3. What Makes Classrooms Work

This section first summarizes the results of our domain analysis of the eight classrooms. Nineteen domains sufficiently accounted for describing and understanding the eight classrooms we studied. We compared classrooms along each domain to distinguish between those that were more or less successful in teaching generic skills. Table 3.1 summarizes findings for each classroom by domain.

Since the discussion of Table 3.1 is lengthy, we will take a moment to look ahead. The comparison of classrooms reveals that they fall into two groups, five that enjoyed a strong measure of success in imparting generic skills and attitudes (interior design, electronics, manufacturing, architectural drawing, and English), and three that were markedly less successful (landscape and two chemistry classes). The similarities that we observed among the five successful classrooms permit us to identify key domains for describing successful classrooms (these are summarized in Table 3.2). From these similarities we derive several themes regarding how to design and conduct a classroom that works. We organize these themes into an instructional model for generic skills. In succeeding sections we present detailed descriptions of three of the successful classrooms. These descriptions are organized according to the components of the model.

Instructional Goals

Our comparison first considers the instructional goals in the classrooms—the particular kinds of knowledge, skills, and attitudes that teachers want students to learn. We begin with goals because research on teaching (Collins and Stevens, 1982; Leinhardt, 1983; Leinhardt and Greeno, 1986) and one-on-one tutoring (McArthur, Stasz, and Zmuidzinas, 1990; Putnam, 1987) reveals that teachers’ planning, instructional activities, and teaching techniques are organized around their instructional goals.
Table 3.1
Comparison of the Eight Classrooms by Domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Interior Design</th>
<th>Electronics</th>
<th>Manufacturing</th>
<th>Architectural Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex reasoning</td>
<td>Repair skills and learn from errors; analysis of problems and generate solution paths; evaluation and monitoring</td>
<td>Analysis of problems and solution generation; repair and troubleshooting; deemphasis on evaluation and reflection</td>
<td>Problem analysis; generate solution; repair; evaluate</td>
<td>Problem analysis; generate solution; repair; evaluate</td>
</tr>
<tr>
<td>Work-related attitudes</td>
<td>Make decisions; take responsibility and devalue appeals to authority in decision-making; boldness; workplace parameters</td>
<td>Responsibility for own actions; use personal interests as guide; focus on functionality</td>
<td>Make decisions; take responsibility for actions</td>
<td>Persistence; make decisions; parameters of workplace</td>
</tr>
<tr>
<td>Cooperative skills</td>
<td>Consensus process within group; group distributes work among members</td>
<td>Contributing partners</td>
<td>Distribute evaluative responsibility among work teams; work out own differences</td>
<td>Use others as resource</td>
</tr>
<tr>
<td>Domain-specific aspects</td>
<td>Deemphasis Electronics is integrated discipline with math and physics; circuitry logic; technical knowledge</td>
<td>Integrates math, drafting, woodworking, computer-aided design (CAD), computerized numerical control (CNC)</td>
<td>Architectural principles and facts; geometry</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.1—continued

<table>
<thead>
<tr>
<th>Landscape</th>
<th>English</th>
<th>Chemistry I</th>
<th>Chemistry II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare; at impasse; students “give up” or go to teacher to solve problem; teacher gives solution to avoid student frustration</td>
<td>Critical thinking skills; nonlinear thinking; generate ideas; evaluate ideas; thinking heuristics and strategies</td>
<td>Rare; teacher assigns lab experiments with prescribed steps; repair skills practiced on occasion</td>
<td></td>
</tr>
<tr>
<td>Majority of time involved in keeping behavior in check; it is important to behave sometimes</td>
<td>Make decisions; take responsibility and devalue appeals to authority; boldness; persistence; learn workplace parameters</td>
<td>Learn to trust lab observations; complete lab assignments</td>
<td></td>
</tr>
<tr>
<td>Generally conflict-ridden but occasionally used group as a resource</td>
<td>Use others as resource</td>
<td>Teamwork to turn in one neat copy of lab report</td>
<td></td>
</tr>
<tr>
<td>Landscape: how to water deeply; encourage deep root system; pesticide use and equipment; water conservation; botany; common and proper plant names</td>
<td>Research skills; deemphasis on composition rules; facts; literature and cultural base for reading and composition</td>
<td>Chemistry facts; vocabulary; balancing equations; oxidation reduction</td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td>Interior Design</td>
<td>Electronics</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>------------------------</td>
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</tr>
<tr>
<td>Design of classroom</td>
<td>Integrated activities; authentic practice; group projects; self-managing teams</td>
<td>Basics and integrated activities; authentic practice; group projects; coaching and self-managing</td>
<td>Basics and integrated activities; authentic practice; group projects; self-managing teams</td>
</tr>
<tr>
<td>Teacher approach</td>
<td>Master-apprentice; adult learning method; teacher and student as equals</td>
<td>Master-apprentice; best motivator is to prepare and support student for task</td>
<td>General manager and master-apprentice; best motivator is to prepare and support student for task</td>
</tr>
<tr>
<td>Teacher goals</td>
<td>Learn to “be bold”; take responsibility for own learning</td>
<td>Exploration</td>
<td>Accomplish a major project using skills</td>
</tr>
<tr>
<td>Learning expectations</td>
<td>High; everyone starts with “C”; teacher is friend but will also fail you</td>
<td>Mixed; if sees effort then high expectations</td>
<td>Mixed; if sees effort then high expectations</td>
</tr>
<tr>
<td>Student evaluation</td>
<td>Group contribution; project completion</td>
<td>Project completion; lab writing</td>
<td>Project completion</td>
</tr>
<tr>
<td>Classroom environment</td>
<td>Classroom/lab; high levels of social talking; good student cohesion/rapport; little acting out or “off task”</td>
<td>Classroom/lab space; high levels of social talking; some classification on basis of skill; some “off task” behavior</td>
<td>Classroom/lab space; high levels of social talking; good rapport and cohesion; some “off task” behavior</td>
</tr>
</tbody>
</table>
Table 3.1—continued

<table>
<thead>
<tr>
<th>Landscape: Incremental tasks; low-level authentic practice; group task assignment; coacting teams</th>
<th>English: Integrated; actual authentic practice; individual projects; self-managing</th>
<th>Chemistry I: Incremental tasks; no authentic reference/practice; partners for labs; coacting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Therapist: Mr. Price is “dad”</td>
<td>Facilitator/guide; all the students are equal</td>
<td>Missionary/traditional teacher role</td>
</tr>
<tr>
<td>Complete the task; behave</td>
<td>Learn to become “nonlinear” thinker</td>
<td>Finish task, even if teacher does it for student</td>
</tr>
<tr>
<td>Low; just get them through the semester</td>
<td>High; everyone starts at C; teacher is friend but will also fail you</td>
<td>Low; grouped by low math skills; lower expectations than chem II</td>
</tr>
<tr>
<td>Low; grouped by higher math skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points for daily task completion</td>
<td>Final paper</td>
<td>Bureaucratic C; homework; labs; mastery tests</td>
</tr>
<tr>
<td>Classroom/lab space; high social talking; cliques; low rapport and cohesion; high level of “acting out”</td>
<td>Classroom space; low social talking; good student rapport and cohesion; little “off task” behavior</td>
<td>Classroom/lab space; high social talking; good student rapport and cohesion; some “acting out” and “off task” behavior</td>
</tr>
</tbody>
</table>
Table 3.1—continued

