Dynamics of Change in High School Teaching

a study of innovation in five Vermont professional development schools

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Chapter 1

Introduction:
Systemic Change and High School Teaching

We have learned that we cannot mandate what matters to effective practice; the challenge lies in understanding how policy can enable and facilitate it.

Milbrey McLaughlin, 1990, p.15

Despite a widespread tendency to hopelessness, change does occur in high school teaching. Indeed, it would be difficult to find a high school in America that does not celebrate one, two, or more of its local teachers—the ones who take a special interest in students, start a small program that encourages active engagement in learning, and generate a local storm of educational enthusiasm around a learning project. The problem is that innovative high school programs do not generalize to the rest of the high school curriculum, so the basic pattern of high school teaching remains intact, eventually sapping innovations of the energy they need to grow. If we aspire to create systemic reform in high school teaching, we need to know how successful innovations survive and how they can grow to affect the larger systems of which they are a part.

The pattern of emergence and sudden decay in high school innovation is familiar. A teacher and some students discover that they can do something interesting with some ideas or methods from a subject area. Soon, a few parents get involved and the media provides some coverage. Then, it’s gone.
David Perkins is just one commentator to note and lament the precipitous rise and corresponding disappearance of promising innovations in high school teaching. An innovation appears. “There, we all say. See, it’s possible. It’s great. Let’s get on with it” (Perkins, 1992, p. 204). Then, with one slight change in conditions, the innovation disappears like smoke, and with it goes another part of our hope for a high school experience that compels students to commit themselves to learning.

However, high schools do continue to cultivate small, innovative programs. Some programs last. Some of them seem to challenge the foundations of public belief about what can work in a high school setting. We set out to examine five innovative high school programs so we could begin to explain how innovations in high school teaching emerge and persist. We focused on six fertile years of experimentation in Vermont, our own state, a period during which the following occurred:

- Research and theory at the national level pointed to the need for “systemic” change throughout the public school system
- The State of Vermont developed and then adopted the Vermont Framework of Standards and Learning Opportunities
- The University of Vermont instituted professional development schools to prepare new teachers in standards-based practice, provide professional development for veteran teachers, and conduct research to illuminate the process of reform in the teaching profession
- Professional development opportunities for teachers, offered by national, state, and local organizations, flourished in high schools across the state
- A network of educators began to develop and field-test methods and materials that supported movement toward standards-based learning and assessment
- Students in innovative programs celebrated their success with demonstrations of improved performance
During the six years between 1991 and 1997, Vermont educators made a concerted effort to change the way high school teachers teach and students learn. By studying the development of innovations in high school teaching that have grown over a six-year period of statewide reform in Vermont, we aimed to develop a sense of how “systemic” change may occur in any reform-oriented setting.

A System of Replaceable Parts

Those who believe that America cannot design or build for the long term have probably not taken a look at the high school curriculum. Born in the 19th century, the American high school follows the ideal of mechanical systems: efficiency, reliability, and replaceable parts. An astronaut returning to earth from a forty-year journey to the outer planets might feel out of place in a modern mall, business office, or factory, but she would feel right at home in her local high school—still a monument to predictable order. The daily schedule is set. The building stands waiting. Teachers find their rooms. Buses roll in. Students stumble into their seats. Text-teach-test. Class ends in 42 minutes. Students rise at the bell and find their next room. Text-teach-test. After six to eight iterations of the same process, buses roll out. Teachers leave their rooms to prepare for another day.

As a publicly funded institution, the American high school has favored efficiency over effectiveness (Cuban, 1990). Funded by scarce local dollars, our schools were designed to handle the largest number of students at the lowest level of investment. With large numbers of students flowing through the halls following the same schedule, maintaining predictable order becomes a central concern in any school. How many minutes between classes? Three to five. How many classes does each student take each year? Five or six. How many each day? Five to eight. How many courses until graduation? Nineteen to 23.5 Carnegie Units: four English, four math, three social studies, two sciences, and a mix of
vocational or college prep subjects, designed to fit two to six “tracks.” The existing system is built with interchangeable parts, so a student from Idaho can move to Vermont without noticing any change in educational process. Simply keeping order among multitudes of adolescents can consume a great deal of energy, preventing anyone from focusing on how to improve teaching and learning.

The goal of instructing all students within the same structure has resulted in an approach to high school teaching that follows a predictable pattern of steps, whether or not all students are prepared to learn within that pattern (Ohanian, 1999; Clarke & Agne, 1997). This also means that high schools devote virtually all their energy to sustaining themselves rather than adapting or changing. Placing 25 students in a classroom with one teacher for 42 minutes ensures, to some extent, that seats will remain in rows, that teachers will keep order from the front, and that instruction will follow the pattern of chapters in existing textbooks, making each year a race to “cover” an expected volume of content.

Interlocking Pieces

Because the high school day was designed to be predictable and orderly, the larger mechanics that sustain daily learning are also predictable and orderly. Policy development, governance, systems design, curriculum planning, instructional development, student discipline, and the entire system were all developed to fit an idea of efficiency. Students are expected to learn the same material in groups of 20 to 30, meeting in six to eight scheduled classes. The components of the system are now interlocking. They work by fitting together. Changing any one of them throws the entire system into disequilibrium. Changing any one of them without changing interacting systems quickly proves futile. It is no wonder that small innovations struggling to emerge in this tight setting fail to thrive. Deprived of sustenance from surrounding systems, they eventually stop growing.
Few complain that the American high school is disorganized or haphazard. In fact, the structures that organize formal learning for several hundred adolescents in one building have to be impressive. The real problem is that the systems we have developed to manage high school learning may not allow for adaptive growth. Our society now wants all high school students to meet performance standards prior to graduation; the high school system remains devoted to covering subjects. Improving student performance requires change, while high schools were designed for stability. What results from this steady obsolescence is increasing frustration. As Tony Wagner has pointed out, “Framing the problem as obsolete systems of schooling that must be reinvented,” not merely reformed, makes the dimensions and complexity of the challenge clearer. Moreover, it suggests that the solution must be a shared responsibility (1998, p. 513). To change at all, the whole system has to change at once. Because revolution seems unlikely in a tightly managed educational system, high schools must begin to evolve.

Evolution depends on the steady emergence of variations in teaching and learning that respond to changing pressures and force the larger system to adapt; even in a tightly managed system, innovations do emerge. During the last decade of Vermont’s reform movement, many of them have proven quite durable. Writing and mathematics portfolios, community-based learning, interdisciplinary teaching, team teaching, project-based learning, computer-based learning, assessment adapting to individual learning styles, and several forms of assessment by exhibition have become permanent features in high schools across the state, with very little policy support from the standards movement. Unlike earlier innovations such as basic competency testing, these innovations require a different format for the high school day. Innovations related to performance standards have begun to destabilize surrounding systems that maintain existing school structures.
Standards-based teaching and learning are forcing supporting systems to adapt. Under the umbrella of the Vermont Framework of Standards and Learning Opportunities, a loose aggregate of partially connected innovations are struggling to reshape the process of learning and teaching in some Vermont schools. Approximately half of Vermont’s high schools—and all the schools in this study—now follow some kind of block scheduling, a format that increases opportunities for performance-based learning. Block scheduling was not planned in Vermont. It emerged in schools where improved student performance has become a mission. Block scheduling was not mandated, either. Rather, it was chosen by faculties whose sense of purpose had begun to change. In beginning this exploration of high school innovation, we saw that the time was right to study the processes by which small innovations in high school teaching emerge and grow in a context partially destabilized by change at other levels of the educational system. Under conditions favorable to systemic change, how does a high school disentangle the interlocking parts of a system to let new ideas emerge and take root?

Adaptation and Evolution

How can we change schools that are too large and complex to be managed by any individual? As befits the uneasy alliance between conservative and progressive tendencies in education, two versions of the change process prevail in public dialogue about high school reform. Favoring accountability in a public system, the conservative tendency would move change from the top of the policy structure, establishing common goals, standards, and measures of productivity to be applied on a broad scale to the whole structure of schooling. Top-down change is often referred to as “systemic” (Cohen, 1995). Favoring responsiveness to individual needs, the progressive tendency would move change incrementally from the bottom of the educational structure, identifying elements of teaching and learning that succeed in one context, then seeking ways to generalize those elements to related situations
(Clinchy, 1996). Top-down reform often seeks increased public accountability from schools and teachers; bottom-up reform more often seeks increased responsiveness among teachers and the many different students they serve. When policy-driven change and practice-driven change fail to connect, both may fail.

Top-down and bottom-up change initiatives may not produce the same level of effect on student learning (see Figure 1). In a comprehensive meta-analysis of factors that affect school learning, Wang, Haertel, and Walberg (1993) determined that variables closest to the student in the classroom have a more profound effect on student learning than distant variables—those related to policy and structure. “The evidence linking distal to proximal variables is sparse,” they observed. “Distant variables such as district and state policies may set the stage for classroom practices that affect student learning….Distant policies are likely to make a difference only when they affect proximal factors” (p. 279). If systemic change is necessary, knowing that practice-based change is more effective than policy-driven
change does little good. We need to understand how policy and practice interact to improve performance during high school reform.

