures. They may spend more time meeting with parents, advising students, and coordinating the involvement of supporters from outside the school, such as employers and community representatives, to serve as speakers, field trip hosts, mentors, consultants for students' projects, panelists for exhibitions of student work, and internship supervisors. All these represent new challenges for teachers, and additional effort which may be difficult to sustain.²⁸

Administrative issues. In a career academy, and in some other programs that combine academic with career-technical coursework, students take a set of classes together, including the core academic classes and a technical class related to the academy theme, e.g., health occupations, or business and finance. Scheduling students together creates the possibility for greater coherence in the curriculum, as teachers can develop assignments or projects that involve more than one subject. Keeping a group of students together also can increase social cohesion and peer support.

Because most U.S. high schools create a different class schedule for each student, developing the "master schedule" that assigns students to classes is extremely complicated. The expectation in a career academy that groups of students will take several classes together is seen as an additional complication because it is different from standard practice. Furthermore, it is desirable for the

(<http://www.digitalsafari.org>), and Sir Francis Drake High School (<http://drake.marin.k12.ca.us>).

²⁸ See the account of Ballard High School in Section 4c.

team of teachers in a career academy to share a common planning period to deal with integrating curriculum, finding common solutions for student problems, meeting with parents, and coordinating employer and higher education involvement. This is possible, and has often happened, but it further complicates the development of the master schedule.²⁹

State and federal accountability laws have added a new challenge to the scheduling problem. Schools are judged according to students' performance on standardized tests, mainly in English and math. The tests do not include anything career-related. One outcome is that most high schools have focused new efforts to bring their low scoring students' scores up by instituting support classes in English and math at grades nine, and often 10. Thus, freshmen who enter high school with low scores take their regular course (generally English I and Algebra I), along with a second class in the same subject that is intended to bring their skills up to the point they can pass the first. Each support class occupies a period in students' daily schedule. In a traditional six-period day, this means freshmen, and often sophomores as well, have two periods of English, two of math, perhaps one of P.E., and one other course (e.g., science, social studies, or an elective). Where there are large numbers of such students, as is the case in many urban high schools, this means most freshman and many sophomores are in these classes.

Support classes affect both college entrance qualification and curricular integration. Since support classes do not generally count toward college entrance requirements, the more of these classes students take, the less chance they will have to meet these requirements. This is an ironic twist, since the support courses are designed to improve skills in directions that might help in

²⁹ See http://casn.berkeley.edu/resources/scheduling_guide.html

college. And since most career-technical courses are electives, this also works against attempts to integrate academic and career-technical curricula, since many students now have fewer elective slots in their high school schedule.

Developing a master schedule that makes a career academy possible, and supporting the work of teachers involved in this kind of program, requires attention and commitment on the part of school administrators. However, curricular integration is typically only one of many change efforts taking place in a high school. For example, most high schools have English and math support programs for students who are not meeting standards. At the same time, many high schools are also trying to offer more advanced classes that enable students to earn college credits. Individual departments often have their own initiatives built around specific textbooks or computer programs. If curricular integration is seen as opposed to other initiatives, or lacks sufficient administrative backing, it will have difficulty in surviving.

Administrative turnover is a frequent problem. When administrators change, there are often policy shifts. These may be driven by educational beliefs and principles, or political considerations. Often new superintendents and principals have their own agendas, and may want to put their own stamp on the institution they now lead. If there is a pattern of frequent administrative turnover, and curricular integration is not given consistent support by district high school administrators, it is unlikely to succeed.³⁰

The intent behind most programs that have curricular integration, such as career academies, is to avoid tracking and enable more students to graduate from high school with a broad range of college and career options. Students are

³⁰ See the account of Cleveland High School in Section 4c below.

usually selected for academies without regard to previous performance, and grouped heterogeneously. However, if a high school has integrated programs in several career fields, there is a danger they will foster new tracks. Different career themes often elicit student interest from different quarters. For example, a pre-engineering program is likely to draw a different kind of student than, say, a performing arts program. To ensure that each academy enrolls a representative cross-section of the school requires, first of all, an adequate information system. If a new tracking system appears to be emerging, school leaders may have to impose an enrollment system that creates better balance between choice and equity.

A key element of career academies and similar programs is the involvement of partners from outside the high school, especially employers in the field related to the theme of the academy, e.g., engineering, information technology, or health occupations. Local workplaces provide speakers, field trip destinations, mentors, and opportunities for student internships. Establishing these connections takes considerable recruitment and coordination work. While teachers are often willing to take on such efforts, they may have little idea how to develop partnerships and therefore be ineffective. Regardless, it takes time, and this must be covered either through reduced teaching loads or increased pay, something many districts cannot afford.

Local colleges and universities can also help high schools develop curricular integration. If the postsecondary institutions have programs related to the career theme the high school students are studying, it may be possible to help students bridge the gap between grade 12 and 13. This can be valuable, particularly for students with no family history of college attendance; however, once again, it takes time and effort to work out the details of such articulation.

4. Examples of what is possible

These difficulties and challenges may help explain why preparing all students for college and careers—a seemingly simple and appealing idea—has not yet become prevailing practice in high schools. Nevertheless, some schools have succeeded in creating and sustaining programs that are committed to that dual purpose. We will describe a few of these in the remainder of this paper. We start with snapshots of two career academies. Next we describe our experience developing a set of career academies in Seattle, Washington; this gives a more dynamic sense of the effort required and the vicissitudes that may occur. Some states rely on regional centers and programs to deliver career-technical education for high school students; we provide a brief sketch of one that has also embraced college preparation as part of its mission. Finally, we profile High Tech High, a charter school founded on the idea of preparing students for college using methods associated with career-technical education.

These descriptions illustrate that, even in an era of test-based accountability, and despite all the other obstacles, some schools are vigorously pursuing the integration of academic and career-technical education. Our descriptions are not intended to demonstrate that these programs are achieving desired outcomes for students; we reviewed available evaluations of such programs in an earlier section of this paper. The purpose of the descriptions that follow is limited to showing that successful implementation of a college-and-career strategy is still possible.

4a. Manufacturing Academy at Laguna Creek High School

The Manufacturing, Production, and Technology Academy is located at Laguna Creek High School in Elk Grove, California, just south of Sacramento. The school has nearly 2,500 students, of whom 32% are Asian, 15% Hispanic, 24% African American, and 28% Caucasian. The family income varies in a

community that includes single family homes and apartments. Over 25% of the students qualify for Free or Reduced Lunch.

When the school opened in 1994, the lead career-technical teacher for the Academy had a state-of-the-art facility and wanted to integrate his curriculum with academics. A science teacher who transferred to the new school at the same time was interested because, as a science teacher he understood the importance of hands-on learning. They provided the nucleus for an academic and career-technical integrated team to which they added a math teacher and an English teacher. During the first years they were a team of four or five teachers, but as the Academy grew, the teaching team grew. Currently there are about 200 students in the program across grades nine through twelve, and eleven career-technical and academic teachers working together to integrate curriculum and support student achievement in different classes. In addition to the career-technical courses, General Science, Physics, Biology, Algebra, Algebra II, Geometry, and four years of English are included. A Social Studies teacher was recently added to the team for United States History and World Geography.

How did they make this happen? In 1995 the team applied for a grant to develop integrated projects using the theory of Action Based Projects, to involve students in real activities of adults in the community. During the next two years, the team participated in a series of professional development workshops during which they were trained on integrated strategies and developed cross-curricular projects. During the workshops they shared their projects and student work with colleagues from other programs and then critiqued the result. Some of the projects developed during these workshops are still used today, but they have been expanded and refined to include both horizontal and vertical integration across four grade levels and five disciplines.

Integrative themes are used at each grade level. In the ninth grade the theme is presentations. Students are required to stand up and speak in all their classes. Ninth graders take English, Algebra, General Science, Technology, Drafting, and have an additional support class. Students are required to find a manufacturing business to study and prepare a report on that business. In the support class they begin to learn the PowerPoint software program. The culminating activity is a presentation to parents, staff, and business partners.

In the tenth grade the theme is teamwork and all students participate in a project with the health charity United Cerebral Palsy. In English they develop a business plan; in Geometry they work on volume assignments that help them design a packaging container from corrugated materials; in Biology they learn about the DNA of cerebral palsy; in their CTE class they create an actual project to donate to those with cerebral palsy; in the support class they continue with PowerPoint, learning more advanced features.

During eleventh grade the theme is career readiness. Students are asked to find a mentor in the community in a business which interests them. Teachers help those who need assistance in finding a mentor, and as part of a routine background check for anyone working with children, mentors are fingerprinted free by the district. Students are required to have ten hours of contact with their mentors, and some mentors visit the school to talk with all students. The culminating activity is "mentor day" for students, staff, and parents. In English, students focus on writing skills with a research paper. All the other teachers on the team support the research and are involved with individual students in the mentor activity. Students are also enrolled in either Algebra II or Geometry, U. S. History, Physics, and a year long course, Design and Implementation. They may also take CAD I (Computer Aided Drafting) for which they can earn three units of California State University credit.

Twelfth grade is structured differently. Students are asked to design a project with cost analysis that combines strategies and learning from grades nine through eleven. They have three classes together: English, CAD, and Design and Manufacturing. For both the CAD and Design and Manufacturing courses, students who earn a “C” or better can earn six units of California State University credit. In the spring, students present their projects to parents, other students, staff, and community partners.

The successful integration of academic and career-technical classes has been possible for several reasons:

- **Strong program leadership.** The lead teacher for the program is dedicated and confident. He is skilled in communication, management, and collaboration. He worked through department chairs to find the right teachers for integration. When he is asked to present at conferences or other professional development activities, he always includes others from the team. He shares leadership and management with other teachers and decisions are made as a team. When he retires or moves to another position, he has mentored others who will take his place to protect the consistency of the program.
- **School site support.** The themes and projects would not be possible without correct scheduling of students and teachers. The Vice Principal who develops the master schedule for the school makes sure all Academy students are identified and placed in the right courses with Academy staff. When students are unable to take an Academy course such as Algebra II or want to take an Advanced Placement course that is not part of the Academy sequence, the Vice Principal and the lead teacher work together to accommodate the student. One counselor is assigned to the Academy students. Site leaders also allow the Support Class to be provided in ninth and tenth grades even though the class size is below the school average. The current Principal of the school was on the Academy team.
- **District and Board support.** From the beginning the district has supported this integration by assisting in grant writing and providing time for professional development. The district Director of Alternative

Education works closely with the lead teacher to ensure adequate funding, equipment and time. She follows through with required paperwork. Board members and the Superintendent attend recognition ceremonies and student presentations.