<table>
<thead>
<tr>
<th>Domain</th>
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<th>Electronics</th>
<th>Manufacturing</th>
<th>Architectural Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postsecondary focus</td>
<td>Employment; career exploration; preparation for college</td>
<td>Career exploration</td>
<td>Career exploration</td>
<td>Career exploration</td>
</tr>
<tr>
<td>Teaching tactics</td>
<td>Individual teaching; rarely lectures; scaffolding and fading; articulation; modeling; war stories; avoid giving “right” answers</td>
<td>Individual and group teaching during walking rounds; articulation; modeling; scaffolding and fading; coaching; real world references</td>
<td>Individual and group teaching during walking rounds; no lectures; modeling; articulation; scaffolding and fading</td>
<td>Individual and group teaching during walking rounds; rare lectures; scaffolding and fading; articulation</td>
</tr>
<tr>
<td>School context</td>
<td>Fine arts requirement; ROP class</td>
<td>Elective; college-prep school</td>
<td>Elective with math credit; college-prep school</td>
<td>Elective; college-prep school</td>
</tr>
<tr>
<td>Teacher experience</td>
<td>Worked as designer; vocational certificate</td>
<td>Certificate in industrial arts and math; MS/MFA</td>
<td>Certificate in industrial arts and math; MS/MFA</td>
<td></td>
</tr>
<tr>
<td>Landscape</td>
<td>English</td>
<td>Chemistry I</td>
<td>Chemistry II</td>
<td></td>
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<tr>
<td>-----------</td>
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<td></td>
</tr>
<tr>
<td>None</td>
<td>Preparation for college</td>
<td>Preparation for college for some students</td>
<td>Preparation for college</td>
<td></td>
</tr>
<tr>
<td>Individual or group teaching during walking rounds; occasional traditional didactic lectures; modeled conflict resolution; articulation about conflicts and misbehavior; set bounds on infractions; ignored some unacceptable behavior</td>
<td>Lectures; handouts; avoid giving the “right” answer; articulation; modeling; scaffolding and fading; coaching; provide analogies; individual instruction</td>
<td>Didactic lectures; do homework problems for class; demonstrate “cookbook” lab; read complex technical information aloud; outline daily schedule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROP class in college-prep school; avoid transfer to continuation high schools</td>
<td>College preparation with variety of “advanced” English courses</td>
<td>Academy program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holds credential in science; BS degree in botany</td>
<td>Holds credential in science and English; BS degree in botany; writing certificate</td>
<td>MS degree in geology; worked in seismology lab; teaching certificate program in progress</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.1—continued

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<th>Electronics</th>
<th>Manufacturing</th>
<th>Architectural Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom resources</td>
<td>Sample books;</td>
<td>Computers; robot arm;</td>
<td>Woodworking and fabrication equipment; computers;</td>
<td>Drafting equipment; special texts on building codes and standards</td>
</tr>
<tr>
<td></td>
<td>demonstration</td>
<td>electronics; CNC and CAD software; components</td>
<td>CNC and CAD software; drafting equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>board materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student background</td>
<td>Eleventh and</td>
<td>Primarily ninth and tenth grade, mix of college-bound and general track students</td>
<td>Primarily tenth and eleventh grade, mix of college-bound, voc ed, and general track students</td>
<td>Primarily ninth and tenth grade, mix of college-bound and general track students</td>
</tr>
<tr>
<td></td>
<td>twelfth grade, many college- or work-bound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student goals</td>
<td>Need credit;</td>
<td>Easy class; work interest;</td>
<td>Math credit; easy class; general vocational skills; college preparation; no goals (placed by counselor)</td>
<td>Need credit; easy grade but found class is difficult; career exploration; college preparation skills</td>
</tr>
<tr>
<td></td>
<td>easy class; work interest; specific learning goals</td>
<td>no goals (placed by counselor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student expectations</td>
<td>Will do well if make an effort; expect individual attention</td>
<td>Will do well if a personal effort made; individual attention available from a knowledgeable and fair teacher</td>
<td>Receive individual instruction from a knowledgeable teacher</td>
<td>Grades reflect effort; individual attention by teacher and cooperation by students with teacher</td>
</tr>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
### Table 3.1—continued

<table>
<thead>
<tr>
<th>Landscape</th>
<th>English</th>
<th>Chemistry I</th>
<th>Chemistry II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse; ROP funds for some materials; limited and inexpensive equipment</td>
<td>Teacher donated two novels for each student</td>
<td>Borrowed textbooks from another school; limited lab equipment</td>
<td></td>
</tr>
<tr>
<td>Class is used as alternative for students who are science credit deficient; behavioral problems for special education placement, eleventh and twelfth grade</td>
<td>College-bound (already accepted), twelfth grade</td>
<td>College-bound, tenth grade</td>
<td>Mix of college-bound and non-college-bound students, tenth grade</td>
</tr>
<tr>
<td>To get biology credit; few interested in botany or horticulture</td>
<td>All college-bound; improve writing skills</td>
<td>Oriented to postsecondary opportunities in multiple and primarily unrelated careers, e.g., marine biology, lawyer, engineer, psychology; also preparation for college and exposure to computers</td>
<td></td>
</tr>
<tr>
<td>Teacher will take care of students and not fail them</td>
<td>Big effort will lead to good grade; teacher is willing to assist and teach</td>
<td>Broad; earn grades to pass the class; goals and learning go together; teacher will provide individual instruction plan for student mishaps; makes it easy to learn; any question is appropriate; chemistry II demands spoonfeeding</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.1—continued

<table>
<thead>
<tr>
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<th>Electronics</th>
<th>Manufacturing</th>
<th>Architectural Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student outcomes</strong></td>
<td>Think through and plan complex design problems; mix of useful and negative cooperative roles in groups; creative/adaptive tactics for unconstrained problem-solving tasks; valued cooperation as part of a group to achieve a goal and importance of justifying one’s opinions with facts</td>
<td>Integrate various forms of technology to produce electronic devices; some focus on building complex devices, some on abstract representations; facile technical language; cooperation skills are useful; groups provide good resource</td>
<td>Think through complex problems; planning is a useful work-related skill; cooperation with a group added to the interest and challenge</td>
<td>Knowing design options allows you to come up with a “fresh” design; using texts as resources is helpful; problem solving is difficult but its benefits are worthwhile; accomplishing the project gives a good feeling</td>
</tr>
</tbody>
</table>
Table 3.1—continued

<table>
<thead>
<tr>
<th>Landscape</th>
<th>English</th>
<th>Chemistry I</th>
<th>Chemistry II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>Critical thinking and writing skills are intertwined; reading and appreciating literature; research and library skills; learn to cooperate with other students; college preparation; deemphasis on grades and punishment provided; effort is made</td>
<td>Passive problem solving; ask the teacher (oracle); use lab partner to do half the work</td>
<td>Receive “extra credit” for minimal effort; incomplete problem solving, e.g., answer only a portion of the lab questions; use lab partner to finish the work more quickly and do half the work</td>
</tr>
<tr>
<td>work-related behaviors;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>individuals work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>intermittently on group assignment; “look out” for the teacher; protect loafers from teacher (little snitching, some peer pressure); rarely persist; repeatedly discuss/pursue blind or empty solution paths; complete daily repetitive assignments; examples of accomplishments: water plants, not weeds; arrange pots for efficient watering; caring that plants may need water over a long weekend; award of a passing grade on basis of completing exam</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Instructional goals can be either domain specific or generic (i.e., applying to more than one domain). For example, a domain-specific instructional goal is learning certain chemistry facts; another is learning how to wire a circuit. In this study we are particularly concerned with instructional goals related to fostering generic skills and work-related attitudes. Generic skills and attitudes help learners make use of domain knowledge and skills (facts, concepts, and procedures) needed to solve problems or carry out tasks (e.g., troubleshooting a faulty circuit and solving a math problem). Other generic skills include applying effort to a task, cooperating with peers, and displaying prosocial behavior. An example of a generic work-related attitude is taking responsibility for one’s own work.

The teachers in our sample had a mix of instructional goals for students that included domain-specific knowledge and skills, complex reasoning skills and problem-solving strategies, work-related attitudes, and cooperative or group skills. Each teacher placed a different emphasis on these goals.

**Complex Reasoning Skills**

In five of eight classrooms, generic problem-solving and thinking skills were included as instructional goals. The vocational classes—interior design, electronics, manufacturing, and architectural drawing—all provided opportunities for students to learn and practice several generic problem-solving skills, including problem analysis, generation of solution paths, evaluation of solution paths, repair, and troubleshooting. Teachers did not necessarily name these skills as instructional goals, nor did they use these terms with students. Rather, the use of these skills was implicitly built in to project work (designing a house or an electrical circuit, and designing and manufacturing a wooden truck), such that students had to exercise the skills while solving problems.

Similarly, students in Mr. Price’s English class learned complex thinking skills that resemble these problem-solving skills. A critical essay project required students to read three novels and to generate and evaluate ideas about their meaning. Mr. Price also taught specific heuristics and strategies to aid students in idea generation and evaluation and was quite explicit in discussing a particular composition process that he wanted students to learn. Research suggests that such explicit teaching and naming of skills is more advantageous than an approach where skills are tacitly exercised by students as they complete a task. Once this knowledge about problem solving is made explicit, it can become an object of inquiry and discussion among a group of learners. In this way, students can begin to understand the nature of expert practice in a domain
and, with practice, learn to use the strategies and processes that underlie such practice (Collins et al., 1989).