Most of the factors identified as influential by Wang et al. lie beyond the control of policymakers. As Milbrey McLaughlin observed while reflecting on earlier studies of school reform, the Rand Change Agent study concluded that policies were seldom, if ever, applied uniformly in the local setting. They were always adapted to fit local practices. “We did not look beyond the policy structure to consider that the embedded structure of greatest import to teachers might have nothing or little to do with policy—it might have to do with networks, school department or other school-level association, or colleagues however organized” (McLaughlin, 1990, p. 12). As McLaughlin concluded:

The dominance of local implementation, the local factors that make variability the rule, and the fluid and often unpredictable character of the local institutional environment all underscore the systemic nature of the problems that the change agent policies address…. Change strategies rooted in the natural networks of teachers—in their professional associations—may be more effective than strategies that adhere solely to the delivery structure outlined by the policy system (p. 15).

How do policies and practices influence each other? The mutual influence of policy and practice is likely to be complex, mediated by existing systems of management, school culture, and local leadership in teaching and learning. Our study of five Vermont high schools aimed to describe the interaction of policy and practice during a period of dynamic change.
Policy Context

The marriage of performance and standards in the Vermont Framework of Standards and Learning Opportunities provides both the backdrop for this study and much of its rationale. In 1992, Commissioner of Education Richard Mills issued “The Green Mountain Challenge,” charging Vermont educators to prepare all students to reach high standards for learning. The motto was: “No exceptions; no excuses.” In community forums organized by state and university educators, citizens then gathered to define what all students should know and be able to do. “The Common Core of Learning” that resulted from these community forums—and ongoing policy work in the State Department of Education—created the Vermont Framework of Standards and Learning Opportunities, a document that now includes approximately 133 standards (Vermont Department of Education, 1996). When the State Board of Education adopted the Vermont Framework in 1996, an organizing focus for statewide systemic change was in place.

In 1992, the Green Mountain Challenge had identified eight strategies for moving to a standards-based educational process, promising “high skills for every student”:

• Establish high standards for what students should know and be able to do
• Transform learning experiences so that all students meet the standards
• Hold the system accountable for student learning
• Manage for high performance at the state and local level
• Reshape education finance and governance
• Fuel change with high quality professional development
• Engage public support for the changes that are needed
• Guarantee children and their families the support they need to succeed
In short, the strategies identified early in the Vermont standards movement call for “systemic” reform, working from the “top” of the state structure (Cohen, 1995). Still, we know little about how changing policy has influenced practice in Vermont high schools.

In Vermont, the marriage of performance and standards has begun to prove fertile, drawing conservatives and progressives into an unlikely coalition. Performance standards describe what students should know and be able to do as a result of learning. That is, they include measures for both content acquisition (knowledge) and the intellectual processes of applying knowledge (performance). *The Vermont Framework of Standards and Learning Opportunities* reflects a similar duality. The first half of the Vermont Standards, called “Vital Results,” describes the kind of general intellectual skill that anyone needs to succeed in modern society. The second half, called “Essential Learnings,” includes a list of content requirements deemed to be basic knowledge by Vermont educators. “Learning Opportunities” are also included in the *Vermont Framework*, describing standards for teaching that should enable all students to meet the established standards. The term “performance standards” nods twice in the direction of those concerned with education reform, once to conservatives who want some accountability in a publicly funded system, and then again to progressive educators and parents who want students to become engaged, involved, and energized by their education. As a single statement of purpose for high school teaching, the *Vermont Framework* has the power to focus the entire state on the organizing purpose of public education.

The marriage of standards and performance in the *Vermont Framework* also creates a unique context for studying reform. Advocates of both accountability and student engagement have been willing to agree that improved performance is the purpose of the current reform movement. They are also willing to concede that systemic change is necessary because ad hoc and partial reforms are so easily overwhelmed by the awful momentum of existing machinery. Fifteen years have passed since *A Nation at Risk* (Commission on
Excellence in Education, 1983) initiated the current reform movement, slowing the pendulum swing between conservative and progressive priorities. However, systemic reform remains the purpose of both top-down and bottom-up school development initiatives.

By 1997, Vermont’s legislature had passed a law requiring equal access to educational opportunity for all Vermont students, effectively converting the Vermont Framework of Standards and Learning Opportunities into a legal imperative. What remained intact were the entrenched management systems and classroom practices that had frozen education in place since the 19th century. Changing a law and establishing a clear purpose for public education are momentous acts, but they do not change what happens in schools. Under pressure, how do high schools change their structures and teaching processes? In a circumstance suddenly destabilized, it became important to understand how high school teaching does change—when it changes at all. To succeed with systemic change, we need to understand the processes by which professional teachers adapt their methods to help students improve their learning during a long period of reform.

**Studying the Dynamics of Reform**

Before we began our interviews and observations, we thought we would be looking at “new” strategies in high school teaching and learning. Perhaps our first discovery was that none of the innovations were, in fact, new. Instead of new practices being developed to fit new policies, we discovered existing programs that were continuously adapting to new opportunities, the most recent of which was the Vermont Framework of Standards and Learning Opportunities. Each of the five initiatives described in this book had a history of development stretching far back into the personal histories of many different innovators. Consequently, we have had to adopt Morris’ distinction between innovation and reform:

*By reform, I mean the rather long periods in which loose collections of activities are initiated that are perceived collectively to be part of the same reform effort. While a “reform” may appear to consist of many small innovations, fed in over time to increase*
the survivability of the “reform,” the process of change is hardly additive. Instead, each addition to a growing reform is subject to further change as soon as it is incorporated into an ongoing reform initiative. **The innovation must change in response to the environment that it is itself intended to modify.**…. One cannot understand the flow of innovations apart from the reform movements within which those innovations occur…. The idea of interdependence of the parts—the idea that changing a part affects many or all other related parts—is central to the concept of a system (Morris, p. 24).

By necessity, change in a complex system is dynamic change; small changes force larger systems to adapt; changes in larger systems force new innovations to emerge. By looking closely at changes in high school teaching in relation to the systems in which they are growing, we hope to gain an understanding of how systemic change occurs in any high school context and how we can encourage further development toward improved learning for all students.

We did not begin this research with a forthright hypothesis. We did, however, begin with a general conception of how change may occur in high schools actively engaged in reform. Figure 3 represents change as a complex organic process in which energy and order interact continuously to produce adaptive growth (Clarke, Sanborn, Aiken, Cornell, Goodman and Hess, 1998). In this conception, most of the energy driving change comes from the interaction of students and teachers who recognize in their daily contact both the need and the opportunity to try new approaches to teaching and learning. Additional energy comes from outside the structure, from groups pushing the schools toward change. Structural order results from the work of policymakers and administrators charged with managing a large and unwieldy organization. When successful change occurs, we thought, it could depend on organic interaction among many interrelated sub-systems struggling to change themselves in response to each other and to a flexible vision of the purpose they share. As chapters 8 and 9 will show, our research has forced us to revise this conception to allow a great deal more variability in the processes of school reform.
How can a school simultaneously maintain and transform itself to support learning for all students? Figure 2 represents a conception of a flexible, self-organizing process that balances the need for both change and stability in complex school settings. Everywhere they are found, complex systems struggle to obey two conflicting tendencies, one that leads toward predictable order and the other that produces new energy. A school struggles to support the development of energy, in the form of new ideas and learning for young people, at the same time it tries to maintain predictable patterns—bell schedules and course requirements, for example—that ensure its survival as an identifiable system (Clarke, et al., 1998). Having spread across the United States in half a century, the structure of the comprehensive high school has proven more predictable than flexible, reducing evolutionary adaptation to the changing needs of American society.

In Figure 2, of course, the “tree” at the center of the change cycle also resembles the four structural levels that Senge believes make up a comprehensive vision for “the learning organization”: events, patterns of behavior, systemic structures, and “a purpose story” (Senge, 1990, chap. 3). A public school faculty may become a true “learning community,”
we thought, when its members are sufficiently organized to work cooperatively without sacrificing the creative drive that comes from personal vision or the consistency that comes from shared vision. We set out to capture the stories of five successful innovations in high school teaching so we could then identify the interplay of forces at work during their development.

In complexity theory, the tendency to move toward order and the tendency to create energy are both self-limiting. Too much order leads to stagnation, congealed patterns of organization too inflexible to adapt to ongoing evolution in neighboring systems. However, too much energy leads to chaos, a level of disorganization that cannot reproduce itself. In a complex system, Waldrop says, “a great many interdependent agents are interacting with each other in a great many ways,” spontaneously organizing themselves to adapt to the larger systems in which they emerge (1992, p. 11). In professional development schools that were purposefully “energized,” we hoped to be able to identify comprehensible patterns in the complex interactions among different levels of high school organization that support growth.

If tension between energy and order does influence the process of high school reform, mapping the transfer of human energy from one level to another could help us understand how an innovation may emerge in one small corner of a high school and then grow to become a strong influence on the continuing evolution of the whole structure. As Margarette Wheatley points out, “Though flexible, a self-organizing structure is no mere passive reactor to external fluctuations. As it matures and stabilizes, it becomes more efficient in its use of its resources, and better able to exist within its environment. It establishes a basic structure that supports the development of the system. This structure then facilitates an insulation from the environment that protects it from constant, reactive changes” (Wheatley, 1994, p. 94). While thoroughly insulated, high schools still do produce innovations that generate change. We set out to map the interactions between the
five levels of organization represented in Figure 2, aiming to identify patterns of development we could associate with “systemic” change in the high school setting.