- **Teachers willing to adapt.** The original members of the integrated team continue to work together. New teachers are interviewed and carefully prepared for teaming and the work of integration. Many of these teachers have had experience outside the academic structure. They understand that this is a different way of teaching and learning, and all staff members are well-versed on standards. Teachers on the team value career-technical curriculum as well as flexibility. Two of the academic teachers have obtained their Vocational Certification so they can teach more than one subject. Twice a year the entire team participates in a one-day retreat to review their work, challenges, and successes, and plan for the future. They also meet as grade level teams to assess student achievement.

4b. Digital Safari Academy at Mount Diablo High School: “Redefining school, redefining cool”

Digital Safari Academy (DSA) is a tenth through twelfth grade small learning community, operating as one of four “schools within the school”³¹ at Mount Diablo High School in Concord, California. The Academy has a theme of multimedia, and is one of approximately 290 California Partnership Academies funded by the State Department of Education. Typically 145 students (45-55 at each grade level) are enrolled in the Academy each year and students take courses in English/Language Arts, Social Studies, Science, Spanish, and Multimedia within the Academy. There is also an optional Virtual Enterprise course and an increased emphasis on entrepreneurship. Additionally, DSA also offers student-run design services to the District, local businesses, and community-based organizations.

³¹ Other academies at Mount Diablo HS include: FAME (Visual and Performing Arts), Health and Fitness; and International Hospitality and Tourism (IHT). IHT is also a state-funded California Partnership Academy. The school also offers auto shop, wood shop, business, computer literacy, and web design courses through its Regional Occupational Program.

DSA students reflect the diversity of the school as a whole and include a mix of African Americans, Asians, Filipinos, Hispanics, Whites, and Pacific Islanders. The majority of the students are economically disadvantaged and the Academy also is inclusive of special education students and has a Special Education teacher as an integral member of the Academy team. Mount Diablo High School, home to the Digital Safari Academy, has an enrollment of approximately 1,700 students with a student population that is 14.2% African-American, 6% Asian, 6.2% Filipino, 45.3% Hispanic, 25.5% White, 2.2% Pacific Islander, and .6% other. The school as a whole is identified as one of the lowest performing schools in the State and has both an API index of “1” and a similar schools rank of “1.” Approximately 54% of students are identified as socio-economically disadvantaged, 28% as English Language Learners, and 14% as Students with Disabilities.

The Digital Safari Academy began in 1996 with funding from a U.S. Department of Education grant that focused on “integrating vocational education with the core academic curriculum.” The initial concept was that instead of simply using multimedia software, students would learn to create it. Students would, for example, use professional multimedia design tools to develop interactive programs about geology as they studied Science, or created websites, digital book reports, and CD ROMs about favorite writers or the Civil Rights Movement as they studied English or Social Studies.

Originally, there was a narrow emphasis on students acquiring specific career-technical skills and a list of multimedia tasks drove much of Academy curriculum. Teachers tended to plan projects related to whatever media technique or skill they wanted students to learn next. As one of the founding teachers describes their early curriculum integration process, “If we wanted to

teach students web design, then we would force a web design project into the academic curriculum. ...The results were most often impressive visually and technically, but empty intellectually and academically.”

Also, in those early years, there developed a strong sense of Academy culture as a student- and learner-centered community that continues to this day. The Academy was (and is) a place where “everyone learns, everyone teaches.” Since the initial federal funding enabled purchase of multimedia equipment and software that was new to both teachers and students, what developed, according to DSA teachers, was a learning environment “where students could create and communicate their thoughts... and visions...(and) ‘Community’ became a code word for how things were done. Students, truly responsible for their learning, began to teach each other. Teachers became part of the community and learned along with the students.”

In 2001, Digital Safari was chosen by the Career Academy Support Network (CASN) to serve as one of four San Francisco Bay Area “Lighthouse Academies.”³² There was growing interest in both Academies and smaller learning communities at the time, and CASN received a grant from the Walter S. Johnson Foundation which involved not only supporting the development of four Bay Area Academies, but also holding a series of Academy Design Studios³³

³² In addition to the Digital Safari Academy, the other Lighthouse Academies included: the Biotech Academy at Andrew Hill High School in San Jose, CA; the Environmental Science Academy at Pinole Valley High School in Pinole, CA; and the F.U.T.U.R.E. Academy (Education/Teaching) at Arroyo High School in San Lorenzo, CA.

³³ An Academy Design Studio is a professional development opportunity for teams of educators, parents, and community members from other schools/districts interested in implementing Academies or other small learning communities. Each of the Lighthouse Academy Design Studios was co-hosted by CASN and the featured Academy. The Design Studio involved not only

so that other schools could come and learn about effective Academy practice. None of the chosen Academies were “perfect” Academy models, yet all had many Academy elements in place, were doing interesting and important work, and were willing to open their practice to others. The Lighthouse Academies project involved annual Lighthouse Academy Retreats; CASN-provided ongoing professional development, coaching and technical assistance; analysis of Academy student performance data as well as training in the use of data to guide continuous improvement; support for developing and/or enhancing all elements of the Academy model, and sub-grants to the participating Academies. The opportunity to grow, share, and reflect with others was a strong catalyst for change.

Perhaps the most powerful aspect of the initiative was the Lighthouse Academy Design Studios. Each of the Academies wanted to show its best work. In the process of planning the Design Studios, the conversations changed and Academy teams, along with their students, engaged in a critical examination of their student work, teacher work, partnerships and practices. In reviewing integrated projects, students and teachers asked what is rigor? What is relevant? What evidence do we have that this is quality work?

In 2001, when Digital Safari was first chosen as a Lighthouse Academy, DSA only included eleventh and twelfth graders. There were a few Academy industry partners; however, there was no Academy Advisory Board. Most importantly, and despite having won 19 state multimedia awards, many of the Academy projects, while strong on technical “pizzazz” were not as strong on

opportunities for an Academy to showcase its best practices and for other schools to visit Academy classrooms and see exhibitions of Academy work, but also for facilitated action planning.

content and rigor. Randy DePew and Heather Nevis, the DSA co-leads, describe the change in the approach to curriculum integration in this way:

“We began to re-evaluate how we conceived of projects. Projects, beginning with our Ebizz project, became multifaceted design problems with multiple outcomes. Instead of being artificially forced into the current academic content, we made the media we used fit a relevant academic problem to be solved. The shift was subtle but profound.”

As a result, in the words of the teachers,

“students now solved real problems using technology and design. And, they used their design to communicate specific knowledge to the world at large. Our students’ critical thinking improved. Their design improved. Our community grew stronger as the tasks we put them to began to demand increased teamwork and time on task.”

Much of the work that began during the two-year Lighthouse Academies initiative continues today. Not only did the Academy curriculum integration process and quality of Academy student work improve, but the Academy also developed a strong Academy Advisory Board with both postsecondary and industry partners, successfully applied for a California Partnership Academies grant, and expanded to include tenth grade students. The goal of the Academy remains “the integration of the core curriculum with a multimedia career pathway through integrated, project-based learning.” Over the course of three years in the Academy, students serve a virtual apprenticeship in doing quality integrated academic-career technical work through a series of grade-level projects that are based in the content of their core academic classes, but “completed through the use of industry standard multimedia tools.” Academy Multimedia classes function much like a professional workplace where students gain career-technical expertise as they grapple with understanding core academic content. Students deepen that understanding as they prepare public exhibitions of their work.

In 2006-2007, DSA students worked on the following major projects in addition to other smaller projects and curriculum units that integrated academic and career-technical knowledge and skills:

10th Grade:

- *Coming to California* (English II, World History, Multimedia I). This is the first sophomore DSA student project and each student is asked to tell the story of her/his family's journey to California. This is adapted from a Digital Storytelling project developed by public radio station KQED.
- *Spanimation* (Spanish I/II, Multimedia I). Students create foreign language cartoon animation using Macromedia Flash.
- *Genetics Multimedia Company* (Biology, Multimedia I). DSA sophomores play the roles of multimedia designers for a company that is producing interactive software aimed at middle school students and delivered via the web.
- *The Legacy of Imperialism: Examining the Past, Preparing for the Future* (World History, English II, Multimedia I). In this project, sophomore teams take on the role of citizens from a developing nation.

11th Grade:

- *A Dream Deferred: Paying Homage to the Struggle* (U.S. History, English III, Multimedia II). Junior DSA student teams work to create a memorial honoring either the African American Civil Rights Movement or another movement working towards equality for all people. Student teams design an actual memorial using 3D software, develop proposals for their memorials in which they must demonstrate their understanding of their subject's importance in the Civil Rights Movement, and then "compete for funding" before a panel of community members.
- *Speaking of Identity* (English III, Multimedia II). Involves juniors in exploring the concept of personal identity through the creation of spoken word projects set to film, photography, or animation.

12th Grade:

- *Ebizz* (Economics, English IV, Multimedia III). In its seventh year, this is the signature project of the Digital Safari Academy and is described by students as "The Super Bowl of the DSA." Seniors work as business teams

to develop a new product and prepare to bring it to market. Student teams work with industry consultants and write extensive business plans, develop marketing materials and television commercials, and compete for funding at the DSA annual Innovation Fair. The Innovation Fair is both a trade show and business plan competition.

- *Going Outside Yourself: The DSA Senior Project* (English IV, Government, Multimedia III). DSA seniors engage in a semester-long, self-designed, action research project with the goal of engaging with the community to make a positive difference. Additionally, seniors create video documentation of their involvement; write research papers which examine the role of government, society, and the individual in their chosen issue; and present their project in an extensive year-end/ Academy-end exit interview.
- *Making Movies: The Heroic Journey* (English IV, Multimedia III). Seniors write, produce, and edit original short films based on the classic heroic journey.