In contrast, students in the landscaping and chemistry classes had little opportunity to practice complex reasoning or problem-solving skills, since teachers emphasized domain-specific skills (discussed below) and organized activities around concrete tasks rather than projects. In landscaping, students worked at specific short-term tasks, such as pruning roses, weeding, or watering. If some difficulty arose, students tended to give up or go to their teacher for help in solving their problem. Mr. Stone, the chemistry teacher, also provided little opportunity for students to practice these generic skills. His students worked in pairs to complete laboratory experiments, each of which presented a well-defined problem that students had to solve, following a proscribed sequence of steps. At most, students practiced repair skills when, for example, the chemicals did not produce the reaction suggested on the lab worksheet. Students proceeded in unison on these labs and used data from the experiment to solve math problems associated with the lab. But students did not generate new problems or make investigations beyond what was asked for on the lab sheets.

**Work-Related Attitudes**

Ms. Adams, Mr. Benson, and Mr. Price (English class) stressed the importance of students taking responsibility for their own learning and for completing their assigned tasks. As a result, they all gave students opportunity to work on their own and solve their own problems, and often exhorted students to “take responsibility” or “figure it out.” Mr. Price and Ms. Adams also stressed a number of other attitudes and dispositions toward work, such as making “bold” decisions and questioning authority, and they tried to foster an appreciation of the contingencies of the world outside school.

Ms. Adams, as a practicing interior designer, made the strongest and most frequent links between class work and school work. She frequently told “war stories” from her work experience to illustrate a point or to justify her behavior toward a student. For example, she did not accept students’ “bad luck” excuses for incomplete work because such excuses would not be accepted by a customer or a boss.

Mr. Price and Mr. Benson—perhaps because they lacked actual work experience in their domains—did not use workplace-based examples to support the development of work-related attitudes. Their appeals to be responsible or persist on a hard task seemed to rest on the value of effort to achieve success. Students who apply themselves are more likely to succeed and, in turn, to become
motivated by their success. In Mr. Benson’s case, these lessons were implicit in the design of his classrooms where electronics students learned to “use the tools of the trade” and manufacturing students learned about roles, teamwork, and tool use as they designed and manufactured their prototype.

In English class, Mr. Price appealed to the notion of lifelong learning. He reinforced a particular disposition toward reading and thinking that he believed would help students in college and beyond. In his landscape/horticulture class, however, Mr. Price failed to impart any work-related attitudes. Many of the students in his class did not even comply with basic standards for classroom behavior, let alone acquire relevant work-related skills or attitudes. He spent a great deal of class time “managing” inappropriate behavior, including instances of leaving the school grounds, fighting and arguing among students, and persistent nonperformance of required tasks. With Mr. Price’s attention focused on managing inappropriate behavior in some students, he had little opportunity to teach generic skills and attitudes to the remaining students who at least attempted to carry out assigned tasks. Mr. Price’s primary goal in this class was to enhance students’ prosocial behavior and teach specific knowledge about gardening or plants. It seemed that Mr. Price was in a bind. On the one hand, he needed to teach enough domain knowledge for students to earn the life science credit attached to the course. On the other hand, he knew that some students had behavior problems that precluded class participation and learning. For these students, behavioral change was his goal.

Work-related attitudes were also not stressed in the chemistry classes. In the laboratory exercises, Mr. Stone encouraged students to learn to trust their observations and to record the data associated with those observations or to observe safety precautions. He also expected students to complete their lab assignments. But this learning seemed task-specific and not linked, for example, to actual work in a laboratory or related “scientific” work. In addition, we observed that students did not pay much attention to the safety precautions presented on their lab sheets. Although Mr. Stone had work experience in a seismology lab, he did not use that experience to place classroom assignments in a broader work-related context.

**Cooperative Skills**

There are several good reasons to teach cooperative skills. In addition to its value as a work-related generic skill, cooperation can increase student responsibility for learning by holding the student accountable for contributing to group work, or requiring the student to help others. Cooperation can enhance
learning efficiency, because team members are additional sources of information/instruction. Finally, cooperation can enhance motivation, since team members are additional sources of motivation and team membership can increase commitment to a project and engagement in a task.

In five classes, teachers had enhancing student cooperation as an instructional goal. Ms. Adams had students work in groups on their design project and explicitly taught a consensus process that students used to make a design decision (e.g., selecting fabric) and to justify a decision (the rationale). In electronics, Mr. Benson wanted students to become “contributing partners”; in manufacturing, he expected students working in groups to learn to resolve differences on their own. Students in the architectural class worked individually on their projects, but learned to use each other as resources for information or for help in solving problems. Again, we note that Mr. Benson was less explicit about stating his expectations as goals. Rather, the expectation for cooperation was implicit in the classroom design. Working together was just part of the classroom culture. Mr. Price wanted students to learn how to use each other as “resources” and designed several group exercises where students assumed different roles (e.g., reader or critic).

In contrast, Mr. Price had a difficult time fostering cooperation in his landscape class. For many students, he focused on improving appropriate individual behavior in class. For others, he wanted students to learn to work together and, on some occasions, gave individual grades based on performance of the group. This practice was applied inconsistently, however, and students often squabbled with him about the points received for a day’s work.

Mr. Stone did not face behavior problems that worked against cooperation, but also did not make cooperation between lab partners or among class members an objective of the learning process. His only inclination toward promoting cooperation was to have lab partners submit one report for the pair.

**Domain-Specific Skills**

Ms. Adams and Mr. Price were both more concerned with teaching a process than on having students acquire specific domain skills. While Ms. Adams valued subject-specific skills and, for example, gave detailed lectures on fabrics in her interior design class, she never tested students on domain knowledge. Consistent with her belief that generic skills would be most important in students’ future jobs, her teaching activities focused on imparting these skills. The class project on designing and furnishing a six-room Victorian house was a
vehicle for engaging students in activities designed to impart generic skills—a project to design a house of any style would have worked just as well.

Similarly, Mr. Price could have taught writing composition by assigning students to write a documented critical essay on a body of literature different from Latin American fiction. In fact, in a previous course he assigned books by contemporary African American authors. While he taught students about rhetoric and the “eight ways of meaning” in the first semester, he intended these concepts to serve more as “tools” than domain content related to writing. His instruction was geared primarily toward teaching processes that would help students engage in reading and writing, promote understanding of the novels, and aid in producing a final paper.

Mr. Benson paid more attention to domain-specific skills, but still focused instruction on application of knowledge and skills to solve problems. The first part of his course was devoted to teaching basic “building blocks” that students would need to engage in more advanced work (e.g., the logic of electronic circuitry and drafting techniques). This sequencing supported his belief that the best way to motivate students was to make sure they had the skills they needed to solve more challenging or advanced problems. Mr. Benson also saw electronics and manufacturing as “integrated” disciplines that joined domain knowledge and skills from separate subject-matter domains, such as physics, mathematics, and technology. Thus, he was not interested in teaching electronics, per se, but on helping students acquire the necessary knowledge and skills needed to solve a concrete problem. Mr. Benson paid less attention to teaching process because, for him, it was not independent of the work. This was consistent with his notion of integration: Specific knowledge and skills must be applied to solve an electronics problem, to manufacture a product, or to make an architectural drawing. Put another way, his instructional domains are more well defined than with interior design or composition, because a circuit or a design for a toy truck or a building will either work or not work. Objective criteria for correctness are more elusive in ill-defined domains like interior design or composition, where success may rest on attributes such as talent, vision, or insight.

Whether dealing with ill-defined or well-defined problems, these teachers defined their instructional “domain” in broad terms that went far beyond domain-specific knowledge. Most important, their view of relevant class

\[\text{1} \] A problem is well defined if a test exists that determines whether a proposed solution is in fact a solution. Ill-defined problems need further specification before they can be solved (see Hayes, 1981; Newell and Simon, 1972).
“content” was not constrained by curriculum frameworks, learning objectives, standardized tests, textbooks, or specific bits of domain knowledge. One reason for this, of course, was that these classes were not prerequisites for any others, nor were students being trained for specific jobs after school. As a result, teachers had some leeway in choosing what content the class must cover. Mr. Benson pointed out that curriculum tracks constrained instruction in his algebra I class, where the program was “restrictive [in the sense that] students must master a certain body of knowledge to advance.”

Another factor contributing to a broad conceptualization of a domain is teacher expertise. These three teachers, Ms. Adams, Mr. Price, and Mr. Benson, had deep knowledge and understanding of their respective domains, in addition to professional experience and/or an avocation for the domain that contributed to their expertise. They were able to draw on their knowledge, experience, and passion for the topic when they designed and executed instruction. This appeared to hold for all the subjects that they taught.