**Vermont’s Professional Development Schools**

A professional development school (PDS) is a partnership between a school and a university aiming to improve learning in both settings (Darling-Hammond, 1995; Levine & Trachtman, 1997). The central purpose of a professional development high school is to create a new kind of relationship between schools and universities that is centered around learning and inquiry. Mutual renewal is the intended outcome of professional development school collaboration, helping people who wish to become teachers to earn a license to teach, supporting professional educators in their growth, and allowing college teachers to understand the teaching and learning process, all while helping high school students improve their learning (Kostin, 1997; Clarke, Dwyer, Glesne, Leo, Kostin, and Meyers, 1997). A professional development school can be thought of as a virtual institution comprised primarily of relationships among colleges, professors, public schools, teachers, pre-service teachers, and public school students. A professional development school is a transformative institution, designed to change both the school and the university of which it is comprised. At the heart of the transformative process are teachers. Teachers need to be at the center of school renewal. Indeed, without their intense commitment to excellence, to reaching all students, and to knowing how to teach effectively, there can be no school reform. Inherent in the concept of professional development schools is the idea of creating a “learning organization,” an organization that adapts to its changing environment as its members interact with each other (Senge, 1990).

From a commitment shared by schools and a university in Vermont to support the growth of the teaching profession, professional development schools have gradually evolved. Throughout 10 years of partnership development at the secondary level, schools and the university have agreed on a collaborative approach to change that puts high value
on improved teaching but lets each school set its own agenda. Local conditions vary, but the central principle remains the same: “If teachers are consistently supported over time in a way that will allow them to develop and grow as they teach, they will gradually professionalize themselves” (Leo-Nyquist, 1990, p. 3).

Professional development schools in Vermont have grown most vigorously in districts that incorporated both graduate level study and teacher preparation as parts of their own school development plans. In retrospect, the existence of an active reform initiative in a school is the one prerequisite to the success of a PDS teacher preparation program. Each of the five professional development school relationships connected to this study includes a teacher preparation program for 6 to 15 interns each year; an ongoing School Development Institute in which teachers earn graduate credits and some development funding by completing school development projects for their districts; a “steering group” of school and university educators who meet regularly to set the reform agenda for professional development school activities; and numerous projects in school renewal supported by the partnership.

We chose to investigate change in five Vermont professional development schools because our experience supported the intuition that the dynamics of change in these schools could resemble the dynamics of change in any high school, but could move quickly enough to allow us to study the process of change. Professional development schools are school/university partnerships committed both to reform and to research on school change. By introducing college teachers and interns to the daily work of teaching and learning, a professional development school may speed the process of innovation in a high school. Such a school may provide a useful setting for qualitative research because partnerships increase the level of human energy available for classroom experimentation and also bring free professionals to conduct research. With increased energy invested in change, we expected to be able to detect the contribution of different elements of the educational system to innovations in teaching and learning.
Those innovations were our starting point. Because we chose to begin by describing successful classroom teaching oriented toward standards, we have very little to say in this study about how innovation fails. The five classroom experiments described in this study are all different, but each represents the evolving response of one high school to the challenge of improving learning against the Vermont Framework of Standards and Learning Opportunities. We have focused on successful adoption of standards in order to answer the question, How does change occur in the energized setting of a Vermont professional development school?

It is unlikely that professional development school relationships “cause” change in either institution. Instead, a professional development school creates conditions that support mutual renewal: increasing available energy as university people join teachers in the classroom, increasing collegiality as teams form to solve problems, and increasing continuity as shared projects take form and grow. At the most basic level, a professional development school adds human energy to schools usually strapped for extra hands. Released human energy can be applied to school development projects. While school-based interns are completing their requirements for a first teaching license, teams of professional teachers in a professional development school are also involved in their own school development course, conducting research over a full school year in support of school improvement (Clarke et al., 1998). The simultaneous activity of pre-service interns pursuing practicum assignments for their courses and professional teachers working together on problem-solving teams creates an enriched developmental setting that fosters adaptive growth. This study represents a team effort by five professional development schools to understand the process of reform in which they are engaged.

The Innovations

We selected one example of innovative teaching in each of the five professional development schools associated with the University of Vermont’s secondary education program. Each of our examples of successful change had been recognized within their
communities as an illustration of the school’s ability to adapt to the standards movement in Vermont. Four out of five of the innovations we studied preceded the Vermont Framework by 5 to 10 years, yet each innovation represents one school’s attempt to move toward standards-based education. We set out to map the interactions among members of these school communities occurring over the six-year period in which the Vermont Framework of Standards and Learning Opportunities was developed and passed into law. What relationships among different levels of school organization supported the emergence of standards-based teaching and learning in reform-oriented high schools?

We chose each of the innovations described in chapters 3 through 7 primarily because they demonstrated that high school teaching can, indeed, change dramatically. Each project we describe has become an exemplar of standards-based design, at least within its own community. In four of five schools, the innovation selected represents a choice from a fairly wide field of innovative practices. Where choices were possible, we chose to study teaching innovations that seemed durable, that had achieved wide recognition within the community, and that represented a point of origin in a conventional subject area. Examples follow.

The “100 Acre” Unit at Otter Valley High School began as a Social Studies course on Vermont geography. However, it expanded into a student-directed investigation of culture, geology, population, economics, and political process carried out by individual students developing land-use plans for “100 acres” of Vermont.

The Imaging Lab at South Burlington High School began as an English course. It grew into courses on advertising and media design, and it then emerged as a full-scale image design laboratory in which students produce media for community organizations.

The Global Perspectives course at Essex High School began as a world history class. It later merged with an English course to become a multi-disciplinary class built around student performance and assessment standards.
Personal learning plans at Montpelier High School began as an effort to provide experiential service learning for some high school students. It eventually expanded into a program of individualized learning for all Montpelier students.

The “Physics War” at Mount Abraham High School began as a unit on Newton’s laws of motion. When it expanded into a simulation of “global armed aggression” on the athletic fields, it included studies of mathematics, world population, history, and geography, influencing the school’s movement toward standards-based portfolios.

While we focused first on each project as an instructional innovation, something new in high school teaching and learning, our main purpose was to identify the processes by which the projects came into being and oriented themselves toward common standards. Innovation, in this study, refers to an approach to teaching and learning under active development in a school during the period from 1992 to 1997.

Interviews and Observations

As a collective research effort by five professional development schools, this project set out to answer one main question: How does an innovation take hold and spread in an active professional development school? Following a qualitative research design, we conducted observations and interviews with individuals who were active in leading and supporting roles in one innovation. We asked the same questions at each of the five Vermont professional development schools:

What is the nature of the innovation?

Responses produced a description of teaching and learning at its current level of development.

Where did it come from?

Responses produced a narrative map of growth for each innovation from multiple origins to the current state.
How do innovations emerge and sustain themselves?

Responses led to the creation of a systems map of the process by which school and university resources interact to support adaptation.

What processes appear to support self-organizing growth?

This produced an explanation of how aspects of a professional development school contribute to continuous renewal.

Each of the descriptive chapters that follow are organized around these four questions. Each innovation profile (chapters 3 through 7) begins with a detailed description, explains the story of how the innovation evolved, presents an analysis of effort at five levels of the organization, and ends with an interpretive section in which the researcher uses the data to explain how change may occur in a high school setting.

The Subjective “We”

Each of the authors of this publication is a site coordinator in one of the five professional development schools described in this study. In a small, rural state such as ours, it is difficult to claim to be unbiased. Working in our professional development schools on a weekly basis, we have become advocates for each of them. Most of us have been active in our schools, as well as in the Vermont reform initiative, throughout the entire period under study. As participant observers, we do not try to profess objectivity. Instead, we demonstrate that our involvement in the schools has given us a thorough knowledge of the stories we set out to tell, with daily access to all of the protagonists. As teachers much closer to the end than to the beginning of our careers, we share a greater interest in reflection than prediction. As practitioners of collaborative change, we are reporting collaborative research. We set out with deep personal interest to find and tell the story of change in our particular
schools so that we can make sense of the story in a way that may benefit others as well as ourselves. What allows change to take root and grow in the energized context of an active professional development school?

**Structure**

In a small and largely poor rural state, no educator can subsist within a single role. In developing the professional development school structure, we have determined that having both an inside coordinator, paid largely by the school, and an outside coordinator, paid mostly by the university, is beneficial. As participant/observers, three of us are outside professional development school coordinators, primarily affiliated with the University of Vermont. Two others are inside coordinators, primarily associated with schools, working part time as adjunct faculty members for the university. Another former principal consults nationally while teaching graduate courses. Five of us have completed our doctoral degrees; two of us remain Ed.D. candidates at the university. Each of us serves in multiple roles that change as situations demand.

**Essex High School.** Clint Erb and Brian Nelligan make up the site coordinator team for Essex High School in Essex Junction, Vermont. Clint is an associate professor at UVM with a specialty in mathematics education. Brian, chairperson of the Essex High School Social Studies Department, will complete his doctorate shortly; he also conducts courses and workshops in 4MAT (McCarthy, 1993) throughout the state and region.

**Montpelier High School.** David Gibson serves as curriculum coordinator and consultant on change at Montpelier High School. He is also a consultant for the Vermont Institute for Science, Mathematics and Technology (VISMT), an organization funded by the NSF to support improvement in teaching and learning, particularly in mathematics, science, and technology.
Mount Abraham High School. Mary Sullivan was an English teacher and middle school team leader at Mount Abraham until she joined the UVM doctoral program last year and took up the site coordinator role at her old school. When not working with her faculty and interns, Mary consults with schools around the state on portfolio development and standards-based instruction at the middle-school level.