4c. Developing career academies in Seattle: Infotech at Cleveland High and Biotech at Ballard

During a seven-year period ending in 2006, CASN provided support to five Seattle (Washington) public high schools with a goal of establishing new career academies that would integrate academic and career-technical education. Support for the project came largely from the San Francisco-based Stuart Foundation and enabled CASN to have a steady presence in Seattle, both through a local part-time coordinator and CASN staff based in Northern California who made frequent trips to Seattle. In a CASN-sponsored 2006 meeting held to take a retrospective look at the experience in Seattle, teachers and administrators in the participating schools and in the district office, along with several other supporters, agreed that the project was successful on many levels, especially these:

- Of the seven academies developed, all but one continues to operate despite the end of CASN technical assistance and financial support.

- The strong business advisory committees CASN helped develop to support the academies continue in that role, with some local support from the school district and the Alliance for Education, the local foundation in Seattle that exists to support the public schools. Through the efforts of the committees, hundreds of thousands of dollars were raised and scores of business volunteers stepped up to support local academies and their students.
- The Alliance for Education and the district's career technical education office continue to support the academies, without the financial backing CASN brought in the past. Some of the schools chose to expand their smaller learning communities at least in part as a result of the perceived success of the academies.
- Teams of teachers from all the academies took part in professional development, especially project-based learning guidance, that they report improved their teaching and provided an effective avenue for collaborating with fellow teachers.
- A cadre of teachers evolved into effective team and curriculum leaders through the lead teacher positions that are part of the career academy model.

Taken as a seven-academy whole, there was limited solid evidence of increased achievement by academy students. CASN gathered data about academy students and all other students at the same grade level during the first three years of the project. In some academies, after the first full year, there were marked, positive differences between tenth grade academy students and the comparison group whose racial/ethnic and socio-economic backgrounds were similar. But when students' academic achievement in the prior, ninth grade year was added, the differences disappeared. In other words, students who chose to be in the academies were already higher-achieving than students who did not choose to be in an academy.

There were some exceptions to this general finding regarding academic achievement, especially at the Cleveland High Infotech Academy. For this reason, and because the Infotech Academy was well implemented in its early

stages, we devote space to describing the evidence of improved achievement, as well as quality implementation, below. We also look at the forces that came together leading to the demise of the academy at Cleveland.

Prior to changes in leadership at the school, Cleveland Infotech was the most successful of the academies CASN helped create in Seattle. In retrospect, however, the most successful of the seven academies developed was the Biotech Academy at Ballard High. It continues to thrive in its seventh year, even after the departure of its very talented lead teacher. Ballard is located in Northern Seattle, a more affluent community, and its new campus opened about the same time as CASN began working with the school to establish a Biotech Academy.

Ballard's development is presented for consideration here for a number of reasons. First, its implementation was very strong and consistent with the principles CASN believes leads to an effective career academy. Despite challenges to maintaining the strong link between the biotech career theme delivered in no small part through project-based learning, and the school's broader academic program, Biotech continues to thrive. Featured in the description below is an example of an integrated project that has rigor, involves several subject matter classes, engages students, and continues year after year. Finally, given the relatively high admission standards to the Biotech program, Ballard's experience with efforts to recruit students with low past performance, but high potential, is worth examining.

Cleveland Infotech: Rise and Fall. Sadly, Cleveland's Infotech Academy was the only one of the seven academies CASN helped develop that did not survive. It was abandoned by the school at the beginning of the 2006-2007 school year, after three years operating as the school's only career academy and two years as one of several at the school. Still, its highly successful initial implementation, early

indications of increased student achievement, and subsequent demise over a two-year period are a story worth telling. The account of Cleveland Infotech that follows offers a number of lessons about what can be accomplished under the right circumstances even at a very low achieving school in a poor urban neighborhood. At the same time, Cleveland Infotech's demise provides a glimpse of the challenges and vulnerabilities involved in attempting to integrate academic and career-technical education in public high schools.

Cleveland High School, located in South Seattle, is among the lowest performing high schools in all of Washington state. For example, when CASN first began working there in 2000, the percentage of Cleveland students who met state standards in mathematics was in the single digits. Cleveland is one of two high schools in the district with a majority of African American students. The next largest group at Cleveland is Asian. There are also significant numbers of Latinos and Somalians and a handful of White students. The vast majority of students are eligible for free or reduced price lunch.

In 2000, Cleveland's computer technology resources were meager. Few classrooms had computers, and the computer labs that existed were far from adequate. The building had a number of architectural features deemed historic, but in general the facilities offered students were sub-par. Although Cleveland has a rich history and many concerned alumni, overall it suffered from most of the pathologies of a decaying urban high school. Discipline and attendance were problems some felt were out of control. Few students chose to go to Cleveland as a first choice, and recruiting new teachers was a challenge.

Seven years later, much has changed. Fueled in part by the lobbying of members of the new Infotech Academy's advisory committee, Cleveland was moved to the top of the list of schools to be renovated, and by the fall of 2007 a

\$50 million near-total reconstruction was completed; students were back at the school in a temporary space after two years, during which time enrollment dropped from about 750 to 600 students in total.

In 2000, Cleveland High took up the challenge of creating an Infotech Academy with enthusiasm, especially since most start-up costs would be covered by funds provided by CASN through its Stuart Foundation grants. CASN funding provided the costs of a lead teacher release period, extra pay for planning by teachers, some equipment and supplies, student support services, and other needs as identified by the team of teachers who agreed to launch the academy with 60 sophomores in the fall of 2001. The total funding commitment to the school, while generous, was actually less than what the California Department of Education provides to new academies under the California Partnership Academy program.

The initial Infotech team consisted of four teachers, one each for English/Language Arts, Social Studies, Science and Technology. But in addition, there was substantial support from CASN, a new and strong business advisory committee, the district's Career Technical Education (then called School to Work) Office, and the Alliance for Education, the foundation set up to support Seattle's public schools. These outside sources, plus the appointment of a very capable lead teacher, helped Cleveland Infotech overcome the challenges described earlier in this paper, at least during its first three years.

At the time the academy was being developed, the Principal was preparing for retirement, but he generally supported the idea of the academy, especially since it brought resources and needed attention to his school. He did not lead the movement to create the academy, but neither did he stand in the way. The outside assistance substituted for a strong internal movement to create

academies, but with time faculty support for the effort grew. Respected teacher leaders became advocates and they insisted that the funding the new advisory committee could provide to substantially upgrade technology should be shared across the school, not just in the academy.

Even before there was quantitative data from CASN showing gains for students in the academy, the district and the Alliance for Education— influenced by the Gates Foundation³⁴— decided that Infotech’s perceived success should be replicated at Cleveland by creating three more academies, resulting in four that would be substantially autonomous (the other themes adopted, after several months of discussion and planning by faculty, were Global Studies, Health and Environment, and Arts and Humanities). This in turn led to the search for an assistant principal who became principal once the incumbent retired. He was chosen because he was an advocate of small learning communities (SLCs) as well as constructivist teaching including project-based learning.

Overall, district officials did very little to help Infotech’s development, or for that matter the later move to four academies, except when pressured by the advisory committee whose members included influential business leaders including the President of the Seattle Chamber of Commerce who made the academy a special project of the Chamber. Despite the absence of high-level district commitment, the CTE office provided equipment and partial teacher salaries for those who taught technical classes.

³⁴ During the time CASN was supporting work in Seattle, the Gates Foundation began its large investment in high school reform. Its early focus was on small schools. The foundation gave about \$25 million in total to the Seattle schools, with more than half that amount going to high schools with an emphasis on creating small schools. Gates assigned “coaches” to help develop these small schools.

A small number of new teachers who were committed to curricular integration and other features of academies/SLCs followed the new principal to Cleveland. For a while, Cleveland Infotech was viewed, at least by CASN, the Alliance for Education and the Chamber, as the most effective high school reform effort that served poor students in all of Seattle.

A motivated, hard-working, young social studies teacher stepped up as lead teacher for Infotech, and worked hard to recruit other interested teachers to be in the program. She also did all she could to work with counselors and others who influence the scheduling of students to put them in the appropriate classes at the appropriate times. During the first two years of the program, CASN actually measured the “purity” of scheduling students into appropriate cohorts and Cleveland scored high on this measure largely because of the efforts of the lead teacher, the help she got from CASN, and support for what eventually became a kind of powerhouse advisory committee. Still, each trimester the exigencies of scheduling in a school of about 800 students meant that some teachers in the academy, even in the early years, were assigned to the academy rather than choosing to be part of the team, and this took its toll on the lead teacher and the ability for the teachers to act as a real team.

The Infotech theme lent itself well to efforts to integrate curriculum and since there was some common planning time for teachers, a number of projects emerged, especially across social studies (the area taught by the lead teacher) and technology courses. Teachers were given some planning time during the school year and in the summer, with pay. Many of them took a series of project-based learning workshops based on Buck Institute³⁵ materials. They received district credit for continuing education for these.

³⁵ See <http://www.bie.org/>

However, given the new small learning community the academy created, teacher energies at first were much more directed to student support. There are many very poor, even homeless students at Cleveland, and when teachers had time to meet as a team understandably they focused their energy less on curriculum and instruction and more on how to counsel students about the many challenges they face including health, family and financial problems.

Still, students learned to do PowerPoint presentations, research the internet using some judgment about reliability, learn other useful software programs, and clearly for the very first class of Infotech students, who were in the more or less pure program, their experience was very positive. Cleveland Infotech was the one CASN-supported academy where there was a consistent pattern of academy students outperforming non-academy students over time even with similar race and income profiles for each group.

While teachers spent less time on curriculum integration than CASN would like to have seen occur, the teachers did as a group decide that they wanted all their graduates to be prepared for college. By the time the first class of Infotech students became seniors, Cleveland was designated as a Gates Scholars school³⁶, the only one in Seattle. This meant some additional funding and a special college counselor at the school, but most important, funds from the Gates Foundation to pay “last dollar” college costs for any deserving student admitted to college.

³⁶ Through the Gates Scholars program, if a high school is chosen to participate, all students who meet four-year college admission requirements, i.e., the proper courses and GPA, are essentially guaranteed a sort of “last dollar” four-year college scholarship. The foundation also provided a counselor at each school to assist students, especially with the college admission/financial aid process. It also provided some discretionary funding to the participating schools.