In contrast, Mr. Stone’s vision of chemistry instruction in the academy program exceeded his ability to execute that vision. While he appeared to have solid domain knowledge in chemistry, he was a new teacher who readily admitted that he had not realized his goals for the class. Although he aimed to help students learn how chemistry is related to everyday life problems and situations, his instructional goals focused on learning terminology, certain principles (e.g., oxidation reduction), and basic laboratory procedures——what he referred to as “chemistry facts.”

Mr. Price’s landscape class included relatively low-level domain knowledge (e.g., how to water deeply to encourage deep root systems) or basic botany (e.g., the parts of plants). Students received a life science credit toward graduation, and the class was a “last chance” science course for many students who enrolled because they had failed the regular biology class. While Mr. Price had a botany degree and substantial practical experience and knowledge about landscaping that might have shaped a more sophisticated curriculum in landscape/horticulture, the needs and abilities of this particular group of students—or his perceptions of those needs and abilities——appeared to work toward simplification of the curriculum and overall classroom design (discussed in more detail below).

**Classroom Design**

Ideally, teachers design classrooms to support their instructional goals, and it is expected the designs will vary to reflect alternative emphases among goals. We compared our eight classrooms along several dimensions of classroom design,
based on the instructional model elaborated by Collins, Brown, and Newman (1989). These features include situated learning, culture of practice, motivation, cooperation, and competition. Because competition was not a factor in these classes, we do not elaborate on this aspect of classroom design in their model. We also compare the roles that teachers adopted to support classroom design and instructional goals.

**Situated Learning**

As indicated in the Introduction, many practitioners and researchers posit that learning through the work process itself is an effective method for acquiring work-related knowledge. In the absence of direct experience, new instructional models support “situating” learning in the context of real-life problems suggested by a culture of expert practice. This requires teachers to take different roles in teaching and for students to take a more active role in learning. In situated learning environments, students carry out tasks and solve problems that are realistic or “authentic” in the sense that they “reflect the multiple uses to which their knowledge will be put in the future” (Collins et al., 1989, p. 487). By working on authentic problems, students come to understand the uses of the knowledge they are learning and different conditions under which that knowledge can be applied. It is thought that this authentic environment increases both learning efficacy and motivation. They also learn how to transfer knowledge and skills learned in one context to new problems or domains (Resnick, 1987a; Singley and Anderson, 1989). Students are actively engaged in a process that requires them to interact with the environment and to deal with new problems that result from that interaction.

In a traditional didactic learning environment, students typically learn math by solving problems presented in a textbook. Such an exercise helps them practice mathematical operations they have learned. By contrast, in a situated learning environment, students would perform mathematical operations in the context of solving a more complex problem so that they would have to reason about the use of mathematics (e.g., Schoenfeld, 1983; 1985). John Dewey, for example, also created a situated learning environment in his experimental school by having students use arithmetic and planning skills to design and build a clubhouse (Cuban, 1984).

Teachers can also sequence situated learning activities in ways that coincide with the changing learning needs of students at different stages of skill acquisition (Collins et al., 1989). For example, tasks and activities can be sequenced along some dimension of complexity (e.g., construct simple electronic circuits before
designing circuits to perform a specific function) or increasing diversity (e.g., intermixing reading for pleasure, reading for memory, and reading to find out some information).

In five classrooms, teachers had students carry out tasks and solve problems in environments that reflected the multiple uses to which their knowledge will be put in the future. Teachers designed project work that students carried out individually, in teams, or both. These projects were complex enough to challenge students to use new domain skills as well as many generic skills. Over the course of six weeks, Ms. Adams’s students designed a contemporary interior for a Victorian-era house. Students researched the original house and its design tradition, drew the house, drafted floor plans, selected furnishings and colors, and prepared boards to display their proposed design. At the end of the semester, each team presented their design orally to the class. Most students worked in teams of four to six, but a few completed individual projects.

Project work dominated all three of Mr. Benson’s classes. Electronics students first worked in pairs or small groups on a set of electronics labs. Lab work was followed by projects of students’ own choosing that incorporated use of computers, a computerized numerical control (CNC) milling machine, and a robotic arm, and required students to identify the problem and find a solution.

The second semester of the manufacturing class was devoted to a whole-class manufacturing project—the design, prototyping, and production of thirteen wooden toy trucks. Mr. Benson organized the class like a manufacturing firm, where student teams performed different functions in the manufacturing process and worked interdependently to produce the product.

Architectural drawing students worked on individual projects to design a dream house, complete with floor plans and renderings, on an actual site in Oregon. Students had to organize their own schedule and tasks to meet preset deadlines.

In Mr. Price’s English class, students read three novels by Latin American authors and wrote a critical essay on the use of “magical realism” and a topic of their own choosing. They did library research and worked in pairs or groups to critique each others’ ideas or written drafts. This class was run like a seminar, not a lecture.

In all these cases, students carried out complex tasks in rich problem-solving contexts and were given the freedom to apply their skills, evaluate solutions, and face emergent problems. Moreover, these situated tasks were sequenced to guide the students through the successful learning of increasingly complex and difficult
skills and knowledge. Later, more complex tasks built on and integrated the skills and knowledge learned in earlier, more basic tasks.

In contrast to these classes, Mr. Price organized his landscape/horticulture class on the model of a “road crew.” This classroom environment produced minimal work from most students, who were expected to complete their job while maintaining appropriate classroom behavior. Mr. Price spent much of his time dealing with students’ emotional behavior, which frequently interfered with teaching and learning in this class.

Similarly, Mr. Stone’s chemistry labs were “cookbook” exercises that required students to simply follow directions, collect data, and use the data to solve math problems. These labs epitomized the kind of decontextualized learning experience that many reformers criticize. Although these students had requisite math skills and were primarily college-bound, the material did not appear overly to motivate students or to engage them beyond following the “cookbook” formula. These incremental tasks were not linked to broad concepts, work, or activities related to space technology, the academy’s occupational focus. Mr. Stone expressed a desire to reorient the class toward project-based work, but had not yet implemented his ideas to redesign the curriculum and class activities.

Culture of Practice

A second characteristic of classroom design is the creation of a culture of expert practice in which participants “actively communicate about and engage in the skills involved in expertise, where expertise is understood as the practice of solving problems and carrying out tasks in a domain” (Collins et al., 1989, p. 488). Coupled with the authentic activities pursued in situated learning, a culture of practice helps students acquire the knowledge, skills, and attitudes typical of practitioners who work within that particular domain. Ideally, interactions between learners and “experts” will reveal underlying cognitive processes that experts engage in as they solve problems. In an interior design class, for example, the teacher can relate a story from her own experience as a designer to explain why a particular fabric is a poor choice for drapes (Stasz et al., 1990). Such expert anecdotes (“war stories”) appear to aid learning by providing students with concrete, memorable stories that communicate valuable

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2It is unclear whether an expert is needed to cultivate what Collins describes as a “culture of expert practice.” It may be that a competent and experienced adult practitioner is sufficient. This question has important implications for teacher training and certification, and we will address it further in the concluding section.
knowledge or lessons (Orr, 1986). They also have a face validity that may increase credibility.

Research on effective work design potentially offers some added insights on classroom design. In particular, research from the sociotechnical systems perspective links the design of work to the satisfaction of the worker (Hackman and Oldham, 1980). This research suggests, for example, that the ways groups are organized (e.g., self-managing vs. coacting teams) and work is organized (e.g., boring, repetitive tasks vs. meaningful, challenging tasks) can affect the amount of discretionary effort that workers choose to devote to a task (Bailey, 1991).

Some classrooms in our sample implicitly or explicitly promoted different cultures of practice; some reflected the adult world of work in the particular domain. Ms. Adams’s class invoked the practice of interior design professionals. Mr. Price’s English class embodied several cultures of practice, including that of the reader, the writer, and the college student. His students most frequently identified with the latter. Mr. Benson’s classes supported cultures where “hobbyists” with interest in the domain and varying degrees of expertise could work on projects and learn from each other or where workers on the “shop floor” collectively produced a real product.

Note that these cultures of practice simulated actual working cultures in varying degrees. Overall, Ms. Adams’s class was most similar to its target culture of professional interior designers, perhaps because she was the only practicing professional among our group of teachers. This gave her special insight into actual working practices. Mr. Benson’s creation of the “shop floor” in manufacturing class resembled that culture of practice, albeit on a small scale. What is key to these cultures of practice—indeed of their resemblance to the culture of working professionals in a domain—is that each supported a situated learning environment where students could acquire high-level skills, including domain-specific and generic skills.