South Burlington High School. Janet Bossange has been site coordinator for four years, before and after completing her doctorate in leadership at UVM. In addition to keeping her hand in the arts, Janet has developed professional development programs in several districts, including a teacher-leadership M.Ed. at Middlebury and a middle-level program at her professional development school in South Burlington.

Otter Valley High School. Carol Spencer has been a middle school principal in Middlebury and Shelburne, Vermont. Prior to joining the professional development schools team at Otter Valley, she taught high school and college level Spanish. When she is not with the Otter Valley faculty and interns, Carol directs a school-to-work transition program in Rutland County and consults widely on middle-level teaching and middle school organization.

John Clarke, Carol’s teammate at Otter Valley, is a former high school English teacher and current UVM professor who began working on the professional development school concept at South Burlington in 1984. Between 1985 and 1989, he developed a partnership at Champlain Union High School. He started the Essex Professional Development School in 1990 with Brian Nelligan and others. John served as research coordinator and general editor for this book.
Chapter 2

Mapping the Dynamics of Change

John Clarke and David Gibson

At our first meeting early in the fall of 1997, the research team began to worry that five separate studies of highly energetic classrooms might conclude with nothing more useful than high praise for the creative teachers—those whose drive allows innovations to emerge and thrive in any high school. Indeed, the teachers whose work forms the center of this study all have the look of inspired teachers—curious, creative, humorous, hard-working, and thoroughly committed to students. Would we end this study able to celebrate only the flair of a few charismatic individuals?

We were separately fascinated by the unique teaching innovations we had begun to describe, but those descriptions had no central theme, except perhaps in their emphasis on student performance and the standards movement in Vermont. Seeking an organizing structure, someone floated a question:

Can we use a visual modeling strategy to show the patterns of activity and the growth of the innovations we are going to document and describe?

We began to wonder whether we could create a kind of “moving picture” of the flow of energy inside a growing school. Could we coach ourselves through such an experimental inquiry method at the same time that we clearly articulated the stories of change? We agreed to ask key participants in each of the sites to tell us when and where significant events occurred and to talk to us about how those related to other events. Over the life of the project, we discovered that we could convert narrative information from these interviews into different kinds of visual representation—and that different representations could open different perspectives on change in the schools we were studying.
Our purpose in beginning this project was to represent, in a comprehensible form, some of the invisible forces at play during any sustained attempt to improve teaching and learning for high school students. Like most veteran teachers, we had developed the vague sense that successful change occurs when unpredictable events suddenly point toward an opportunity or problem we have ignored during the stress and tumult of daily work with students. Experienced educators learn to focus hard on the daily challenge of kids and content, while keeping some small part of their attention tuned to changes in the atmosphere that suddenly intervene to redirect the flow of human energy. The fire alarm may ring at any time. A voice on the intercom may announce an unexpected faculty meeting. A memo may be waiting in the mailbox describing the new testing schedule. The superintendent may list new priorities for the coming year. In a large and complex setting such as a high school, many different events are occurring all the time, making meaningful patterns hard to detect. Connections among these events probably exert a powerful influence on a school’s ability to sustain long-term change.

We suspected that educational innovations that survive daily tumult and continue to grow must be able to derive sustenance from unpredictable fluctuations in their surroundings. Classroom innovations that persist must be able to tap into some reliable source of sustaining energy or change their focus to attract new energy. Because schools have little access to external resources—and because learning is a thoroughly human enterprise—we suspected that the sustaining energy working across the school organization would have to be human energy. To teachers and school administrators locked away in their classrooms and offices, the flow of human energy moving throughout the school would remain invisible itself, but we should be able to perceive its influence in the work of innovating students and teachers. If we were to look closely at teaching innovations that survive and flourish over a period of years, we might be able to discover how change evolves in a high school setting.
As we listened to the stories of change in our five schools, the analytic grid shown in Figure 3 became the primary analytic protocol for converting interviews with actors in the change process to maps of human energy flow. The grid divides the school setting into five “layers” of organization, each of which may exert some influence on innovation in high school teaching. Presumably, influence at any level may affect student learning directly, or, more likely, change conditions in other layers in a manner that supports or restricts development. Each of the studies that follow this chapter describes interactions among these five levels:

**State and Federal Policy** – Initiatives launched at the level of government policy with the intention of driving change on behalf of standards

**School District Initiatives** – Efforts launched within the surrounding district, but not within the school itself, aiming to direct or support change in the direction of standards-based reform

**Systems Change** – Adaptations in the structure and processes of the school itself, including changes in the calendar, schedule, grading system, governance process, school leadership, or relationship with university partners

**Faculty Development** – Organized professional development preparing teachers to engage in reform; includes school-based institutes, school-based courses for credit, problem-solving teams, and individual inquiry carried out for a professional development plan

**The Student Experience** – Faculty interaction with students either in the classroom or in other settings, within the context of an “innovative program”
References to critical events during reform should appear in the stories told by our respondents. We could assign each event to one of our five “levels” of school organization. The pattern of events over six years might reveal patterns in the flow of human energy as reform matured. We began to believe that “systemic change” would have to engage all five levels, moving all in the direction of standards-based reform. Our strategy was to trace the flow of events across these organizational levels over a period of six years, looking for patterns of activities supporting successful school reform.
Simultaneous Timelines

As the researchers conducted their interviews and revised them to create a coherent “story,” John converted the stories into six-year timelines with the major events arranged in five organizational layers. In January 1998, about midway through our research, all of the project researchers met together again to see whether the stories were developing and to find out if the mapping techniques were helping to clarify the process of development. The meeting began with each site’s story and asked whether the first mapping of the timeline supported the story’s main features. The maps were messy. Horizontal lines showed where events started and ended, but a tangle of interconnecting lines stood for a variety of influences at a variety of levels of intensity, and they came and went like tracks in a poorly designed rail-yard.

Surprisingly, in spite of the tangles, someone drew a connection.

“Yes, that’s it. The story’s here. Back in 1992, this district was playing along with the state, while teachers were fighting over roles and responsibilities, and the two never intersected at all.”

The maps showed two clusters of activity, simultaneous but unconnected. “Parallel play,” said one researcher, “and it’s on the map as clear as day.” Presenting and discussing early versions of the timelines included in Appendix A produced simplified timelines that could tell different stories in the same graphic language.

We began our study with a detailed description of an instructional innovation that was receiving recognition within the school, hailed as an example of change in the direction of standards-based teaching. With full descriptions in view, we began to interview innovating teachers about different aspects of their projects, then expanded the interviews to include others in the school community. By interviewing other individuals who had appeared in the “stories” we heard from the innovating teachers, we aimed to assemble one coherent story connecting all the individuals and events described by different respondents. From the stories, we abstracted specific events that had played some part in the genesis of the innovation or in the development of related events. Then we assigned them
to one of the five levels of organization. Figure 4 is a hypothetical timeline map separating events from a “story” into simultaneous timelines at five levels.

The heavy horizontal timelines on our maps represent long-term events, such as a master’s degree program offered within the school for three years, and also short-term events, such as courses or workshops being held in a single month. Longer horizontal lines seem to indicate momentum, continuous pressure exerted by ongoing activity. Vertical arrows show how one event was said to influence another in the stories we assembled. Vertical arrows within a layer seem to indicate self-reinforcing interactions among simultaneous events. A vertical arrow pointing upwards and crossing an organizational line indicates a “bottom-up” influence, pressure at a lower level that forces a higher level to adapt. A vertical arrow crossing downward across an organizational boundary indicates “top-down” influence. At the policy level, the timeline of events that generated the Vermont Framework of Standards and Learning Opportunities is represented the same way on each map, augmented by other policy-level events mentioned in the narratives (Vermont Department of Education, 1996). Timeline maps for the five schools can be seen in Appendix A.

Phase Maps

Interpreting the revised timelines also required a visual method. Researchers stood by the overhead, explaining how certain events led to other events. Researcher John Clarke asked, “If you squint your eyes, do your stories seem to flow?” Everyone squinted at the timelines, reducing their numerous arrows and lines to clusters of connected activity. If someone wasn’t sure about their connections, he or she got up and started talking about the story line and making new ink marks on the overheads. As they talked, others remarked, “That part of the story isn’t on your map! Where does it go?” As a result, the maps evolved to reflect growing coherence in the narratives. With increasing coherence, the maps also began to show distinct phases in the process of development. Those phases were visible in clusters of vertical arrows, moving either up or down across organizational lines.
New superintendent puts emphasis on technology integration.

Grant funding from local high-tech businesses.

Technology partnership brings student interns.

Manual and guides designed.

State commissions technology study.

Technical standards developed.

Grant funding from local high-tech businesses.

New superintendent puts emphasis on technology integration.

Modified long-block schedule creates flexible time.

A/V specialist helps bring training to the school.

"Field trips" for faculty.

“Student internships”

Student teaching assistants.
We developed phase maps from timelines by circling clusters of vertical arrows that connected events within a period of time, identifying phases of activity within a narrative. Figure 5 illustrates that the hypothetical timeline from Figure 4 appears to represent four fairly distinct phases of activity.

Creating the phase maps in Appendix B required cycles of revision between John Clarke and the school researcher that ended when the researcher and respondents agreed that the phases were accurately described. If a gap was visible in a timeline, such as the gap in systems adaptation in Figure 5, we assumed that district initiatives and faculty development represented different phases, even though they were largely simultaneous. John converted timelines into phase maps and the researchers again checked the visual representations with our primary subjects to see whether participants would recognize the validity of our proposed phases. The maps evolved again, then stabilized into the forms that are included in Appendix B. We used the phases in these maps to organize the chapters of this book, explaining how change evolved within each of the schools.