The issue of “support classes” in English and math, so common now, was not prominent in Seattle at the time Infotech was developed. The state testing program was still in a pilot status, and while test scores were certainly considered important, they had no high stakes consequences at the time, neither for students nor the schools. There was no mandate for additional English and math courses, and no impact on properly scheduling Infotech students into academy classes. However, as time passed and state test results became more of a driving force in Seattle, there were school-wide efforts to raise scores on the Washington Assessment of Student Learning (WASL) through focusing more on the standards emphasized on these tests in students’ core classes. And indeed, Cleveland students did make considerable progress on the WASL.

By the spring of 2005 and 2006, when the WASL was administered, all of Cleveland had been divided into academies. WASL scores went up substantially in 2005, the largest growth rate in the district, and the growth was maintained in 2006 (see Table 1).

In the spring of 2004, Cleveland was not organized into academies except for Infotech, and Infotech’s WASL scores were higher than the rest of the school. By 2005, there were four small schools/academies at Cleveland, and in 2006 there were three. There is no way to attribute absolutely the large gains to the move towards SLCs but it is fair to say that the move to academies was the only major reform implemented at the school during this time.

Table 1

YEAR	Met WASL Math Standard	Met WASL Reading Standard	Met WASL Writing Standard
2004	5%	22%	28%
2005	23%	57%	55%
2006	21%	67%	60%

At any given time, students would take two or three academy classes. Given the school's trimester schedule, whereby a student completes a full year of a subject during two of the three trimesters offered during the school year, scheduling challenges were present from the beginning. Each year the academy added another cohort of students; thus the entering class in the fall of 2001 graduated in June of 2005.

Both student and teacher scheduling went relatively well during the first three years, during which time the program grew from about 60 tenth graders to about 150 total students across grades 10-12. Each year, all Infotech students took a core information technology course such as web design or multi-media. Teachers were generally scheduled with some common planning time.

In the initial years of Infotech, the lead teacher and others in the program fought hard to have students placed in the appropriate academy classes. But this struggle wore heavily on the lead teacher, and at one point she and the rest of their team concluded that the only way they would be able to have students placed appropriately, employ teachers fully committed to the academy, and control the overall student climate for the academy, was to find an off-campus site—in other words, to gain considerable autonomy. Based on the lack of space anywhere near the school, the lack of budget for off-campus facilities, and given

the fact that Cleveland overall was under-enrolled, efforts to accomplish this were unsuccessful. Each year the struggle got worse, but at least during the first three years, scheduling adhered to the cohort model CASN so strongly supported.

Seattle is a big, wealthy city, with a large higher education and corporate infrastructure, served by a relatively small school district (the Seattle Public Schools now enroll under 50,000 students in total, down from nearly twice that number two or three decades ago). As a result, support for the schools is strong. Several high schools have their own foundations that raise a good deal of money annually. The Alliance for Education alone raises a good deal of money from industry, but also through active seeking of government and private foundation grants.

The career academies CASN helped begin all profited from the generous Seattle community, but none more than Cleveland Infotech. Through the Chamber of Commerce, a semi-retired high tech executive with a great business sense, strong connections in business and government, and the willingness to volunteer many hours became chair of the Academy advisory committee, a position he kept for the entire life of the Infotech Academy. The committee, with very strong support from the Alliance for Education and the Chamber of Commerce, raised more than a million dollars in grant money, including support from the prestigious Social Venture Partners (SVP) group and the Paul Allen Foundation. Scores of volunteers were organized by SVP to tutor at school, judge student work and help the academy make better use of technology. Its bi-monthly meetings attracted many important visitors, and the Infotech Academy suddenly became popular even among district officials who often attended these meetings, even if they never actually visited classes.

The apparent success of the Infotech Academy at Cleveland in its first three years, and pressure from the Gates Foundation led to the decision by the district and the school to move Cleveland to four small, semi-autonomous schools. A new principal was appointed to that position specifically because of his interest in the small school model. In the year before the move to the four small schools, he was the assistant principal at Cleveland and led an impressive planning process, with plenty of input from teachers, resulting in the four school themes and some basic design elements for each. In addition to Infotech, three new academies came into being: Arts and Humanities, Health and Environment, and Global Studies. During the two years that he served, the new principal worked hard to tackle Cleveland's traditional problems of student discipline and attendance, while essentially starting up three new academies, albeit with some help from CASN and coaches provided through Gates Foundation funding.

Establishing three new academies had severe effects on the existing Infotech Academy. The original model was grades 10-12, but now a ninth grade class had to be admitted as well, swelling the size of the academy to over 200 students. New teachers were assigned to the academy rather than volunteering. Gates' coaches urged academies to function independently, possibly even following different bell schedules. Two new assistant principals were assigned to the school, but their roles and responsibilities in relation to autonomous academies were unclear. It soon became evident that Cleveland could not maintain electives and advanced classes without enrolling students across academies. At the end of one rather hectic year with four struggling academies, the school decided to reduce the number of academies to three, eliminating Arts and Humanities. More important, from the perspective of Infotech, the original lead teacher took a leave of absence, and never returned to the school.

In January of 2005 the district abruptly removed the new Cleveland

principal and replaced him with the principal from Rainier Beach High School, the other very low performing high school in Seattle. The Infotech advisory committees and members of parallel committees that were being developed to support the other two academies drafted a letter to the school district expressing their concern that the change in principal should not lead Cleveland away from the small learning community model which – by that time, the second full year of implementation – seemed to be taking hold and had very strong support from teachers. Teacher team meetings were moving from discussions just about students to conversations about how to improve instruction.

In fact, the school's new administrators showed little interest in forwarding the small school model. They did not often attend the weekly meetings of teacher teams, or meetings of the advisory committees. The lead teachers, who previously held considerable respect from their colleagues and the former principal, now saw their roles diminished as the school moved slowly back to a traditional governance model.

CASN and the Gates coaches remained at the school and even facilitated a summer retreat to try to re-establish the commitment to the principles of the academies, but neither group had much influence on the Principal. Originally the agenda for the retreat was to be instructional improvement, but the administration felt that the emphasis needed to be on team building and “cultural competence.” Some time was allotted to work on curriculum, and there were also joint meetings among the steering committees and their respective small school teacher teams that were very fruitful. But at that August meeting it was clear that little had been done to appropriately schedule students and teachers into the three remaining academies for the fall 2005 semester.

When school opened in September, very little remained of the original

small schools. The school administration blamed the newly implemented student information system for the lack of coherent scheduling. With the assistance of one of the Gates coaches, some adjustments were made in the second semester to improve the scheduling.

During this time the Infotech Steering Committee made attempts to understand how its considerable influence and resources (substantial funds remained from various grants it had secured) could be used, given the changes that were occurring. The committee chair asked to meet with the principal to discuss the committee's role; however the principal appeared to be unresponsive to this request, after which the committee essentially disbanded.

By January, 2006, virtually all the outside groups that were supporting academies at Cleveland withdrew their people. This included CASN, the Gates coaches, Social Venture Partners, and to a lesser extent the Alliance for Education. CASN returned to the Stuart Foundation the portion of its grant that was to be spent at the school that year, and Social Venture Partners had its money, which went through the Alliance for Education, returned as well. Letters were sent informing the school superintendent and others that these funds were being returned because the original premise for them – academy/small school development, no longer applied at Cleveland. In its letter announcing the withdrawal of funds, the Alliance for Education wrote: "We deeply regret the circumstances under which we are returning these funds – both for the disappointment to SVP and its members and for the lost opportunity to students at Cleveland."

On a positive note, the experience of the first three years with Infotech proved that despite the many obstacles in a traditional public high school, especially one serving low-income students, a model that integrated technical

and academic education was viable with strong leadership, and with strong community support. But we also learned that administrative support for the changes at Cleveland was fragile at best and too dependent on a single person—in this case, the new principal hired to implement small schools.

One observer who knows the district well believes that Cleveland had little chance to succeed with such radical changes without a thorough assessment of existing staff's capabilities and willingness to work in a new environment. For the shift to really work, he told us, Cleveland's new principal could have been given greater latitude in choosing his teaching staff and the ability to transfer a significant number of teachers out of the school and bring in others. A small number of teachers who wanted to work in a low performing school and believed in "smallness" did join the staff as openings occurred, and from our perspective they made a difference in trying to change the culture of the school.

Ballard Biotech: Excellence prevails. The Ballard Biotech Academy set a new standard for rigor among career academies CASN helped develop. Here are some excerpts from an "expectations contract" all entering students are required to sign:

"Welcome to our community! The Biotech program at Ballard High School offers a rigorous, integrated course of study in mathematics, science, and language arts that better prepares students for either college or the workplace upon graduation. Students enrolled in this community...should seek to become socially and environmentally responsible citizens, effective communicators, and independent thinkers....You will be expected to develop critical thinking and problem-solving skills throughout the program; we will often ask you to investigate real-world problems that need real-world solutions. Your classes will ask you to explore and discuss ethics, civic responsibility, and other issues pertinent to biotechnology; independent research plays a large part in our program. You will be challenged to build a solid foundation in written and oral communications skills throughout our curriculum."

In Seattle, as in most of our work, CASN focused its efforts on schools that largely serve lower income, lower performing students. The exception was Ballard High School, a new school in a solidly middle class neighborhood in the “North End” section of Seattle where we worked to help create two new academies, both of which continue and thrive. One of the Ballard academies focuses on the maritime industry, has very strong support from the large maritime industry in nearby Puget Sound, and attracts students whose academic achievement is near or below average for Ballard. Some participate in that academy because they seek direct entry into the readily available entry-level jobs in the industry, others use the program as an avenue to college. The program is relatively small (fewer than 75 students across grades 10-12) and exists in the shadow of the much larger Biotech Academy whose reputation helps to attract high achieving, highly motivated students.

The Biotech Academy was the only one of the academies begun with CASN support that had admission requirements that would guarantee attracting high performing students. Entering ninth graders had to be on-track to meet four-year college math requirements to be admitted. Demand for the program from nearby middle schools and from some private schools has always been high, and most years some students are turned away.

A precursor to the academy already existed at Ballard in the form of a team-taught math/science combination with a focus on biotech, including a genetics class. As early as 1997, Ballard High struck up a partnership with local biotech companies, especially Immunex (since sold to Amgen) to support the math-science combination.