Three classes failed to establish either situated learning environments or to foster effective cultures of practice that would provide opportunities for learning high-level skills. Mr. Price’s landscape class, for example, successfully supported the culture of the “road crew,” but few would argue that high school is the place for teaching the low-level skills associated with basic gardening and landscaping. In spite of Mr. Stone’s past employment in a seismology lab, his chemistry classes offered standard decontextualized science exercises, and did not support any recognizable culture of practice beyond that of the college-bound high school student.
Motivation

A third characteristic concerns motivation. While schools often use extrinsic factors to enhance student motivation (e.g., grades and teacher praise), intrinsic factors (e.g., challenge, interest, and degree of student control) are often more effective (Malone, 1981; Malone and Lepper, 1987). Although grades are a ubiquitous presence in schooling, teachers can design instruction that appeals to intrinsic motivators as well. For example, when a Latino student (in our previous study) objected to designing a Victorian house that he could not “relate” to, the teacher suggested he design a house for “a rich ‘Chicano’ who made it in the barrio . . . who wants a really classy place to live and enjoy his money” (Stasz et al., 1990). This student began with a simple one-bedroom house and ended up with a sophisticated design in the Southwestern tradition.

The main motivational feature in the five successful classrooms—interior design, electronics, manufacturing, architectural drawing, and English—was the teachers’ emphasis on intrinsic over extrinsic motivational factors. Teachers de-emphasized grades and did not discuss performance criteria in terms of grades. Rather, they focused on finding ways to engage students to exert effort, recognizing that every student could learn and make a contribution to the class if he or she applied effort. All three teachers saw individual interest as the key to mobilizing effort. Mr. Price and Mr. Benson, for example, encouraged students to follow their interests in identifying themes for critical essays or for choosing electronics projects.

These teachers also used challenge as a motivator. Ms. Adams, for example, exhorted students to go beyond the status quo (e.g., painting walls beige) and make “bold” design decisions. Moreover, when she “saw students reaching,” she “raised the ceiling.” Mr. Price acknowledged the difficulty of the novels students read, and used that challenge to appeal to students’ eventual sense of accomplishment as they came to understand them.

Mr. Benson recognized the intrinsic appeal of technology to many of his students and purposely integrated sophisticated technologies into his classroom instruction. He allowed electronics students, for example, to use these technologies as much as they liked to complete their assignments or projects. Some chose to use them exclusively, while others preferred to work with physical components in a more hands-on mode.

Teachers used student expertise as another motivational device. Mr. Price, for example, invited a French exchange student in the class to speak about the European view of the U.S. invasion of Panama. He also relied on Spanish-
speaking students to translate words or passages in the novels. Mr. Benson acknowledged that some students were more expert than he on the computer-aided design system, and he gave them free rein to assist other students or experiment with the system itself.

In these classrooms, the mobilization of effort, interest, challenge, and expertise was an essential part of the classroom design, and teachers organized instructional activities with motivational goals clearly in mind.

In addition to teacher strategies for motivating students, students identified specific teacher characteristics as motivating factors. In every class we visited, even the less successful ones, students mentioned teacher enthusiasm for the topic or genuine concern for students as having motivational appeal. Students spoke, for example, of Mr. Benson’s “infectious” enthusiasm for electronics and design work. Ms. Adams had a reputation as a “tough” but caring teacher; a feeling of mutual respect was evident in her classroom. Mr. Stone’s students were drawn to enroll in the academy program because the teachers affiliated with the program “cared.”

Although the landscape and chemistry classes were taught by enthusiastic and caring teachers, other factors seemed to hamper student involvement and motivation. In the landscape class, students who were at all inclined to work typically faced menial, uninteresting tasks, like watering a flowerbed or digging a ditch. In this case, the design of the classroom activities seems at fault. When challenging tasks arose—like repairing a faulty sprinkler line—students seemed unable to proceed without the teacher’s help. In this example, students seemed to lack the skills needed to solve their problem. Few students worked with enthusiasm unless the teacher was in view. As mentioned earlier, the teacher felt he needed to deal with students’ behavior problems; attention to bad behavior seemed to overwhelm other instructional goals.

Few students in Mr. Stone’s class seemed motivated to go beyond minimum performance. Students were focused on just “getting the work done” needed for at least a C grade, because the academy demanded at least C performance. Students who did not pass regularly administered proficiency exams in each subject with a C or better had to be tutored by their teacher and then retake the test. This “bureaucratic C” created an interesting dynamic where the students

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3The number of students with behavior problems—so many that the teacher had to focus on noninstructional goals for some students—may also represent a failed counseling function at the school. At least, it raises the question of why a classroom teacher was left to cope with such problems, to the detriment of students who were at least willing to cooperate in class or who desired to learn something about the subject area.
seemed to expect the teacher to “spoonfeed” them by giving them explicit
directions—or even doing the problems for them—or just telling them the
answer to any question whenever they asked. The teacher complied with these
expectations by “handholding” the students. For example, he allowed students
to do their “homework” while he went over the problems in class; he dismissed
some student questions because the answers would just “confuse” them or give
them information they did not need to know; and he did not challenge students
to solve problems on their own.

**Cooperation**

Learning to work cooperatively with others is an important skill for the
workplace, where group work and collaboration among team members or
individuals is increasingly becoming the norm. Cooperation can also be a
powerful motivator, especially if task completion requires different skills of
different individuals. Cooperative activities can encourage students to share
knowledge and skills, help each other, and support a culture of practice.
Teachers can go beyond forming groups to designing specific activities that
require students to engage with the task and each other in specific ways.

In most classrooms in our sample, students learned to work together in self-
managing groups in which cooperation was important. Sometimes they worked
in teams and were graded on team effort. Other times they worked alone, but
engaged other students to help solve problems, sound out an opinion, or ask
advice. Or they worked in pairs to do electronics labs or on a project of their own
choosing. Importantly, the teachers behaved and were accepted as contributors
to cooperative effort, whether they worked hands-on with the students (Mr.
Benson) or more as facilitators and guides on the sidelines (Ms. Adams, Mr.
Stone, and Mr. Price).

Ms. Adams taught specific techniques to enhance cooperation (e.g., consensus
building), and also had groups evaluate their own performance and determine
how performance could have been improved. While Mr. Price designed group
activities to teach students to use each other as resources, Mr. Benson had a less
structured approach. In electronics, for example, he let students choose their
own partners and left them to work out any role difficulties among themselves.
He intervened in extreme cases—as when two students ended up fighting—and
suggested that students change partners as their own interests changed. In
manufacturing, he assigned some students to specific teams because of their
skills (e.g., students good in math to the drafting team), but otherwise permitted
students to form their own teams and to negotiate any differences within or between teams.

The landscape class supported coacting groups that report to a teacher/supervisor and where each student has an individually defined task, like picking weeds or pruning a rose bush. In the chemistry class, student pairs divided lab activities on their own but were basically just following a set of step-by-step instructions. In neither class did students have authority to proceed as they saw fit to generate a group product, service, or decision.

Even where teachers had students work in teams, we saw some negative effects that diminished cooperation. For example, we observed some student pairs in electronics where one student was the “learner” and the other was the “assistant.” Students who stayed in the “assistant” role, for whatever reason, lost opportunities to become more independent thinkers and problem solvers. In these cases, the team is self-managing apart from the teacher, but one member of the team is “supervised” by another. In Ms. Adams’s class, one group adopted a “military” style where one student emerged as the “leader” who delegated individual tasks to others. Another group formed a “loose anarchy” where a de facto leader emerged, but otherwise cooperative roles were not well defined. At least one member of this group typically contributed minimally, but the others rarely used peer pressure to control noncontributing members.

While such cooperative activities may be the norm in the industrial arts and design classes, they were somewhat of a novelty to students in the English class. Those students were more used to competing for grades and seeking help or approval from the teacher than helping each other on papers. Mr. Price particularly stressed how the group can provide social and emotional support for difficult tasks, in addition to task-specific skills or knowledge.