In this hypothetical school story, we see that a new hire in the audio-visual department (see timeline item) represents the first substantial change that precipitates a related cluster of changes (identified by bubble cluster 2). This new specialist leads the school to increased funding sources and faculty training opportunities, as shown by vertical arrows in the diagram. As a result of the cluster of changes that emerge from the new hire and the school’s obtaining new sources of outside technology funding, other factors already in place, such as the block schedule, begin to show activities clustering around them (see bubble cluster 4). From this related sequence of clusters of change, we may gather that patterns of change—related to both timing and momentum—can be seen as a flow of activity over time and between levels of educational systems (see flow arrow in Figure 6). The timelines, phase maps, and flow charts are an attempt to capture these dynamics of change. Taken together, they offer a "snapshot" of change activity and show the influence of one factor upon the others; when clusters of related activities concentrate energy, they move change forward.
Figure 5
Hypothetical Phases of Change

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DOE creates $500 &quot;reward&quot;</td>
<td>Grant funding from local high-tech businesses</td>
<td>Technology partnership brings student interns</td>
<td>Technology team</td>
<td>&quot;Field trips&quot; for faculty</td>
<td>Student internships</td>
</tr>
<tr>
<td>State commissions technology study</td>
<td>Manual and guides designed</td>
<td>State formation of Technology in Education Committee</td>
<td>Math &amp; Writing Portfolio</td>
<td>New superintendent puts emphasis on technology integration</td>
<td>Student teaching assistants</td>
</tr>
<tr>
<td>Student teaching assistants</td>
<td>Technology integration in all classes</td>
<td>DOE creates $500 “reward&quot;</td>
<td>Board adopts Framework of Standards &amp; Lng Opps</td>
<td>New superintendent puts emphasis on technology integration</td>
<td>Student internships</td>
</tr>
<tr>
<td>District Development Initiatives: Priorities, Funding, Leadership</td>
<td>Systems Adaptation: UVM Partnership</td>
<td>State Policy Initiatives: Planning, Adoption</td>
<td>Faculty Development: Courses, Teams, Individuals</td>
<td>Student Experience: Project Design, Course Design, Student Learning</td>
<td>Student Perspective</td>
</tr>
<tr>
<td>State Education Commission Technology Study</td>
<td>Staff establishes standards for technology education</td>
<td>Technical standards developed</td>
<td>Modified long-block schedule creates flexible time</td>
<td>A/V specialist helps bring training to the school</td>
<td>Technology team</td>
</tr>
</tbody>
</table>

Hypothetical Phases of Change
**Flow Maps**

*When David Gibson got up to describe Montpelier’s phases of change, he put the Montpelier overhead on top of the Essex map. People thought he was just being funny, and it did look unreadable, except for one thing. “Look at this,” he said. “There’s a similar flow in these two stories at about the same time on the timeline. I hope we find more of these as we go along.” Indeed, patterns of coalescence repeated themselves on different maps, albeit at different times. Some patterns were repeated in different schools, but the more compelling interpretation was that the different maps represented the same wave pattern—at different intervals during the change process.*

By creating boundaries between the clusters of activity appearing in our phase maps, we created representations of the flow of human energy over the six years between 1992 and 1997. In our flow maps, the lightly shaded area indicates the parts of the organization that were active as change evolved, providing an estimate of “density” within the organization, the degree to which all layers were engaged in change at the time. We interpolated the dark arrow near the midpoint of the shaded area to represent the direction of energy flow across organizational lines.

Our purpose from the onset was to create a visible form for the invisible dynamics of change. To do so, we began to imagine that the human energy required for systemic reform would flow in any district among the five levels of school organization over a period of seven years, as represented in Figure 6. We assumed that change could begin at any level of the school organization, from the interests of students, located at the bottom of the charts, to state and federal initiatives located at the top of Figure 4. We also assumed that change starting at any level of the “system” would have to influence adjacent levels of the system in order to persist. That is, a faculty-engendered innovation that did not engage the students or entice other teachers to try similar techniques could not gather systemic momentum. In a similar way, new requirements developed by a district would fail if they ignored state initiatives or left conventional school structures in place. We imagined that systemic change could begin at any level, but the flow of human energy on the grid would eventually expand to involve all five levels at once—the whole system.
New superintendent puts emphasis on technology integration

Grant funding from local high-tech businesses

Technology partnership brings student interns

Manual and guides designed

State commissions technology study

DOE creates $500 "reward"

Board adopts Framework of Standards & Lng Opps

Staff establishes standards for technology education

A/V specialist helps bring training to the school

"Field trips" for faculty

Modified long-block schedule creates flexible time

Student internships

Student teaching assistants

Technology team

Technology integration in all classes

State Policy Initiatives:
Planning Adoption

District Development Initiatives:
Priorities Funding Leadership

Systems Adaptation:
UVM Partnership

Schedules, Curriculum Development

Faculty Development:
Courses Teams Individuals

Student Experience:
Project Design Course Design Student Learning

Student Perspective


Figure 6
Hypothetical Pattern of Energy Flow
Format for the School Studies

By collecting information separately but processing it collectively, we had devised a general strategy for discovering how some teaching innovations survive and flourish in a public high school. The chapters that follow derive their structure from these four phases of research.

Phase 1: Describing the innovation itself

By spending time in each of the classrooms that we had identified as having a major teaching innovation, we aimed to create detailed descriptions of what students and teachers were doing. If we assumed that each detail had a point of origin somewhere in the history of the project’s development, we would be able to use our detailed descriptions to regulate and guide our exploration of how the whole innovation came into being, one piece at a time. Each of the chapters that follow begins with a description of how students were learning in an innovative classroom.

Phase 2: Tracing the evolution of the innovation

By interviewing the main actors, we aimed to discover how different aspects of the innovation had come into being. We traced stories from the classroom out into the school community. Student interviews inspired questions for the teachers. The stories that teachers told led us to other teachers and to school administrators who had played a part. School leaders named district leaders or policymakers at the state and federal levels. We traced stories to other stories, aiming to assemble at last coherent narratives with few mysterious strings or gaps. Each of the chapters that follow includes a coherent story derived from many interviews about how an innovation evolved.
Phase 3: Linking critical events to related events

From the research and narratives, we abstracted specific events that our respondents had cited as important to the development of the innovation. Some events—such as the arrival of a new curriculum coordinator offering support for faculty ideas—played a direct role in a project’s development. Other events indirectly created the kind of context that would allow innovations to grow—for example, a school/university partnership bringing students and college teachers to campus. We “mapped” events mentioned in our interviews on the five-level grid in Figure 3, then connected events to each other, reflecting how our respondents had described the flow of influence from one event to another. The timeline maps for each school were confirmed with interviewees, then included in Appendix A.

Phase 4: Mapping the flow of human energy

We assumed that the events themselves would carry energy over time, from 1992 to 1997, and that they would also carry energy from one organizational level to another. We used the timeline maps to develop the maps of energy flow included in each of the following chapters, representing the general flow of effort over six years across the five “levels” of the school organization. The maps of energy flow gave us a way to model the change process in different schools. By comparing the maps and assessing ongoing school reform efforts in 1997, we began to develop general propositions about how change occurs in an active professional development school. Each chapter about change in one of our schools follows the pattern of these four phases, from a project description to a theoretical model of change, with our explanation of how change occurred.

We wrote the chapters in four recursive cycles. As we revised our chapters, John Clarke edited the drafts to increase coherence between maps and narratives and to introduce stylistic consistency among chapters. Each chapter, however, also focuses on a dominant theme distinctive to the change process within a particular school.
Later, in Chapter 8, we will return to the ways we processed the patterns of change in schools, using a second stage of analysis in which we looked for patterns of interaction between events that seemed to correlate with sustained systemic reform.
Chapter 3

Developing a Standards-based Geography Unit: Working Change from the Top

Carol Spencer

Members of the local Planning Board entered the room solemnly, arranged seating for the expected audience, checked the agenda, and shuffled papers. They asked to hear the first petitioner, who hoped to develop a family-owned site into a combined winter ski area and summer camping resort. In an effort to sweeten the pot of easements he would need from the town, he included plans to enlarge the town’s sewage system. Tension in the room increased as the petitioner answered questions, produced facts from extensive research, explained detailed maps of the proposed project, and patiently explained his multi-faceted plans to a skeptical board. After probing questions and much debate, the Planning Board approved all but one phase of the plan, affecting a river running through the property. Dissatisfied with the board’s decision, the petitioner promised to return with additional information.