A science teacher, Penny Pagels, with biotech industry experience, was hired for the precursor program and she became the lead teacher for the academy. To make it an academy by CASN standards, English was added to the program in the 1999-2000 school year so that students took three classes per day in the academy – half their schedule. In its first year the program served only ninth graders, and it grew to a full program (grades 9-12) over the course of four years. Its students have high grade point averages and many graduates attend four year colleges. In the 2006-2007 school year, the program was going strong with nearly 200 students, grades 9-12.

While the district office had little involvement with the development of the Biotech Academy, the Ballard principal at the time was an enthusiastic supporter. Despite its North End location, Ballard's reputation had slipped in the nineties and the principal wanted to boost the academic program even before the construction of a new campus. He was looking for a strong math-science emphasis and encouraged the early partnership with Immunex and the hiring of Pagels to teach the science portion of the precursor program. He was also very supportive of the efforts CASN later made to expand the program by adding a third academic class, creating an advisory committee, creating mentor and intern programs, etc. Most important, he worked hard to create the teacher team that started the program, ran interference for the team with the rest of the faculty, and facilitated appropriate scheduling of students and staff. By the time he left the school three years later, the program was in place with its own strong reputation and support. The principal position has turned over four times in the past five years, but Biotech has survived each change.

A strong team of teachers volunteered to participate in the Biotech Academy. Especially in the first two years when there was technical assistance and funding for extra pay for planning, they met during the summers and

occasionally during the school year to map out curriculum, design integrated projects, and to otherwise make a coherent program. They developed the sequence of courses for grades 9-12 that would be considered academy classes, as shown in Table 2.

Teachers struggled with issues of honors and Advanced Placement (AP) classes, eventually deciding to include neither as part of the academy. “The focus of Academy classes is to promote integrated curriculum and have students learn to apply skill standards in mathematics and language arts to science,” stated the academy team in a letter to parents explaining the policy. Offering honors and AP classes works towards even greater tracking of students, and makes effective cohort scheduling difficult. To address parent concerns that denying students honors classes might hurt their chances for admission to good four year universities, Biotech worked out a way to attach a letter to student transcripts that could be sent to colleges that explains the rigor of the program and the skills the students acquire by completing the academy sequence of courses. While there is no careful follow-up of academy graduates, anecdotal reports indicate that Biotech students have been admitted to many of the nation’s best four year colleges and universities, and the absence of AP and honors classes seems not to be a barrier.

Table 2

Year One	Year Two	Year Three	Year Four
Biology I/II	Chemistry I/II	Genetics I/II	*Non-Academy Sciences Physics I/II or AP Chemistry or AP Biology
Language Arts 9	Language Arts 10	Language Arts 11	*Non-Academy AP Language Arts
Math 2	Math 3	Pre-Calculus	*Non-Academy Calculus or Statistics
Integrated projects	Integrated projects	Leadership (Biotech Expo) Mentorship/internship Program	College preparation

Career-technical teachers in Seattle receive special state certification that qualifies them to teach technical classes, and the credential is a vehicle for covering some portion of their teaching time with district funds for career-technical education, thus freeing up the school budget and cutting costs for integrating academic and career-technical curriculum. For example, Pagels, a fully certified science teacher, was able to get career-technical certification, thus opening up district funding for her extra preparation period used for her role as lead teacher.

Career-technical credentials are granted based more on work experience than education. As of 2007, all of the teachers who teach the biotech science sequence (biology, chemistry and genetics) have career-technical certification. Since the curriculum meets Washington's career-technical standards, students can earn career-technical and/or science credit for the science classes in the academy.

In the early years of the Biotech Academy, teachers at each grade level tried to conduct at least one significant integrated, project-based unit each semester. The following account of what has become a standard unit for ninth or tenth grade students taking biology (more about which students take biology is included in the description of the High Potential Low Performing (HPLP) initiative, below) was written by Pagels. This unit has been popular with students and teachers, and meets the high academic standards of the Biotech Academy:

“Central to each year in the Academy was the integration of the core academic subjects. Academy teachers agreed to one integrated project per semester. In the biology group, the first semester project planned is the conservation unit. In biology class, students are instructed to collect and keep all of their garbage during a two-week period. For each 24-hour period, students maintain a log of their contribution by retaining and carrying their garbage with them and keeping tally of what they consume. Each day in biology class, students separate and weigh their garbage into categories based on the City of Seattle recycling guidelines. All garbage, even food waste, is sorted, weighed and placed in designated containers in the classroom. Students tally their consumption every day during the two-week period.

“In language arts class, students read from the book, *Stuff. The Secret Lives of Everyday Things*, by Alan Durning. Each chapter in the book chronicles the everyday items used by an average Seattleite, from a cup of coffee and a newspaper to running shoes and a car. Each vignette explains background that goes into creating everyday products – what countries supplied the raw materials, the energy consumed in manufacturing, and the environmental, social and financial costs involved in bringing the finished product to market. In both biology and language arts classes, students discuss these topics vis-à-vis ways to problem solve by reflecting upon consumer choices.

“At the end of the garbage collection and tally, students then use their data in their mathematics class. The data are used to teach students how to use actual sample data to extrapolate to a larger population. Students learn how to express their data in various formats (e.g. graphs and charts) and they learn how to manipulate their data to tell a story. Finally, as a

culminating project for the unit, in their languages arts classes, students work in groups and create an informative newsletter that centers on conservation issues of concern. They are directed to incorporate some components of the consumption unit as well as to include short persuasive essays about individual topics of interest. Students then select the top newsletter, which is then published in part in the Ballard High School newspaper.

“This first semester integrated project is a powerful unit that integrates the strengths of the three courses in the Academy. Students apply skills learned in math and science class which help them collect and analyze data. They then use critical thinking skills to assess a stated problem about consumption in the developing world outpacing natural resources to maintain a global economy that encourages further consumption. Students are exposed to contemporary environmental issues of their time that will require solutions in their lifetimes. By weaving this unit in mathematics, science and language arts students are exposed to the importance of reading, writing, experimenting, analyzing data, and thinking collectively to solve problems.”

As with the Cleveland Infotech Academy, Biotech did very well in the first two or three years to keep students in cohorts, taking the prescribed classes, with teachers sharing students in common planning periods. With time and changes in staff, such purity of scheduling has eroded some, but overall the integrity of the program is maintained. Students’ scheduling demands outside of the academy, “singleton” courses that have only one section, and minimum class size requirements have all led to scheduling that is less than perfect. Funds to pay teachers for collaboration are limited, and Pagels points out that even with a financial incentive, high school teachers, especially those who teach several classes, have little time to meet.

Yet through some integrated projects, mentorships and internships for some students, participation in the region’s annual biotech competition for high school students, and field trips and other opportunities offered by business partners, the program has maintained its integrity. It even managed to get

through what some thought would be a crisis when Pagels had a minor “burnout” and took a leave of absence to work in science education at the University of Washington’s Fred Hutchison Cancer Research Center after the 2005-2006 year. One of the Academy’s other veteran science teachers, who also had considerable industry experience, stepped up and the general quality level and reputation of Ballard Biotech continues. But the danger of burnout is real, and its details, as described below, are worth airing.

The Biotech Advisory, or Steering Committee has always been relatively small, fairly academic, very hands-on in working directly with students, and not as involved with raising funds for the program. Fortunately, the fundraising issue resolved itself over time; parents in the program who can afford to do so can make contributions to help cover costs of specialized supplies, field trips and other expenses that were previously covered by grant funds. The district’s CTE office continues to support some teacher time and equipment as well, since there are CTE certified teachers in the academy.

At the beginning of the academy, even before it was officially launched, Immunex, then the major biotech force in Seattle and a locally-managed company, had a full-time education liaison, and she recruited a first-rate committee of industry and higher education people, virtually all of whom had science backgrounds. They have always done well in finding internship positions and mentorships, helping to judge student work, and coordinating with the annual biotech science competition.

The advisory committee was also responsible for pushing the academy to initiate what came to be known as the *High Potential Low Performing (HPLP)* effort – a way to identify and serve students who were not so high performing as those typically admitted in the ninth grade, but with high potential. Many hours

of discussion by the committee went on before the High Potential Low Performing initiative began.

If efforts to integrate career-technical and academic education are to focus on science-related career areas, the issue of equity in recruitment and enrollment is inevitable. When the program recruited from entering ninth grade students alone, very high achieving students applied and they immediately took college-bound biology and math. The steering committee and the teacher team agreed that efforts should be made to have a more diverse student population. To do this, the academy cut ninth grade enrollment to 30 students only. When those students became tenth graders, they would be joined by 30 new students: tenth graders recruited directly from Ballard High School. Pagel described for CASN Biotech's HPLP efforts and her personal perspectives about teaching the "regular" and the HPLP students:

"In year two of the Academy (2000) a two grade level cohort was added in that a 9th grade class and a 10th grade class comprised the new biology cohort. The purpose was to include students at BHS who did not learn of the Academy in middle school and to increase enrollment of students classified as high-potential, low-performance (HPLP). In order to recruit HPLP students into the Academy, biotech teachers met with the mathematics department and explained the Academy program to define the type of students sought. Since math 2 is the required level for biology, all Academy students must qualify for math 2. Academy teachers then presented to classes of math 1 students to explain the benefits of applying to the Academy the following year. Math teachers helped recruit into biotech classes by either writing recommendations for students or recommending students who should be invited to apply to the Academy.

"The aim of the recruitment was to explain to other teachers in the school how the academy could provide a well-supported environment for struggling students so they could succeed. Additionally, the Biotech Academy had become labeled as an "honors" program, contrary to the intention of the Academy founders. By actively recruiting HPLP students, the goal was to further diversify the student make-up of the Academy.

The HPLP students were added to the 10th grade biology cohort. This 10th grade group was then effectively mixed as a group with high achieving students and low achieving students. Although both groups of biology students (9th grade and 10th grade) were presented with exactly the same math and science curriculum in their academy classes it was apparent that a dichotomy between the two grade levels existed. For example, the fact that the 9th grade group was even in math 2 meant they were effectively a full year ahead in the math track. In order to eliminate unnecessary competition, the 9th and 10th graders were mixed in their math courses that helped improve achievement for all.

“Whereas the younger students were referred to as “geniuses”, the camaraderie between the two ages improved during the course of the school year. The 10th grade students who were HPLP continued to struggle with the rigor of the Academy; however most students opted to stay in the Academy. Academy teachers continued to provide extra support for these students by hosting study hall after school and meeting regularly as a team to discuss students of concern.