**Teacher Roles**

Different classroom design characteristics imply a different role for the teacher and different expectations about what students should and can learn. Specifically, a teacher who designs a classroom that embodies these characteristics is likely to establish a “master-apprentice” relationship with students, or act more as the students’ coach or guide in the learning process. This teacher will expect students to be actively engaged in learning and to come to the classroom with knowledge, skills, and experience that the teacher can build upon. Teachers and learners can participate together in the learning process. In contrast, a teacher adopting a more traditional role would perhaps use lectures, discussion, and guided review techniques to impart knowledge and skills to
students. The implicit expectation in this approach is that students lack necessary domain knowledge and skills and the teacher’s job is to direct learning in ways that transfer knowledge from teacher to student.4

Relationships we observed arising between students and teachers in classrooms that worked were not the typical student-teacher relationships, but resembled those of masters and apprentices. The teacher was regarded as the expert or “model” practitioner of the craft, and he or she also possessed greater factual knowledge or skill. Students had a limited knowledge of facts and skill but were increasing both continually. Teachers did not hold the “master” role authoritatively, but rather conveyed the message “I am here if you need me.”

Teachers did little lecturing. The few lectures we observed came just before students were beginning a new task, when the teacher either reviewed earlier material relevant to the current task or instructed them in new procedures (e.g., using the robot arm or using the card catalog).

One-on-one tutoring or master-apprentice interactions were the main methods by which Ms. Adams, Mr. Benson, and Mr. Price (in English class) distributed information and shaped the students’ progress. These teachers often circulated throughout the classroom, stopping to visit each group. Ms. Adams was skilled at giving constructive local critiques of designs and dispensing important pieces of information on request. Depending on the student’s or group’s needs, Mr. Benson might draw a diagram to illustrate a point, reteach a mathematical formula, or just stand back and admire the work.

As with other master-apprentice situations there was no discrete distinction between student and teacher, but rather a continuous gradation of expertise from low to high. Teachers readily acknowledged that some students possessed superior skills. Teachers took advantage of student skill variation, and the fact that cooperative work was the norm, by encouraging more advanced students to help less advanced ones. This policy permitted teachers to spend more time with students needing most help. For the most part, students seemed comfortable with their roles, be they apprentice or “master” to another student. The English students appeared to have the most difficulty adjusting, because many had learned to view English teachers as the “authority” who determines how performance criteria relate to grades. Mr. Price had to work hard to legitimize a process where students ask questions and get advice from each other, rather than seek the teacher’s.

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4For further discussion on teacher roles and their relation to expectations about student learning see Berryman (1991) and Raizen (1989).
Teacher roles in the other classes were quite different. Mr. Price was more like a “therapist” than a teacher to some landscape students. With working students he infrequently guided them and more frequently supervised them—gave specific instructions, checked their work, admonished them for faulty work. Mr. Stone was the “oracle” to whom students came for answers. His “missionary” attitude or role was one of giving constant help and “protecting” students from their own failings (e.g., collecting papers so students would not lose them).

Teaching Techniques

Teaching techniques refer to actual teacher instructional behaviors or tactics used to implement instructional goals. The techniques that teachers adopt are embedded in the context of instructional goals and the particular learning environment, and are best understood within that context. Chosen techniques can either succeed or fail; they may or may not bring about the desired change in student behavior or help students’ learning.

Collins, Brown, and Newman (1989) provide one useful formulation of teaching methods that they believe are designed to give students “the opportunity to observe, engage in, and invent or discover expert strategies in context” (p. 481). That is, these techniques are designed to support situated learning and authentic practice, as discussed above. The six methods that they identify fall roughly into three groups:

• **Modeling, coaching, and scaffolding** are designed to help students acquire an integrated set of cognitive and metacognitive skills (e.g., learning strategies) through processes of observation (via modeling), and of guided and supported practice (coaching and scaffolding). In addition to observable behaviors, teachers can model mental activities, e.g., as when a teacher models the use of heuristics, the general “rules of thumb” that domain experts use to guide their problem solving.

• **Articulation and reflection** are designed to help students both focus their observations of “expert” problem solving and gain control of their own problem-solving strategies.

• **Exploration** is designed to encourage learner autonomy, in carrying out problem-solving processes and in formulating the problems to be solved.

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5See Collins, Brown, and Newman (1989) for further discussion about teaching methods to support situated learning.
Teachers in successful classrooms relied heavily on modeling how “experts” carry out a task. In Ms. Adams’s class and Mr. Benson’s class, this often involved manipulating physical objects and demonstrating correct procedures. In English class, Mr. Price often modeled internal cognitive processes and activities as well (e.g., articulated his own thinking to generate themes in a novel and provided heuristics for terminating a library search).

These teachers also used coaching, scaffolding, and fading. Mr. Benson primarily used highly interactive coaching to help students through particular problems they faced when carrying out a task. Mr. Price provided scaffolds in the form of physical supports (e.g., diagramming three ways to structure a paper) and suggestions or help (e.g., reminding students to use personal events in their lives as a stimulus for identifying themes). He also provided emotional scaffolds, by acknowledging and accepting students’ discomfort with “negative capability”—the notion that temporary confusion is preferable to quick judgments about the meaning of text. All three teachers demonstrated an ability to provide just enough help to allow students to progress without making a decision or solving a problem for them.

These teachers also employed techniques to get students to articulate or reflect on their knowledge, reasoning, or problem-solving processes. Mr. Price had students assume the critic’s role in cooperative activities, thereby leading them to formulate and articulate their own thoughts about the novels. Ms. Adams had students reflect on their own performance as a group and discuss how group performance might have been improved. Finally, Mr. Benson also encouraged exploration in his advanced electronics students, who were “turned loose” to identify a project, set their own goals for it, and carry it out.

Generally speaking, all of these techniques are suited to a project-centered classroom where students are given considerable freedom to carry out individual and group tasks. Since students have different degrees of skill and are not proceeding in unison, teachers must be ready for flexible interactions where students place unpredictable demands on them. They tend not to follow lesson plans but instead follow individual student progress. This student-centered approach results in opportunistic, not planned teaching.

In the other three classes, teachers and students did not assume master-apprentice roles and, for the most part, did not use the methods discussed above. While Mr. Price did use modeling techniques in his landscape class to, for example, demonstrate the proper use of a tool, most of his time was consumed by managing inappropriate behavior—fighting, shirking work, truancy, and heated confrontations (both between students and directed at him personally).
Mr. Price dealt with bad behavior because he genuinely wanted to help the students, some of whom were in danger of dismissal from school or assignment to the continuation high school. His genuine feeling for students, and his intense interaction with them, suggested a therapist-patient relationship. With those students who made some attempt to work (about half the class), his role was more of “supervisor” to “workers.” Either way, it is safe to say that this class was atypical of most high school classes.

Mr. Stone spent much of his time lecturing or reviewing homework problems or laboratory exercises with the whole class. He made it clear to students that he was there to answer questions and help students, and said that he used student questions to gauge their learning. Mr. Stone used similar techniques in both chemistry classes, despite the fact that students in one class had higher math ability than students in the other. One might expect that the more “advanced” students would be given more responsibility—less spoonfeeding on his part—or more challenging work. Mr. Stone acted as though his students should not be pressured or challenged too much, because they “needed” care and nurturing.

**School Context for Teaching and Learning**

Teachers and classrooms operate within a particular context, beginning with the school and community environment and expanding to district, state, and federal levels. The broader context affects teaching and learning through such factors as resources allocated, policies, organizational structures, and processes (Oakes, 1989). Study of this context is needed, particularly at the school level, to understand the conditions or constraints that teachers and students face because these help shape the teaching and learning we observe in the classroom. Context is also important to policymakers because we have incomplete knowledge about how schools produce the results we want. Context information may provide clues about why certain outcomes prevail over others and how to change policy to alter classroom practice and thereby improve or produce different outcomes (Oakes, 1989).

We focus on three indicators of school context that research identifies as enabling conditions for promoting high-quality teaching and learning: student access to knowledge, press for student achievement, and professional teaching conditions (Oakes, 1989). Taken together, these indicators help define a classroom’s “sense of place” within the school.
Access to Knowledge

Access to knowledge refers to the extent to which schools provide students with opportunities to learn various domains of knowledge and skills. Access can be quite directly linked to student outcomes. Access is influenced by basic resources, such as time, materials, staff, facilities, and so on. Access is also influenced by curricular emphasis and structure, such as classroom or course assignment practices (ability-grouped or mixed instructional groups) and the curriculum associated with each group, and by teacher qualifications or opportunities for staff development.

All three high schools in our study tracked students, and tracking practices influenced who enrolled in classrooms we observed. Some research suggests that a heterogeneous mix of students tends to raise the level of teaching and can also counteract negative affects associated with tracking students: Individual achievement and aspirations are lower among students in low-ability and nonacademic tracks at the secondary level (Oakes, 1986; 1989). In the classes we studied, the mix of students depended on the type of class (academic or vocational) and the kind of credit attached to it.