As the bell rang, Ellie Davine’s class in Vermont geography came to an end for the day.
Davine, a social studies teacher at Otter Valley High School, and Bill Petrics, her university intern preparing to teach, designed and published an award-winning, standards-based unit in Vermont geography that blends an examination of physical and human geography with a wide-ranging exploration of Vermont’s current land-use issues. After creating a land-use plan for some patch of Vermont, each of their students must endure a culminating ‘hearing’ in which they demonstrate knowledge of land-use laws, geographic and physical dimensions of land in Vermont, and civil processes designed to ensure compatibility between individual land use and town regulations. Ellie and Bill set out to redesign their course on Vermont geography believing that they could involve even the most challenging students at Otter Valley High School by merging academic knowledge and skills with practical application to local problems. They designed and field-tested their course in a semester-long workshop sponsored by their school district, which invited them to design units of study based upon the Vermont Framework of Standards and Learning Opportunities. As they learned to use standards as a basis for their unit design, they began to focus their students’ learning, as well as their own teaching and assessment methods, on expectations for adult performance in their community. In addition to giving Ellie Davine and Bill Petrics a chance to teach and design cooperatively, the unit has become a model of standards-based design in the eyes of their high school colleagues and of educators statewide. Vermont’s state department of education has recognized “Vermont Geography” as a model of standards-based instruction and published the unit on a Web site available to all teachers (http://www.floodbrook.k12.vt.us/Units/UnitMenu.html).
Developing 100 Acres

In “Vermont Geography—Unit of Study Based on the Vermont Framework of Standards and Learning Opportunities,” students at Otter Valley Union High School “inherit” a parcel of land somewhere in Vermont, presented to them first as vague lines and colors on a topographic map. Their task is to complete a land-use hearing that determines whether they may use, develop, or preserve the land they receive, a task requiring a thorough analysis of the land as well as the area in which it is located. After nine weeks of studying their land in the context of physical and human geography, each student presents a land-use proposal to a mock planning board resembling the local boards that make planning decisions in Vermont towns. Then, as members of the planning board themselves, the students participate in evaluating other proposals. In its first and second years of implementation, every student in Ellie Davine’s and Bill Petrics’s classes—including many students with special needs—has completed and presented a land-use proposal.

Once the students receive their “inheritance,” the Vermont geography unit unfolds in three interrelated parts. The first part of the unit concentrates on basic geographical skills such as map reading and interpretation, with lessons on Vermont as a geographical place. During the next part of the unit, students research environmental factors to determine how Vermont’s climate, waterways and natural resources may influence the way land can be used. Finally, the students examine U.S. census data via the Internet, gathering data for the town or region where their parcel of land is located. What makes Vermont different from any other state? What makes the Vermont landscape unique? Who are the people who live here? Which developments “fit” the people and the region? Students seek answers to these questions from a variety of sources, including U.S. Geodetic Maps, maps of population density, and simple road maps. To prepare for their land-use hearing, they generate a portfolio of geographical information for their parcel and create a written land-use proposal. Understanding the geological past, including physiographic regions and
glaciation, lets them see how physical structures shape human activity—for the whole state and for their own “100 acres.” It also lets them see how human activity and geography shape each other.

Bill Petrics and Ellie Davine designed their unit so that they could assess student performance against the Vermont Framework of Standards and Learning Opportunities, a general guide for curriculum development that includes both content standards, called “fields of knowledge,” and general intellectual skills, called “vital results.” After considering academic and practical aspects of the unit’s content, they chose six standards to focus their design (see Figure 7). After choosing target standards, they designed the land-use simulation to lead students toward achieving these standards. The unit’s activities now show a decidedly constructivist pattern: a sequence of inquiry exercises helping students learn about Vermont geography, followed by doing geographic analysis, applying land-use principals, and finally creating a land-use proposal.

On the first day of the unit, each student received the unit overview included in Figure 7. Students then received notice of their inheritance, clipped from a topographic map, and began to generate a list of questions about their inherited land. After small groups presented their questions, the teachers related the student questions to the required “checklist of information” which had to be included in each student’s portfolio before he or she would be deemed ready to address the mock planning board with his/her land-use proposal at the end of the unit. As students began completing tasks leading to their final portfolio, Ellie and Bill showed them rubrics, tools that described the pathway to success for each major activity (see Figure 9). Setting a clear purpose early on and defining a clear process allowed students to work with increasing independence as they progressed through the unit.
### Figure 7
**Overview of Standards and Criteria**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students use geographical knowledge and images of varied places to understand the present, communicate historical interpretations, develop solutions for problems, and plan for the future.</td>
<td>• Understand present-day Vermont geography.</td>
</tr>
<tr>
<td>• Communicate how geography influenced Vermont history.</td>
<td>• Develop solutions to real Vermont land-use problems.</td>
</tr>
<tr>
<td>• Plan land use for Vermont’s future.</td>
<td></td>
</tr>
<tr>
<td>Students examine the interrelationships among physical earth processes, ecosystems, and human activity.</td>
<td>• Examine Vermont’s present land use by determining how the natural environment affects or has affected human activity.</td>
</tr>
<tr>
<td>Students analyze the nature of conflicts, how they have been or might be resolved, and how some have shaped the divisions at various times in the local community, Vermont, the United States, and the world.</td>
<td>• Analyze the outcome of land-use conflict in Vermont.</td>
</tr>
<tr>
<td>• Identify present-day land-use conflicts and determine how conflict resolution might shape Vermont’s land use in the future.</td>
<td></td>
</tr>
<tr>
<td>Students use verbal and nonverbal skills to express themselves effectively.</td>
<td>• Express effectively by verbal and nonverbal presentation a solution to a Vermont land-use problem.</td>
</tr>
<tr>
<td>Students use computers, telecommunications, and other tools of technology to research, gather information and ideas, and represent information and ideas accurately and appropriately.</td>
<td>• Research United States census data and any other electronically available data affecting land use in Vermont.</td>
</tr>
<tr>
<td>• Represent the data in written and verbal expression.</td>
<td></td>
</tr>
<tr>
<td>Students take an active role in their community.</td>
<td>• Take active role (participate) in a governing body (planning board) by listening to student presentations, asking appropriate questions, and making informed decisions.</td>
</tr>
<tr>
<td></td>
<td>Checklist for Geographic Portfolio</td>
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</tr>
<tr>
<td>1</td>
<td>Landform region</td>
</tr>
<tr>
<td>2</td>
<td>Topographical variations, including elevations, slope gradients, prominent physical features, unique or unusual landform</td>
</tr>
<tr>
<td>3</td>
<td>Proximity to lakes, rivers, streams (complete identification by name, size, length, and source — use of maps, tables, and graphs preferred)</td>
</tr>
<tr>
<td>4</td>
<td>Water shed or basin for the region</td>
</tr>
<tr>
<td>5</td>
<td>Source of potable water supply (quantity and quality)</td>
</tr>
<tr>
<td>6</td>
<td>Effects of glaciation</td>
</tr>
<tr>
<td>7</td>
<td>Geology (a complete inventory of all possible minerals)</td>
</tr>
<tr>
<td>8</td>
<td>Soil type and typical soil depth</td>
</tr>
<tr>
<td>9</td>
<td>Climate by season, including seasonal temperature and precipitation statistics, length of growing season (use of maps, tables, and graphs preferred)</td>
</tr>
<tr>
<td>10</td>
<td>Natural vegetation inventory</td>
</tr>
<tr>
<td>11</td>
<td>Wildlife inventory</td>
</tr>
<tr>
<td>12</td>
<td>Natural or man-made environmental hazards</td>
</tr>
<tr>
<td>13</td>
<td>Known environmental restrictions</td>
</tr>
<tr>
<td>14</td>
<td>Available forms of transportation and their proximity</td>
</tr>
<tr>
<td>15</td>
<td>Existing infrastructure (public water and sewer, bridges, schools, roads, etc.)</td>
</tr>
<tr>
<td>16</td>
<td>Closest energy source (distance and types)</td>
</tr>
<tr>
<td>17</td>
<td>Population density and size for the region and town</td>
</tr>
<tr>
<td>18</td>
<td>Ethnic, religious, and racial characteristics of region’s and town’s population</td>
</tr>
<tr>
<td>19</td>
<td>Educational characteristics of region’s and town’s population</td>
</tr>
<tr>
<td>20</td>
<td>Economic characteristics of region’s and town’s population</td>
</tr>
<tr>
<td>21</td>
<td>Age distribution for the region’s and town’s population</td>
</tr>
<tr>
<td>22</td>
<td>Household composition statistics for town and region (number of households with one adult and one child, etc.)</td>
</tr>
<tr>
<td>23</td>
<td>Agricultural characteristics of region’s and town’s farming operations</td>
</tr>
<tr>
<td>24</td>
<td>Commercial, industrial, and mining characteristics of the region’s and town’s businesses, industries, and extraction companies</td>
</tr>
<tr>
<td>25</td>
<td>Residential or housing characteristics of the region and town (single family, duplex, multi-family, etc.)</td>
</tr>
<tr>
<td>Criteria</td>
<td>1</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td>The proposal uses geographic information to reflect an understanding of Vermont geography.</td>
<td>No Vermont geographic information used.</td>
</tr>
<tr>
<td>The proposal develops solutions to Vermont land-use problems and plans for the future.</td>
<td>No solutions to a Vermont land-use problem are given, and no plan for future land use made.</td>
</tr>
<tr>
<td>The proposal communicates how geography influences existing land use.</td>
<td>No existing land uses given, and no reference to how geography affects land use.</td>
</tr>
<tr>
<td>The proposal examines, compares, and contrasts natural environment with human activity.</td>
<td>No reference to how the natural environment compares and contrasts with human activity.</td>
</tr>
<tr>
<td>The proposal analyzes how land use can cause human conflict.</td>
<td>No possible human conflict resulting from the land-use proposal given.</td>
</tr>
<tr>
<td>The proposal reflects the use of research into U.S. census, and effectively represents the information.</td>
<td>No U.S. census data researched or used in the proposal.</td>
</tr>
</tbody>
</table>
As each student began investigating a different plot of land, students knew increasingly more than either teacher about the specifics of the different parcels, and even the areas in which they were located. With expertise growing among students, the teachers and students swapped roles. Students explained issues related to their land, while teachers listened and asked questions. Ellie and Bill speculate that the individuality of each portfolio sparked students’ interest and motivation. While each portfolio had to answer the same questions, each student had unique problems to solve and unique information to analyze and prepare.