“The HPLP students required a great deal of support and attention -- especially the second year that this group entered the Academy. In fact, most of the 10th grade biology class who entered the Academy in 2001 were classified as HPLP by the teachers who recommended them. Some were ELL students, some were special education students, and some had a history of attendance issues and disciplinary problems. Over 60% of the class of 22 students had been flagged by their recommending teachers, and described in such creative ways as “disruptive in class, energetic, but has the ability to focus when given clear boundaries and expectations.

“The biggest challenge of including the HPLP students in the Academy was maintaining the level of rigor that had been established. What’s more, since both 9th and 10th grade students would be mixed in their math 2 sections, the importance of maintaining rigor and consistency in the teaching material was tantamount to including a diverse group of learners in the Academy.

“Even though the two biology sections were taught in the same manner, there existed a wide difference in the class averages of the students. The 9th grade students maintained a class average of 87% (high B) and the 10th grade students maintained a class average of 70% (low C). In some periods during the school year, half of the 10th grade group was failing to meet standard; this never occurred in the 9th grade group. The 9th grade students were a highly motivated group of learners. The 10th graders

lacked motivation in general. It was difficult to find ways for them to learn with the same level of enthusiasm.

“Because I had the 10th graders first period and the 9th graders second period, often, I was exhausted (having utilized all my energy getting the students to participate and focus on the lesson of the day) before the second period 9th graders arrived. That said, within five minutes of second period, the sparkly 9th graders would ignite my enthusiasm as these younger students demanded and embraced learning.

“The fact that the 9th grade students had been guided, if not forced, by their parents to apply to the Academy in the 8th grade clearly played a role in why this group as a whole was vested and more dedicated to their academic success. In various years, the 9th grade group was problematic in that they exhibited negative behavior in the form of entitlement to certain things. For example, if we were doing a lab that some of them had done in middle school, there would be a small revolt from some students – who complained about participating.

“During these times, the HPLP group was by far easier and more fun to teach because they had not had a positive lab experience until their biotech class. In retrospect, including the HPLP group into the Academy forced me to re-think my teaching style and adjust things appropriately. Classroom management was more demanding in the HPLP group, in different ways than the 9th grade group. Over time, I was able to be more flexible with some lessons, yet still hold all students to the high standard they expected. What made it different from teaching a general science class is that both grades of Academy students had actually chosen to be there, in my class. This is fundamental to the success of the Academy. Student and teacher buy-in to the program and its objectives allows for creativity and accountability in learning. It is truly invigorating to teach in a community where everyone wants to be a part of it and wants to contribute and participate in day-to-day activities.

“Some of the greatest struggles occurred if students, regardless of HPLP or 9th grade, could not succeed in math 2. Nearly all students who failed math 2 and who had to be held back in math, could not succeed in chemistry the following year. The Academy chemistry teacher made several exceptions by allowing students to continue in the program, only to watch the students flounder. This led to attrition within the first semester of the second year. Although we attempted to allow for tutoring and provide extra help to these students, the fact remains that they struggled miserably.

“Perhaps the greatest success of the HPLP group was that the Academy became richer and more diverse. If HPLP students were able to continue and flourish in the second year, which included chemistry and math 3, then we had succeeded in our mission. These students would continue to struggle in some cases. But those who rose to the challenge would finally reach a new level in their learning. What’s more, after completing the second year, these students would now meet the minimum state university application requirements for math and science.

“If students continued on into the third year, genetics and pre-calculus, then this was the greatest accomplishment. In the second year, we experienced the most attrition in the Academy; however the greatest attrition rates were from within the HPLP group. For those who did stay in the Academy, I believe that community that the Academy provided to this population contributed in part to their success. Again, in the second year, these students were mixed grade levels in math class which meant the high level, younger students still provided a positive influence.

“Additionally, school wide, the biotech program had a high level of respect amongst students. In the halls of Ballard, students knew that being in the biotech program was rigorous and if a student was a part of it, there was a positive association. It was known as the “cool” program at the school which meant it carried with it a level of prestige. Indeed, when we addressed “students of concern” and placed students on probation, time and time again, the students begged to stay in and keep trying.”

Pagels’ report to CASN about her four years teaching and leading the Biotech Academy at Ballard offers very thoughtful comments from the front line. The notion of a “lead teacher” in career academies and other forms of smaller learning communities is rarely questioned; someone has to get the work done and who better than someone who also serves in the classroom.

But teaching a nearly full schedule of high school classes is a tough enough job without the added responsibility of “leading” a group of teachers in an effort that requires a good deal of planning, curriculum development, diplomacy, parent contact, and problem-solving. Here Pagels describes her experience, and how it finally led to her leaving Ballard, at least for a while (she still has a leave of absence from the district and may return to teaching). A

strong foundation was built for the academy including very committed parents and the program's steering committee; thus it survived her departure at the end of 2005-06. Still, it is valuable to hear what she has to say about her job as lead teacher.

“As lead teacher in the Academy, in addition to teaching four science sections, I was responsible for scheduling teachers in the Academy, scheduling Academy classes and helping maintain the school schedule for Academy course offerings, attending all Steering Committee meetings, organizing fieldtrips, submitting grant proposals to the Gates Foundation, organizing curriculum planning meetings, and organizing regularly scheduled Academy meetings. In any given year, these responsibilities would change slightly. In the first two years, I shared the lead teacher role with another teacher in the Academy. By the third year, when the Academy had grown to over 175 students, I was the only lead teacher. By that time, my responsibilities had increased with the increased number of students and cohorts.

“Having a second prep for the academy helped tremendously in that I had in-school time to deal with Academy issues. However, after-school responsibilities increased to the point where, at certain times of the year, I would spend hours after school tending to schedule conflicts, parent demands, and meetings. Due to the regular demands of teaching lab science classes, I found that the lead teacher responsibilities were challenging in that I would lose actual classroom prep time, which meant countless hours after school or on weekends to perform my classroom duties. Lab science classes demand more time in lab prep and set up—something that cannot be accomplished outside of the classroom....The greatest challenge I faced was finding ways to manage the science classroom teaching demands while concurrently managing the Academy program needs.

“Perhaps the greatest on-going challenge of running the Academy was maintaining positive public relations with the entire school. In the dynamic urban public school system, nothing is certain. That is, each and every year there are changes that affect the district, the school, scheduling, funding, and staffing....The school staff did approve starting up the Biotech program, and with that approval, we launched. Years later, after the Biotech Academy was established and had become successful, resentment from some school staff members was evident. As a result, we

had to make periodic presentations to the staff and administration to explain the goals and objectives of the program. Even biotech teachers faced criticism from within their departments, which led to smaller-scale, department presentations. Throughout the history of the biotech program, there have been several conflicts and or discussions about class offerings and scheduling. Most recently, with the addition of more advance placement (AP) courses in the school, managing the biotech teacher teams became problematic....

“ In the end, running the Academy and teaching four advanced lab science classes, took its toll. After seven years (including the 1998 biotech pathway launch) of running the show, I needed a break. After a positive year of working with stellar students and a dedicated staff, I stepped down from the lead teacher role and took a leave of absence from teaching so that I could pursue other interests.

“The demands of maintaining a program of high integrity in a community that has high expectations for its public school- were never-ending. Unique to the biotech program is the incredible supportive parent community of Ballard. But with that support also comes a level of entitlement that at times, poses a great challenge. At times, the parent demands were daunting – especially during the college application process. Issues of dissatisfaction with teachers in the Academy or Academy curriculum led to meetings and negotiations with parents – something that doesn’t occur typically in general education classes. Sometimes, the pressure of serving the parent community while concomitantly managing the program and teaching staff was a bit overwhelming. In future, I would recommend a rotating lead teacher role amongst the Academy teacher team. This may help ease the pressure of having one point person in addition to preventing burn out of Academy teachers in general.

“The Biotech Academy continues to thrive and the integrity of the program and its positive reputation is in tact. The model of combining academic course work with professional training for post-secondary education and careers is clearly working.”

4d. Tech Center at Yorktown: The Putnam/Northern Westchester BOCES

The Board of Cooperative Education Services (BOCES) was created by the New York State legislature in 1948 to allow two or more districts to share resources and services. One of the main instructional programs supported by BOCES is Career and Technical Education (CTE) with the goal of providing high school students the opportunity to explore different careers. Students are generally bused to the BOCES facility for two or four hours of classes and may attend for two years, usually in grades eleven and twelve. An optional New York State Education Department (NYSED) approval process makes it possible for students to earn a Regents Diploma with a CTE endorsement from a BOCES Center. The Regents grant academic credit if the program can prove it is justified.

In 1996 the Regents increased graduation requirements for all students; they are now required to take four years of English and Social Studies, as well as three years of both Math and Science. This change caused the CTE Coordinator for the Yorktown Tech Center to be concerned about enrollment in CTE programs, as was the New York State Assistant Commissioner for CTE, a former CTE instructor. They worked with other CTE Directors from the 38 BOCES statewide to develop an approval process that would grant academic credit for BOCES courses if certain conditions were met every five years. In 2001 the Yorktown Tech Center obtained approval for the academic credit and Regents Diploma. The Center was the second BOCES in New York to be granted this credit and diploma.³⁷ In 2006 the approval process was conducted by the Association of Career and Technical Education (ACTE) with a team of national educators using the New York State approval guidelines.

³⁷ For the approval process and CTE requirements see <http://emsc.nysed.gov/cis>

The Yorktown Tech Center is located on a 24-acre campus in Yorktown Heights. The Center serves approximately 12% of the juniors and seniors from 18 local districts in northern Westchester and Putnam counties. District demographics vary from very affluent areas such as Chappaqua, to more blue-collar areas.

In the past, academic integration was focused mainly on remediation for students. That has changed to include more academically rigorous courses that meet Regents and home school requirements. At the Yorktown Tech Center, academic teachers work in teams with CTE teachers. Six English teachers, three Math teachers, three Science teachers, and two Social Studies teachers team with CTE teachers. They work in the classroom together and have weekly common planning time. They also make decisions regarding budget and are able to develop their own schedules. When new teachers are needed, the existing teams conduct the hiring interviews. Twenty-five percent of the teachers at the Center are academic teachers.