The vocational classes taught by Mr. Benson and Ms. Adams were elective courses and attracted a mixed group of students who were interested in the subject area, and, in some cases could use the class to fulfill a graduation requirement. College-bound students may actually have less access to these classes simply because these students need a certain number and type of credits for college enrollment: They take fewer elective courses and more courses whose credits are recognized by postsecondary institutions.6 Thus, they lose a potential opportunity to learn generic skills taught in vocational classrooms.

College-bound students opted to enroll in Mr. Price’s English class, while vocational or “general” students enrolled in landscape/horticulture. The college-bound students in Mr. Price’s class had three fourth-year English classes to choose from. Most landscape students were either placed in the class by a counselor or needed the science credit for the course because they had failed biology.

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6In California, courses with “A–F” credits are those accepted by the state college and university systems. Other classes may receive credit (e.g., math and science) that count toward graduation, but are not counted toward college. In fact, a student’s grade-point average is often calculated without “elective” credits, thereby decreasing its value to the student. In some cases, this creates a disincentive to students to engage in class and try to perform well.
Although the high school housing the academy program tracked students, the academy itself has a diversity policy to enroll a heterogeneous mix of students. The administrators strongly believe that all students can benefit from the academy, and thus all must have access. Nevertheless, most of the students in Mr. Stone’s chemistry class were college bound. In addition, Mr. Stone could assign two types of credit: chemistry—accepted as a science credit for college—and “descriptive” chemistry—counted as science credit for high school graduation, but not college enrollment. According to the roster, at least four students in his two classes were receiving credit for “descriptive” chemistry.

A second factor affecting access is resources. Because their classes were sponsored by the state’s Regional Occupational Program (ROP), Ms. Adams and Mr. Price (landscape) received extra funds to purchase materials (e.g., supplies for the house design project and gardening tools). Because of high class enrollments, and extra funding from the ROP, Ms. Adams had a larger budget than most regular vocational classes at the same school. Mr. Price had few resources for his English class, and often used his own funds to purchase books. Similarly, Mr. Benson purchased computer software and other materials for his industrial arts classes. He also had some sophisticated equipment (computers and the robotic arm) purchased by the school. Students complained, however, that the electronics equipment was often lacking or broken. Some coped by hoarding working equipment in their personal lockers. While Mr. Stone’s lab seemed adequately equipped, students were using old chemistry textbooks begged from another school because there were no funds to buy them. He hoped that students would have new books next year.

Except for Ms. Adams, then, teachers generally felt that they lacked adequate resources; Mr. Price and Mr. Benson bought needed resources with their own money. While a school (or teacher’s) resource level, in itself, does not guarantee a high-quality educational program, increased resources can make a difference if used effectively (Oakes, 1989).

**Press for Achievement**

Press for achievement is indicated by institutional pressures that the school exerts to get students to work hard and achieve. Programs with a strong press for achievement expect and value high achievement; teachers and students take teaching and learning seriously. Students are engaged in a rich and challenging curriculum with adequate resources. Teachers are evaluated according to their ability to engage students and by their pedagogical skill. Noninstructional teacher duties take second place; they do not interfere with or interrupt teaching
lessons. Teachers expect that students are capable of high-level cognitive processes and mastering rigorous curriculum content.

The schools and teachers in our sample communicated different expectations and values about achievement to their students. Obviously, any school that tracks students does not hold the same achievement standards for all students. But it appears that individual teacher standards can make a difference for students.

Although vocational classes were less valued than academic classes in the schools where Ms. Adams and Mr. Benson taught, their personal views about students explicitly challenged the schools’ views. Both of these teachers had high expectations for student achievement, which they believed was linked to effort. They worked with and supported any student who tried. They “designed in” interesting and meaningful learning activities, employing high-level cultures of practice. They expressed a personal commitment not to “throw back” any student. While Mr. Price had similarly high expectations for his English students (consistent with the school’s expectations), his learning expectations for the landscape students were quite different. In landscape he wanted students to maintain a level of behavior that did not interfere with the class; this attention to behavior led to highly structured activities and boring tasks, in service of avoiding mischief, and seemed to override any expectations about achievement per se. School staff and other students voiced similar expectations for the landscape students.  It is true that the landscape students were of low academic ability and that many also had emotional or behavioral problems; nevertheless, we observed some of the same students, as well as students with similar characteristics, functioning more effectively in other classrooms where teacher expectation for learning remained high for all students.

The academy program’s press for achievement was defined with a mastery criterion. Students took proficiency tests in each class until they achieved a grade of “C” or better. Teachers were expected to give extra help to students who failed. This “bureaucratic C” communicated a clear expectation but also seemed to have a dampening effect on less-able students. Students seemed to expect the teacher to spoonfeed all the answers to problems and often demanded direct answers to their questions. The environment did not appear to foster individual thinking or higher achievement or effort for most students. The teacher also had different expectations for the two classes, which had been formed based on

7To illustrate, Mr. Price recounted a discussion he had with the principal, where he objected to some of the students who were assigned to the landscape class. He won his case by asking the principal if she was willing to take responsibility for these students “walking around campus with power tools.”
students’ math skills. In addition, as discussed above, some students earned credit for “descriptive” chemistry because it was believed that they could not succeed in regular chemistry.

**Professional Teaching Conditions**

Teaching conditions can empower or constrain teachers as they attempt to create and implement instructional programs, and they define how schools function as a workplace for teachers. Although professional teaching conditions have not been directly linked to student outcomes, there is evidence that a “professional” staff will work toward implementing strategies and programs to improve results (Oakes, 1989; Bodilly et al., 1993). At schools with professional teaching conditions, for example, teachers have some autonomy and flexibility in implementing curriculum and instruction, participate in schoolwide decisionmaking, and spend time on such activities as goal setting, staff development, program planning, curriculum development, and collaboration.

Teachers in our sample expressed different feelings about their relationship to school administrators, other faculty, and opportunities for staff development. As an ROP class, interior design was basically ignored by the school administration, although Ms. Adams was strongly supported by the ROP administrator on campus. The school’s benign neglect actually proved advantageous to the teacher because it left her wide berth to experiment. On the negative side, Ms. Adams was isolated from the larger school teaching staff and did not participate in activities that can foster the exchange of knowledge, such as collaborative staff planning, intellectual sharing, and teamwork. On the other hand, Ms. Adams did not seem to feel disadvantaged or marginal in any way. As long as she could teach as she liked, she was satisfied.

Although landscape was technically an ROP class, the teacher had no affiliation with the ROP administration. As the school counselor explained, the size and number of ROP programs in this suburban school are comparatively small, so their affiliated ROP lets them do as they like. This freedom supports an atypical program that is arguably detrimental to students. Officially, the ROP offers entry-level job training for local job markets where the entry wage is above minimum wage. Their mission also extends to career exploration opportunities and preparation for higher education in a related field. They typically hire instructors with recent working experience in the areas they teach. As noted in our earlier report (Stasz et al., 1990), Ms. Adams’s interior design class is a good example of the ROP’s “schooling for work” focus. By contrast, Mr. Price’s landscaping/horticulture class was widely viewed by students, teachers, and
school administrators as a “dumping ground” for emotionally disturbed, special education, or academically weak students. One teacher described it as the “holding pen for Ivy Walls,” the local continuation school. Although this class was clearly on the academic margins it was central to the school culture: It provided a place for “marginal” students. Mr. Price had strong support from the administration precisely because he was one of the few teachers who could handle “difficult” students. Thus, he had a good deal of autonomy in teaching both the landscape and English classes.

Mr. Benson found administrative support for his industrial arts classes, but for different reasons from Mr. Price. Mr. Benson had crafted a high-level vocational program that had high enrollments and attracted a heterogeneous group of students. His classes were a prime example of “good” vocational education in a comprehensive high school. Mr. Benson was also active in state-level industrial arts organizations that enhanced his professional contacts outside the school.

Mr. Stone’s classes were in a special program that was strongly supported by the school and district. As a new teacher, however, he seemed to need more support than he got. Mr. Stone said he had been sent to a workshop sponsored by the Coalition of Essential Schools (cf. Sizer, 1984) that influenced his ideas about teaching but did not provide any practical methods for applying these ideas in class. He got some lesson plans and informal mentoring from a more experienced chemistry teacher at the school who had taught the labs. Because the academy program was in its first year at the time of our study, the curriculum has not been very well developed, and district officials admitted that curriculum and staff development are sorely needed. In the meantime, Mr. Stone appeared to struggle and feel frustration at his inability to carry out many of his instructional goals.