As individuals succeeded with different parts of their land-use portfolios, they developed roles as “experts” in the class, helping other students through the difficult or technical parts of preparing a proposal. “The focus is really on their parcel of land,” Ellie Davine explained. “But in the process of learning about their parcel of land, they’re learning about Vermont and its physiographic regions, about physical geography, human geography. By learning what’s already existing on their land, what’s around their land, why things are located where they are, they learn about Vermont.”

A wide variety of activities with different kinds of information engage different facets of student intelligences (Gardner, 1983)—reading and analyzing print materials; working with primary sources in map interpretation; land-use regulations; charting; graphing; measuring; and graphic design. Students complete impact studies and negotiate land-use restrictions and permits as required in Vermont law. They make oral presentations, participate on the planning board, and prepare written work for a skeptical “public” made up of other class members.

Both Ellie and Bill remarked to me on the enormous student interest in their work throughout the unit, as evidenced by high student attendance and productive class periods. They were motivated by owning land and doing something both ecological and profitable with it. One student exclaimed: “Are you kidding? This was important to me! It was mine.”
I had to do something great with it.” As Ellie explained, “We tried to focus on the skills which students can carry right along with them in their lives, along with the content. I want students to be able to read and interpret what they read, and to understand it, with an equal emphasis on any content they learn.” Bill Petrics said, “Students have seen that learning extends far beyond the 45-minute class. Students want this type of approach. I hope they will come to expect it.”

Since its first field test last year, when the Vermont geography unit was published on the Vermont State Department of Education’s Web site, called “Vee One,” teachers from other parts of the State have begun to call, make inquiries, and share ideas. The Vermont geography unit marks the beginning of a faculty’s transition to the use of standards as targets for student learning, and as a way to weave coherence into a fragmented curriculum.

The Standards-Based Unit Design Project

How was “Vermont Geography” transformed from a conventional geography course “covering” a wide array of geographical information to a standards-based unit based on student inquiry? In the fall of 1996, Bill Petrics had just begun his year-long teacher licensing program at Otter Valley Professional Development School when he picked up a mailing. It was about a unit design project being run by his school district, developing model units for the new Vermont Framework of Standards and Learning Opportunities (Cornell & Clarke, 1998). The purpose of the project was for teachers to develop, pilot, and revise a standards-based unit of study which, when completed, would be published and available in the district, along with the student work from the unit. An additional expectation of the project was that teachers who participated would also become resources for other Rutland Northeast Supervisory Union (RNE) teachers who wanted to learn about standards-based unit design. Bill Petrics knew that he would be required to develop standards-based units as part of his master’s and licensure program, whether or not he joined the project with his cooperating teacher.
He approached his cooperating teacher, Ellie Davine, to see if she would be interested in teaming up to write a unit together. He saw the invitation as an opportunity to deepen both his partnership with his mentoring teacher and his own learning in the teacher-prep program. “We had been told at our orientation for the UVM intern program that we would be required to design a standards-based unit for our portfolios. Then the notice came, and I realized I would get tutoring help and get paid $250.”

Ellie Davine, a conscientious and forward-looking social studies teacher, also knew that adaptation of her curriculum to the Vermont standards lay ahead. Still, it was the invitation from her new intern which prompted her to join the project. She had been a recent graduate of the University of Vermont’s teacher intern program herself, before becoming a mentoring teacher at Otter Valley Professional Development School. Working as a team with Bill Petrics could solve several problems at once. Ellie Davine and Bill Petrics then joined 17 teachers and teaching interns to meet with Nancy Cornell, the district curriculum coordinator, five times in the fall of 1996. Each teacher aimed to produce a packet of materials that could be useful to others, involving standards, performance tasks, rubrics, enabling activities, a teaching schedule, instructional resources, and examples of student work. Each team received a project-support stipend for completing and field-testing a unit, funded by a Goals 2000 Grant.

The design process emphasized four major changes in conventional high school teaching and learning. First, teachers were urged to design instruction to support student progress toward outcomes defined in the Vermont Framework of Standards and Learning Opportunities. Second, the standards-oriented design process focused on student performance, shifting class time away from teacher-talk and content memorization to hands-on activity with the content. Third, teachers developed assessment plans based on rubrics that students and teachers could use to check their progress toward the standards. Finally, teachers were urged to organize their units to guide students toward a culminating task, a
challenge that would bring all their knowledge and skills into play for personal and public evaluation.

Nancy Cornell explained the sessions:

_We had one meeting where we gave people an overview of the project and schedule, and an overview of the standards-based unit design model. Then we had another meeting, where we started going through the unit design step by step. I’d teach them a step, and then we’d talk about it, and they’d talk about it with each other. Sometimes they would work on pieces during our session. And when we got to the end of the steps, they went off with a big chunk of time in which to produce a first draft. They each had to meet once with someone else in our group to exchange feedback, and they had to meet once with me._

As a new teacher, Bill appreciated Nancy’s stepwise structure: “The design method that Nancy Cornell had developed followed a natural progression, and took us to the root of how to develop a unit based on these standards. Structure can stifle imagination. But for a beginner, the more structured course was perfect.”

For Ellie Davine, the defining event in the unit development process was taking it to the students for a field test. In Ellie’s words,

_Once you get this great unit on paper, and you think you’ve thought of everything, then you get into the classroom and start to present it to students and they look at you as if you were green. That’s a reality check. When you have 15 or 20 blank faces looking at you, you think, oh, well, we need to go back and do that a little differently._

During January’s field test, Ellie and Bill continued to design and refine their unit, conferring on the phone regularly and meeting after school. They were constantly assessing: “What did we do, how did it go, should we go on, should we go back? Should we do it differently? Did they get it?” They made adjustments all along, Ellie recalled.
Once the students had completed their land-use portfolio presentations, Ellie and Bill again revised the unit, adding more enabling activities, modifying ones they had included, and eliminating others. They refined their assessment tools, setting the rubrics to support improved learning. They got the unit ready to “publish,” within the district, through Nancy Cornell. The unit was finally complete in March. At the end, Ellie remembers:

*We knew the kids had learned something. We wanted to share it. We spent a whole day again, going over each page of the unit, and put it into publishable form, and finished it up and bound it. Come May first, which was the deadline, we handed it in. About a month later, Nancy told us about the state competition offering $500 for exemplary standards-based units. About six weeks later, we learned that we won the state program.*

**Designing Top-down Change**

With deliberate attention and effort between 1992 and 1997, different parts of the state, the university, the district, and the school aligned themselves to create an invitation innovation that would support the movement toward standards that would emerge in 1996 as *Framework of Standards and Learning Opportunities*. Appendix A includes the critical events (represented as horizontal lines) and influences among events (represented as vertical arrows) in the development process at Otter Valley from 1992 to 1997, derived from interviews with Ellie Davine and Bill Petrics, department chairs, university instructors, school administrators and district-level leaders. At Otter Valley Union High School, three years of intense interaction between the school district and state, followed by three more years of interaction between administrators, teachers, and students within the school, eventually yielded the emergence and dissemination of Otter Valley’s first standards-based units.

The story of the “Vermont Geography” course really began five years before Ellie and Bill started to design their unit—in the mind, heart, and offices of Nancy Cornell, director
of curriculum and assessment for the Rutland Northeast Supervisory Union. Working first at the policy level with district principals and later with Otter Valley’s teachers, Nancy Cornell carried standards-based unit design from its conception in national and state dialogues to its implementation at Otter Valley High School. She was actively engaged in the debate on Vermont’s core curriculum from 1992 to 1994, meeting with representatives of the New American Schools Project and discussing the Vermont Common Core of Learning as it developed in the state department of education. With Bill Mathis, her superintendent, and more than 30 Vermont educators, she had helped write a book on the processes of school change (Mathis, 1994). Together, she and Bill Mathis began to imagine a “great matrix in the sky,” linking Vermont’s standards to a performance-based curriculum for the district’s students. Working with teams of teachers and following examples of excellent teaching from the district, she developed a district-wide framework for guiding student performance called The Addison Northeast Learning Proficiencies (Cornell & Clarke, 1994). Finally, she applied for the Goals 2000 grant and developed the guides which provided support and coaching as the design teams began their work in 1995.

Nancy’s acceptance of “standards” as a basis for curriculum evolved gradually over a period of several years, largely as an effort to preserve the right and obligation of teachers to design curriculum that fit the needs of their own students. Ongoing work with university interns and yearly school development institutes kept school reform moving at Otter Valley. As Vermont’s standards gained form between 1992 and 1997, Nancy was active at all five levels of organization, trying to connect the idea of performance standards to teaching and learning in district classrooms.

During the six-year period from 1992 to 1997, a policy-level discussion between the district, state, and national organizations gradually expanded to include system administrators in the schools, faculty involved in professional development and, finally, students in Otter Valley classrooms. As the Otter Valley timeline in Appendix A shows, however,
moving standards-based design from concept to actuality began as a policy-level discussion that did not at first include engagement with existing systems, faculty development activities or the student experience. The three- to four-year gap between the Green Mountain Challenge and Nancy Cornell’s unit design project was a period necessary to the development of concrete strategies for implementation of new standards. It was also a tumultuous period in the Rutland Northeast Supervisory District, during which the school board enacted extensive budget cuts and imposed a contract on district teachers that severely reduced teacher participation in all non-teaching activities. In light of the struggle between teachers and the board during this period—visible in the three-year hiatus on interaction among systems, faculty development, and the student experience from 1992 to 1995—the timeline may best represent a re-ignition of district-wide development activity after a difficult interruption.
Phases in Top-Down Reform

The phase map for Otter Valley in Appendix B converts the events and influences of Otter Valley’s timelines into clusters representing four phases of change between 1992 and 1997 in the Rutland Northeast Supervisory Union, commonly known as the RNE.