Students typically attend one two-hour session (a day) earning CTE credits and/or academic credits, and return to their home school for the rest of the day. Seniors have the option to attend for four hours. Physical Education is provided, if needed, so students can complete graduation requirements at the Center. All programs include writing, journals, presentations, and portfolios. Grading procedures are in place, including academic work in CTE classes. College recruitment also takes place on campus. Students may return to their home schools for sports, music or AP courses. Some students have internships.

Students who earn a “B” or better in senior English can earn transferable State University of New York credit that qualifies for English 101 in state colleges and universities. Work is currently underway to provide the same kind of credit

for English 102. A team of college professors and high school English teachers met during the summer of 2006 to examine standards and required student work for this credit. Much discussion took place about the different kinds of required essays. The Tech Center CTE and English teachers were able to demonstrate their inclusion of all the required work using samples of student work and portfolios. They are meeting again during the summer of 2007.

The math course on the student transcript is determined by the student's home high school. The math teacher and CTE teachers have developed a matrix with the New York State five content areas for math; they show how number sense, algebra, geometry, measurement, and statistics and probability are included in the CTE classes such as Auto Body and Culinary Arts, as well as in the math classes. Mapping across the standards includes examples from each of the 21 CTE program areas. For example, in Culinary Arts the curriculum includes weight, volume, equivalents, and measurement which can be "mapped" back to the NYSED math standards.

In the Transportation Academy, Government/Economics and CTE teachers have developed a series of integrated units. For example, the Government text is *Your Rights and Your Responsibilities and the Law*. Students study government regulations, the Truth in Lending Act, Fair Credit Reporting, Equal Credit Opportunity Act, Electronic Fund Act, and Fair Debt Collection Practices Act. They also learn about the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA). In the CTE class the curriculum includes owning and operating a business, safety requirements, and also OSHA and EPA guidelines and regulations. The standards from the two courses support one another. Seniors earn academic credit for both Economics and Government, courses required for high school graduation.

Health, Environmental Science, and English are integrated through a series of books which focus on health and environmental themes. Students read *Midwives*, learning about reproduction; *The Hot Zone*, respiratory issues; *The Man Who Mistook His Wife for a Hat*, aspects of neurology; *Into the Wild*, ecosystems; and *Solar Storms*, energy.

English and Science are also integrated with Cosmetology. In English students read articles and write essays about professionalism and infection control. In Science they study bacteria and infection control. Science experiments include hair coloring products. They study the same topics in the Cosmetology class. The Senior Exit Project is included in all three courses: students develop a plan for a salon including research, an essay, a written business plan, and a PowerPoint presentation.

Funding for BOCES is tuition-based. Academic teachers are part of the regular tuition costs paid for students from participating districts. Local participating superintendents, who see the value in using an integrated approach, vote on the budget and have approved the inclusion of academic staff as an integral part of students' education. Through the inclusion of academics, the emphasis at the Yorktown Tech Center changed over time from a traditional vocational education program largely unrelated to academics, to a high quality career technical program that includes academics and prepares a broader cross section of students for both college and careers.

4e. High Tech High, San Diego

Throughout this paper, we highlight the many obstacles to even the best-intentioned efforts to integrate academic and technical education in public high schools. But High Tech High (HTH) in San Diego offers a refreshing exception. As a small, charter high school, its founders made a commitment at the outset to a pedagogical approach featuring “project-based learning, interdisciplinary teaching,” and “bridging academic content with vocational education methodologies.”³⁸ They had the wherewithal to follow through on their vision, helped substantially by the flexibility of their charter, their considerable autonomy, strong partnerships that included a good deal of funding from private employers and foundations, and the ability to attract staff committed to the vision.

They also invested considerable energy into working with state agencies and regulations and maintaining good relations with the urban districts where HTH and subsequent HTH-operated elementary, middle and high schools are located. They carefully crafted high school classes to meet requirements for admission to the University of California or California State University (known as the “A-G” course list), gained the state’s first statewide charter from the California Department of Education, demonstrated that constructivist, project-based curriculum can address state standards, and even developed their own teacher credentialing program.

One might dismiss all this as an aberration, a sort of “perfect calm” of circumstances that brought together powerful community interests, inspired leadership, healthy resources and the flexibility of the charter. Skeptics would say that HTH’s success (high scores on standardized tests, long waiting “pools”

³⁸ From “High Tech Learning, A Proposal and Petition to Operate a Statewide Benefit Charter School,” Presentation to the California State Board of Education, May, 2005.

for admission, unparalleled positive press) is unique, and its lessons hard to apply to the reality of California's urban high schools. But that attitude overlooks all the careful thought that went into planning the school and now its expanded family of schools. In any case, it is worth understanding the details of the commitment to and implementation of curriculum integration and project-based learning at HTH. We start with some HTH history, and then focus on a strong, exemplary model of its integrated approach to pedagogy in its urban ecology cluster.

HTH was first conceived by an ad hoc group of 40 civic leaders, high tech executives and educators in San Diego in the mid-nineties. They were motivated by their concern that the public schools were not helping to prepare enough qualified young people for high tech jobs, with the problem especially worrisome regarding women and people of color. Their initial focus was on working directly with existing public schools, but with time their focus turned to starting a new school. The effort was led in part by Gary Jacobs, Director of Education at Qualcomm, and Kay Davis, Director of the San Diego Business Roundtable.

By 1998 they raised funds to hire Larry Rosenstock to develop and implement a new small high school to address their concerns. Rosenstock had considerable experience as a vocational teacher, a school principal, a lawyer working on education equity issues, and just before the time he began this new assignment, as the director of the U.S. Department of Education's New Urban High School project. From the New Urban High School experience he brought a set of high school reform principles to the work of developing HTH.

Rosenstock led the planning effort from 1998-2000, working most closely with Jacobs. They located a site – a building that was part of the closed Point Loma Navy base, and sought a charter with the San Diego Unified School

District. Rosenstock focused on the new school's design, securing the charter, and hiring the initial staff. Jacobs and others in the community focused on securing the Point Loma building, and finding the needed financing.

From the beginning, Rosenstock worked closely with two former colleagues: Rob Riordan, an expert in project-based learning and bridging academic content with vocation education methodologies, and David Stephen, an architect and expert in designing education environments. (Both Riordan and Stephen remain with High Tech High and its umbrella charter management organization that will open its seventh and eighth schools in the San Diego area in the fall of 2007.)

In their 2005 report to the California Department of Education, High Tech High listed three goals for its schools:

- To integrate technical and academic education in schools that prepare students for post-secondary education and for leadership in the high technology industry.
- To increase the number of educationally disadvantaged students in math and engineering who succeed in high school and post-secondary education and become productive members and leaders in the new economy, particularly in California.
- To provide all HTH students with an extraordinary education, and to graduate students who will be thoughtful, engaged citizens prepared to take on the difficult leadership challenges of the 21st century.

HTH is able to enact these principles in part because of the unique schedule they have developed for students and teachers. Most students have a core program that consists of a humanities block (Language Arts and Social Studies) and a Math/Science block. Students stay together during these four periods, with just two teachers, one for humanities and the other for Math/Science. Those two teachers often share a common prep period. This

opens up countless opportunities to collaborate around curriculum in the four core subject matter areas all students take virtually every semester and the real opportunity to develop, carry out, evaluate and present in-depth projects. Beyond that, all teachers are required by contract to be at school each day one hour before classes begin, thus creating more opportunity for collaboration.

A typical teacher of math-science or language arts/social studies has two groups of students each day, each in a double period, keeping student contacts in those blocks to around 50 per day. In addition, most teachers teach another elective class, usually one that is less demanding in terms of preparation. Students take six periods, and there are a number of other elective classes including foreign language, the arts, and more specifically “technical” classes taught by full-time elective teachers.

Many questions come up about the schedule just described. Where do you find teachers who can teach both math and science, English and social studies? How can the specific course requirements imposed by the University of California, i.e. the a-g sequence, be met in this model? What about AP classes? And in the era of accountability to standardized tests, doesn't the focus on project-based learning, and the time that it requires for students on their projects, divert attention from “covering” the many state standards?

Suffice it to say that HTHS has worked out the answers to most of these questions with considerable success. Their small size, ability to attract strong teachers, the advantages of being a charter school, and the support they get from the community and the charter management office seem to come together, and students are doing well on standardized tests and getting into strong four year colleges, including the University of California. The school received a six-year accreditation from WASC.

As for addressing state standards, in the charter application this is addressed as follows:

“Cross-Walking Projects to Standards

As High Tech High teachers develop projects that engage student interests, they are mindful of California State Content Standards for grades 9-12. For example, a High Tech High chemistry teacher may have each student create a documentary about the harmful effects of illicit drugs on the human body. The unit addresses many state standards in chemistry, such as functional groups, bonding, the periodic table, and molecular structures. At the same time, however, such a project integrates well with math and humanities and achieves real-world relevance as students use technology to create educational videos that can be shared with other schools as part of a broader drug and alcohol abuse prevention initiative.”

As stated at the beginning of this case study, the integration encouraged by HTH is not necessarily between specific academic and career-technical classes, but rather between academic *content* and vocational education *methodologies.*” The HTH schedule most readily facilitates integration between and among the humanities and math/science blocks, though elective classes such as art or principles of engineering can also be woven into a project.

In a traditional sense, HTH does not have many career-technical classes. However, owing to good relations with the Regional Occupational Program (ROP), and to state laws and regulations that do not discourage it, a number of less traditional career-technical classes exist at the school because their teachers have vocational/ROP credentials and they have written their curricula to conform to ROP requirements. These include biotechnology, certain art classes, multi-media, and principles of engineering. With the approval of ROP classes comes ROP financial support for those classes, a practice also used in many career academies, and a tribute to the flexibility that is possible under state ROP legislation.

There is no real formula for what constitutes academic/vocational integration at HTH. All teachers receive training in project-based learning (PBL) from Riordan and others. All new teachers undergo two full weeks of training before they begin teaching at HTH, and this is organized around the principles and pedagogy described above. Furthermore, HTH takes the idea of senior projects quite seriously, and each year all seniors work on a senior project with a common general theme. For example, in 2005-06, teams of students designed and built small submarines that had to sustain the test of being submersible. The school is built in such a way that there are vast spaces and tools to work on such projects, and to display them once they are finished. Each year the senior projects have become more sophisticated; in 2006-07, greater effort was made to present projects in a way that other students could understand the learning involved for those who produced the projects.