Although teaching conditions varied for teachers in these classrooms, they did not strongly affect teaching practices: All had autonomy in the classroom. Mr. Price seemed somewhat uneasy about his role in the two classes we observed. On one hand, teaching the landscape class gave him some leverage over the administration. On the other, he knew the class was a “dumping ground” for marginal students, and he put much effort into working with those students on nonacademic issues. Finally, Mr. Stone was clearly not getting the support he needed, but we are unable to determine if that support would have improved his teaching practices.
An Instructional Model for Generic Skills and Attitudes

Our comparison of the eight classrooms suggests several themes regarding what makes some classrooms successful in imparting generic skills and attitudes. The key domains for describing successful classrooms are summarized in Table 3.2. The fourfold framework outlined there—instructional goals, classroom design, teaching techniques, school context for teaching and learning—provides an analytic framework for discussing and evaluating the classrooms that we observed. The four components can be viewed as the parts of an instructional model for generic skills and attitudes. Teachers who wish to include generic skills and attitudes among their instructional goals can draw on this model to help them design and conduct their classes.

Table 3.2
Components of an Instructional Model for Teaching
Generic Skills and Work-Related Attitudes

<table>
<thead>
<tr>
<th>Instructional Goals</th>
<th>Classroom Design</th>
<th>Teaching Techniques</th>
<th>School Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex reasoning skills</td>
<td>Situated learning</td>
<td>Modeling</td>
<td>Access to knowledge</td>
</tr>
<tr>
<td>Work-related attitudes</td>
<td>Culture of expert practice</td>
<td>Coaching</td>
<td>Press for achievement</td>
</tr>
<tr>
<td>Cooperative skills</td>
<td>Motivation</td>
<td>Scaffolding</td>
<td>Professional teaching conditions</td>
</tr>
<tr>
<td>Domain-specific knowledge, skills</td>
<td>Cooperation</td>
<td>Articulation</td>
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<td></td>
<td>Teacher roles</td>
<td>Reflection</td>
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<td>Exploration</td>
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</table>

Although we have discussed our findings in these domains separately, they are linked in practice and must be considered in an integrated fashion in order to design classrooms that work. Figure 3.1 indicates the way in which the components interact: Instructional goals influence classroom design and teaching techniques; classroom design and teaching techniques influence each other; and school context influences goals, design, and techniques. We traced these interactions in our analysis of the classrooms in our sample.
It appears that generic skills and work-related attitudes can best be taught in classrooms and programs that blur the traditional distinctions between learning in school and out of school (cf. Resnick, 1987b). This approach requires teachers to explicitly adopt instructional goals that include generic skills, in addition to domain-specific skills. It requires them to create classrooms where students can acquire and apply knowledge and skills to real-world problems, learn to work with others in a community of learner-practitioners, and develop intrinsic motivation for learning and working. It requires teachers and schools to adopt the view that all students are entitled to and can benefit from learning opportunities. All students need to acquire not only knowledge and skills but also a positive perspective on learning that includes their own responsibility for it. Finally, this approach requires schools to provide a context that enables, encourages, and rewards the effective teaching and learning of generic skills and attitudes.
Student Perceptions and Accomplishments

The model we have outlined focuses on teaching practices and policies that can support them: It does not address learning outcomes. What is the experience of students in classrooms where teachers purport to impart generic skills? In this study, we do not attempt to systematically measure learning through tests of knowledge or skills. However, we do gather data on student learning through our observations, responses to student surveys, and student focus group discussions. We use student perceptions to corroborate our observations about what the model posits as effective instructional practice.

Following the framework outlined by Collins et al., (1989), we can expect students in situated learning environments to be actively using knowledge in an applied way, perhaps in multiple contexts. Students would, for example, be engaged in a project that requires problem solving and exhibits several generic reasoning skills: problem recognition, problem analysis, generation of solution paths, evaluation/monitoring of solution paths, repair, and reflection (Stasz et al., 1990; Newell and Simon, 1972; Simon, 1979). Students engaged in a culture of expert practice should be engaged in focused interactions with other learners and experts for the purpose of solving problems and carrying out tasks. Cooperative learning and problem solving should be evident, with students sharing knowledge and skills or trying to help each other overcome difficulties. Since situated learning is expected to enhance motivation, students should appear engaged in their work and perhaps articulate the intrinsic value of learning a subject apart from just getting a grade or fulfilling a course requirement.

These expectations about classroom activity and student learning were met in classes that situated learning in authentic practice, but not in others. In Ms. Adams’s and Mr. Benson’s vocational classes, and Mr. Price’s English class, our observations and students’ perceptions indicate that students were independently engaged in complex problem-solving tasks that required them to identify problems, posit solution paths, evaluate their progress, and so on (see Table 3.2). The following three sections provide more details about student accomplishments in English, electronics, and manufacturing.

This kind of independent problem-solving behavior was not evidenced in the other classes. Mr. Price’s landscape students had difficulty completing even the simple, procedural tasks that were assigned to them (e.g., weeding and pruning roses). With more complex tasks, like repairing a broken sprinkler system, students would reach an impasse and ask the teacher for help. As mentioned above, students appeared to need supervision and expect Mr. Price to answer their questions and intervene in their squabbles. It was not unusual, for example,
for Mr. Price to find a student who was not working, who, when confronted, would then complain to Mr. Price that he had not been given a job. Generally speaking, about two-thirds of the students attempted any work at all; about half of these appeared to exert some effort.

Similarly, the laboratory exercises, followed by solving math problems, did not appear to engage or challenge the chemistry students in the same manner that we observed in other classes. In the lab period, their performance was rather rote—they focused on following steps, recording observations, and filling in answers to questions. The remainder of the lab period was spent using data from labs in math problems. The teacher and students worked problems together on the board; again students were focused not on solving problems, but on getting answers to write on their papers. During class time, many students did their “homework” as the teacher reviewed it. This behavior did not seem to bother the teacher or other students, who had taken the time to do the homework problems on their own. By and large, the students were passive problem solvers, who occasionally answered the teacher’s questions about a lab or math problem, but more often waited for or demanded that the teacher give them the answer. This teacher, then, was the “oracle” to whom the students turned for knowledge.

In both landscape and chemistry, students seemed to adopt “disengagement strategies,” i.e., strategies for shirking work, keeping a “lookout” on the teacher, or getting one’s work finished with the least amount of effort. These strategies, however adaptive they may have been in the classroom, will not serve students well in future work or postsecondary education settings. Though unintended by teachers, these strategies were clearly lessons learned or reinforced in these classes.

Student discussions in the focus groups corroborated our observations.8 Except for landscape and chemistry classes, students discussed and gave many examples of what they had learned and accomplished in class. A common theme in the vocational classes was the students’ gradual acceptance of the class as a place where students had to work to succeed, but could expect the teacher’s help in exchange for personal effort. Students who had initially taken the class for an easy grade or to fulfill a requirement became “enculturated”; they were sold on the teacher’s conception of why the subject matter or classroom experience was

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8We did not plan to conduct a focus group in our initial study of Ms. Adams’s class (Stasz et al., 1990) but had many conversations with individual students. We did not conduct a focus group with the landscape students because the teacher felt that the students would not contribute enough to make it worth our while. We did not dispute the teacher’s judgment. In retrospect, this comment reflected his low expectations for the students. However, in individual interviews the students proved capable of providing information about their perceptions and accomplishments.
important for them. Once they “bought in,” they became more engaged and were able to benefit from the class as the teacher intended. This sentiment also rang true in the English class for many students, but at the end some still complained that they did not like the novels or found some of the work a waste of time. In landscape class, few students expressed a sense of accomplishment with what they were learning. The students who did cooperate and try to work noted that Mr. Price had to spend much of his time dealing with the “troublemakers.” Mr. Stone’s students were focused on finishing the work to get their grades but also liked the academy program generally because of its smaller class size and “caring” teachers. Unlike students in the vocational classes, the chemistry students did not discuss lessons learned in class about, for example, problem solving, personal interests, or feelings associated with accomplishing a task well.

In the next three sections, we use the design framework to organize descriptions of three classrooms that work. We attempt to illustrate how teaching goals and techniques, classroom design, and so on, come together in a classroom. We also describe student perceptions based on data we gathered in our classroom observations and student group discussions. These three classes are meant as concrete examplars of teaching practice that can foster teaching and learning of generic skills.