In addition, nearly all juniors are engaged in a semester-long internship working on some problem that is of interest and concern to the larger community. These internships must have a strong academic component as well as a real-world connection.

The shape of the integrated projects varies a good deal depending on the interests and real world connections of the teachers. In the statewide charter application, a few of the projects were briefly described in the context of how they align with state standards. Some are done within a single course; most are carried out across classes (see Table 3).

In grades 11 and 12, students have the same teacher for English/social studies, but math and science are taught separately. This enables the school to better align courses with college requirements. And while there are no formal

AP or honors classes at HTH, juniors and seniors can sign an agreement to do extra work and achieve at high levels in order to receive honors credit that helps boost their GPA for college eligibility. Many students also opt to take AP exams. There is some support for those who study for the AP exam, but HTH does not emphasize AP for its students, and for the most part students have to prepare for the exams on their own.

Collaborative, project-based work at HTH emerges largely from teacher interest and background, as well as connections they may have in the outside world. It often relates to the internships all students do as juniors, and to the required senior projects. It is driven by guiding questions and goals, using the guidelines for PBL that have been developed over many years, and as currently promulgated by organizations such as the Buck Institute for Education,³⁹ as well as individual experts.

³⁹ <http://www.bie.org/index.php>

Table 3

PROJECT TITLE	SUBJECT/GRADE	STANDARDS ADDRESSED
Mock Trials in the Humanities Classroom	11 th grade History and English	CA History Standards 11.1, 11.3, CA E/LA Standards: Reading (1.0, 1.1, 2.0, 2.1, 2.3, 2.4, 2.5), Expository Critique 2.6, Listening and Speaking 1.0, Comprehension 1.1, 1.2, 1.3, Organization and Delivery of Oral Communication (1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10), Analysis and Critique of Oral and Media Communication 1.11, 1.12
UV Radiation Project	10 th grade Chemistry	CA Chemistry Standards (4a, 4c, 4e, 4f, 4g, 9b); Investigation and Experimentation Standards (1a, 1b, 1m)
This New House (Environmentally Sustainable Dream House)	10 th grade Math, Chemistry	CA Geometry Standards (5.0, 7.0, 8.0, 9.0, 10.0, 11.0, 15.0, 18.0, 19.0, 20.0); CA Chemistry Standards (3a, 3b, 3c, 3d, 4a, 4b, 4c, 4e, 4f, 4g, 4h, 4i, 7a)
Rock Climbing Project (learn the physics and write a guidebook)	11 th grade Math, English, Multimedia	CA E/LA Standards: Writing (1.1, 1.4, 1.5, 1.8, 2.3), Written and Oral Language Conventions (1.1, 1.3) CA Physics Standards (1a, 1b, 1e, 2c, 2h); Trigonometry Standards (12.0, 14.0, 19.0); Algebra Standards 14.0, 19.0
Drug Project	10 th grade Humanities, Science (Chemistry and Biology), Statistics, Multimedia	CA E/LA Standards: Reading Comprehension (2.1, 2.3, 2.4, 2.5, 2.6, 2.8); Literary Response and Analysis (3.2, 3.5, 3.12), Writing (1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9); Writing Applications (2.2, 2.3); Mathematics: Probability and Statistics (5.0, 6.0, 7.0, 8.0); World History, Culture, and Geography (10.4), Biology (1b), Physiology (9a, b, c, d, e, i); Conservation of Matter and Stoichiometry (3a, b, c, d, e, f, g); Acids and Bases (5a, 5b, 5c, 5d, 5e, 5f, 5g); Organic Chemistry and Biochemistry (10a, 10e); Investigation and Experimentation (1a, 1b, 1c, 1d, 1j, 1l, 1m)
Virtual Museum	10 th grade Humanities, Multimedia	CA History-Social Science Standards 10.1, 10.4

One integrated project we looked at is the “Integrated Urban Ecology Study of the San Diego Bay.” This project is led by a science teacher, Jay Vavra, teamed up with a humanities teacher and math teacher working with juniors in

their core subjects on a year-long effort that has resulted in the publication of field guides and studies each school year since 2003-04, when the collaboration began.

Vavra's students focus on the San Diego Boat Channel, located in HTH's backyard. The channel and the entire Bay have suffered considerable degradation as a result of human activity. Learning about that degradation—studying it, mapping it, measuring it, and advocating to change it—became the focus of the work that some 200 HTH students have done over the past four years.

Each year students in the urban ecology/San Diego Bay cluster have produced and published a book, always in partnership with community groups like Sea World, the Jane Goodall Institute, the National Oceanic and Atmospheric Administration (NOAA) or the Port of San Diego. They conduct all the research, do the graphic design, learn the publishing software, do the layout, and write the text. The books are sold by such online retailers as Amazon.com, and some have been used in community college classes.

The work of the project is well documented in various research and magazine articles including one by an editor of the 2006 publication, *Perspective of the San Diego Bay: A Field Guide*. Evan Morikawa, a senior at the time, wrote in the Fall, 2006 edition of *California Association for the Gifted*:

“One of the striking features of this project is the opportunity to effectively combine many different disciplines. As a result, the more teachers and subject areas that are involved, the more comprehensive the project becomes. There will always be the artist, the scientist, the technology wizard who, through their combined efforts, add portions to the project. This leads to development of team building and group organizational skills.

“We chose the San Diego Bay as the subject matter of the field guide because of its accessibility and the large social and ecological impacts that it has on the community. In our project, biology was used as a scientific indicator of bay health, while the historic and creative writings focused on stewardship and human exploitation.”

The details for how this collaboration or others at HTH work day to day or week to week are really beyond the scope of this paper; but the results are clear to observers. One such observer was Kathleen Cushman who published an article in the November, 2005 edition of *Edutopia* that focused on the project’s 2004-05 publication, *Perspectives of San Diego Bay*:

“The kids couldn’t have done it without help, of course – and in fact, getting that help was all part of the project. After joining Jane Goodall’s worldwide organization, Roots & Shoots, aimed at youth making a difference in their community and its environment, they wrote a proposal to the national nonprofit organization What Kids Can Do, which funded their basic expenses with a small Student Research for Action grants. As the semester progressed, they arranged training in GIS by a local university research team, plumbed the archives of the city’s historical society with help from its curators, and sought scientific advice from the Scripps Institution of Oceanography...and the Los Angeles Natural History Museum.

“For these student publishers, who are now busy tracking sales and creating press kits, their professional aura and public audience mean more than any A on a report card. “Every kid has the question in class: ‘Where am I going to use this in the real world?’” says Evin Morakawa, one of the field guide’s chief editors. “Well, you can’t get much more real world than this. My friends were, like, ‘I’m studying for finals right now,’ and I was, like, ‘Well I’m going to make and publish and print and sell a book.’”⁴⁰

HTH’s success in its seven year history are surely impressive. Its commitment to learning by doing, to integrating subject matter and to mixing academics with vocational methodologies runs contrary to a public education enterprise which seems driven by accountability measured by standardized test

⁴⁰ <http://www.edutopia.org/node/1396> (retrieved 10 November 2007)

results alone. To date, few have challenged its work, and the school receives literally hundreds of visits each year. They have staff in their charter management office who devote much of their time to hosting visits from educators around the nation and world.

But consistent with its mission and its commitment to equity, all HTH schools have worked hard in the past two years to substantially raise the proportion of students from lower-income, less-educated families. The school has always been one of choice, and while significant numbers of students of color have always enrolled, those numbers, (and especially the numbers coming from less-educated families) are now increasing as a result of recent outreach efforts.

HTH remains committed to teaching rooted in the real world, and to equity.

5. Conclusion

High schools in the U.S. are the target of continual criticism and reform. The dropout rate is still unacceptably high, especially among low-income and minority students. The search for solutions is ongoing.

As in most countries, U.S. high schools traditionally have provided one course of study to prepare students for college, and a different course of study to prepare students for work. But since the 1980s the idea of combining these two kinds of curriculum seems to have gained appeal. Many teachers and local administrators, as well as state and federal policy makers, are attracted to the idea of preparing students for *both* college *and* careers, so that students have a range of options when they graduate from high school. Educators would like to encourage students' college aspirations, while recognizing that most students actually do not complete bachelor's degrees. Accordingly, the *High Schools That Work* network continues to expand, the number of career academies continues to grow, and innovative high schools such as High Tech High (see Section 4e) and

The Met⁴¹ are demonstrating that work-based internships and project-based learning can be used to prepare students for college and careers. Increasingly, federal policy and powerful organizations representing career-technical education (CTE) are supporting the use of high school CTE as part of an integrated curriculum that prepares students for postsecondary education, and for work, at the same time.⁴² Some states are developing comprehensive plans to combine CTE with college preparation.⁴³

Given that current state and federal policy interventions in high schools are focusing almost entirely on academic achievement, it is remarkable that these efforts have continued and even increased. Evidence that has accumulated over the past two decades is modestly encouraging, but not strong enough to propel a movement in this direction (see Section 2). Although existing evidence does not yet provide definite proof that this kind of combined curriculum improves educational outcomes for students, we think it is enough to justify continued development – and evaluation – of this approach.

We do not advocate placing all high school students in college-and-career programs. We also do not advocate targeting these programs at groups of students defined by prior achievement. The evidence suggests that high-achieving and low-achieving students, as well as those in between, can benefit from this approach. However, for the low achievers practical problems arise because academic support classes do not leave time in their schedules for complete sequences of CTE and college-preparatory coursework. At the high-achieving end, students (and their parents) may be reluctant to substitute CTE for Advanced Placement classes. Overcoming these challenges, and others as

⁴¹ <http://www.themetschool.org/home>

⁴² See <http://www.acteonline.org/>

⁴³ For example see *New Directions for High School Career and Technical Education in Wyoming*, developed by MPR Associates, at <http://www.mprinc.com/>

described in Section 3, will be necessary if a curriculum that integrates academic and career-technical education is to be made available to larger numbers of students.

Despite the challenges of implementation and the incompleteness of the evidence that this strategy produces the desired effects, the necessity of reconciling universal college aspirations with the realities of labor markets implies that programs combining academic and career-technical curriculum will continue to develop.

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