**Phase 1: Policy deliberation**

District administrators carry on an energetic discussion with state leaders, their university partners and national leaders in school reform about higher standards for all students.

**Phase 2: Developing Structures and Processes**

The district superintendent, curriculum coordinator and university partners redesign curriculum structures to support standards-based teaching and learning.

**Phase 3: Course and Program Redesign**

Nancy Cornell begins the RNE unit design project with support from Goals 2000, while her university partners convert their own school-based courses to a format consistent with Vermont standards.

**Phase 4: Experiments in Teaching and Learning**

Teachers and their university interns design, field-test and revise standards-based units in the Otter Valley curriculum.

At the end of Phase 4, Otter Valley High School adopted a full-semester block scheduling format (the last professional development school to do so) in order to make time for performance-based learning and standards-based assessment within the school day.
Although the four phases in Appendix B have a clean, rational look, each phase was characterized by an intense struggle among alternative ideas, some of which remain in contention today. The struggle took place in dialogue among educators from the national level to the Otter Valley classrooms. As Figure 10 shows, however, the dialogue never crossed more than two or three levels of school organization at any time. During the first two phases, students and teachers remained largely unaware of how standards might affect their teaching. By 1997, standards-based units were developing in the social studies department, where teachers began talking about the project. However, consistent interaction between innovative teachers and governing systems (such as the district’s curriculum advisory committee) and between district development and policy formulation efforts within the school administration and board, was not evident. During the time of this study, an organizing vision never emerged to help all members of the school to see their own work in light of a common purpose. Systemic change at that point appeared to be a distant chance, with much work ahead with students, faculty, and school administrators.

**Phase 1: Policy deliberation**

During the first phase described in this study, Nancy Cornell and her superintendent, Bill Mathis, conducted lengthy interactions with state, university, and national educators to set the agenda for educational reform. This led to publication of the *Field Guide to Educational Renewal*, a book arguing vehemently for local empowerment (Mathis, 1994). At the same time that Nancy Cornell was working with Marge Sable of New American Schools to develop standards-based instruction, she was also working with her university partner, John Clarke, to engage teachers in locally controlled curriculum design (Cornell & Clarke, 1994). Top-down pressure from state and federal initiatives, colliding with bottom-up pressure from a financially strapped district, brought energy to the dialogue between local and regional educators.
The superintendent’s vision provided a stable platform for active innovation. “He was asking me for a ‘great matrix in the sky,’” Nancy explained, “making sense of all of the changes coming from the Frameworks, from the state and district assessments, and from other state-level education legislation. It was my job to explain all the pieces and find out how they fit together.” The struggle between local control and larger initiatives produced a compromise: a performance-based curriculum document based on locally designed standards. “RNE Proficiencies,” a document used with others gathered by the state department of education to develop Vermont’s “Common Core,” subsequently became an early precursor to the Vermont standards.

**Phase 2: Developing structures and processes**

Realigning a diffuse district curriculum with a completely new set of standards would require a simple but powerful design process appropriate for grades K–12. Nancy Cornell and John Clarke experimented with unit design guides derived from authentic pedagogy (Wiggins, 1992) before they began to integrate the RNE proficiencies. The unit design process at this phase consisted of a structure of focusing questions, organized to support student inquiry and lead to a final performance. One of their unit design guides included a briefly sketched example called “100 Acres,” which was included in the materials for Bill Petric’s school-based teaching methods courses. When Nancy completed the unit design guide for this project, she incorporated standards, focusing questions and culminating tasks as organizing features. The Vermont Framework of Standards and Learning Opportunities, now organized to describe general intellectual skills as well as content standards, formed the base of the unit design project, replacing the “RNE Proficiencies” in course design.
Phase 3: Course and program redesign

In Phase 3, Nancy Cornell and her university partners developed a format for school development institutes that organized faculty teams to solve problems in teaching and learning in their classrooms. The problem-solving format created a context in which teachers could treat unit design as a form of action research (Clarke et al, 1998). At the same time, John Clarke and Michael Dwyer, chair of social studies and a professional development school general methods instructor, redesigned the school-based courses for university interns so that they required standards-based unit design (Clarke et al, 1997). As pressure for statewide coherence mounted, the Vermont “standards” replaced the RNE Proficiencies in both school and university course development.

With the conflict between teachers and the board beginning to fade, Nancy Cornell added incentives to the assemblage of resources she had gathered. She wrote a Goals 2000 Grant to the State Department of Education, and proposed that the grant pay people $1,000 per unit to develop, test, and publish a unit. “My original thought was only to open it up to teachers in the District,” Nancy said. “John Clarke, our partner in the professional development school, asked, ‘How about letting the interns in?’ … We came up with the idea of letting interns in if they were paired up with teachers. I was worried about what the interaction would be like, with teachers and interns in the same room, sharing work and progress with each other. It was a risk.” As the relationship between Ellie and Bill demonstrates, the risk was worth taking.

The standards-based Unit Design Project provided a creative opportunity for Ellie Davine and Bill Petrics and for the other teams in the district. In a respectful, collegial atmosphere, experienced and new educators from all over the district, from elementary, middle and secondary levels, came together with a common task—building units with a common purpose. In addition to designing standards-based units, the teachers had a chance to collaborate with other teachers in the course—to share breakthroughs, reveal
new understandings, vent frustrations, and dispel confusion. Some were designing learning experiences for primary students, while others were working with high school students. Yet using a common language, discussing concerns, and raising questions gave each participant a sense of the power of the *Vermont Framework of Standards and Learning Opportunities* to create coherent curriculum for students as they traveled through the grades.

Nancy Cornell believes that winning the state-level award helped Ellie and Bill to fulfill the project’s last goal, dissemination. Ellie and Bill began to present their unit at conferences and workshops, gaining recognition for their accomplishment. Ellie and Bill received invitations from other social studies teachers to pair up and collaborate on unit design during the next school year. By June 1998, all of the Otter Valley social studies faculty and the school’s librarian had participated in the design and teaching of at least one standards-based unit. “We had a juried unit coming out of Otter Valley Union High School!” Nancy exclaimed. “There was great excitement. The superintendent was proud. So was the principal. The culture in this school is not to ‘strut your stuff.’ It’s to lay low. If you’re doing something really cool, just do it.” This time, the whole state was watching.

**Sustaining Top-down Change**

Currently, standards-based unit design is not an innovation which has been adopted system-wide, or even school-wide, at Otter Valley. The use of the *Vermont Framework of Standards and Learning Opportunities*, and a developing commitment to ensuring that all students achieve the standards, continue to be individual departmental commitments at Otter Valley. Figure 10 represents the general “shape” of change over six years in which a vague idea became a concrete experience for a few Otter Valley students and teachers. The case of Vermont Geography demonstrates that standards-based change is feasible at Otter Valley, not that it is likely to occur in the future without additional connections between
district policies, funding patterns, curriculum alignment, and professional development activities. Extending the success of Vermont Geography into other facets of school life remains a challenge in each of the five organizational levels represented in Figure 10.

As standards-based design was implemented at Otter Valley, it did not transform existing systems that support conventional practice. Block scheduling is now in place, but other important systemic factors work directly against the expansion of standards-based design in the practice of Otter Valley teachers. To accommodate a “tracked” curriculum, Otter Valley teachers have four classes to prepare, necessitating more course redesign than time will allow. Because teaching assignments change each semester, most teachers do not teach the same courses consecutively. Although colleagues do share resources on an informal basis, it has not become common practice for teachers in any department to use common units. Finally, there is the question of students’ efficacy. Since students at Otter Valley have limited exposure to inquiry-based learning, they would need extensive support in order to complete units such as “100 Acres” in all their courses. Because Ellie Davine and Bill Petrics teach a new group of students each semester, they have to “sell” standards-based learning to initially resistant students twice a year, sacrificing their ability to “cover” the existing curriculum.

Without a district-or school-wide initiative to move to a standards-based curriculum, there is little impetus at the present to spread standards-based design beyond these two teachers and the other individual teachers who have chosen to make this commitment. In fact, limiting factors in the environment at Otter Valley may slow down any change. The school has been through nearly 10 years of difficult and complex changes in leadership, some tight budget years in which faculty were reduced in force, and several years of hostile negotiations resulting in an imposed teacher contract. Each of these factors acts as a barrier to interaction across organizational lines, preventing individuals from seeing their separate work in light of a common vision for learning. It is an understatement to say that there is
Figure 10
Pattern of Energy Flow: Standards-based Unit Design at Otter Valley High School

State Policy Initiatives:
- Planning
- Adoption

District Development Initiatives:
- Priorities
- Funding
- Leadership

Systems Adaptation: UVM Partnership
- Schedules, Curriculum Development

Faculty Development:
- Courses
- Teams
- Individuals

Student Experience:
- Project Design
- Course Design
- Student Learning

Student Perspective


- Green Mountain Challenge
- Common core of learning
- Math & Writing Portfolio
- Vermont School Report implemented
- DOE creates $500 "reward"
- EEO Act 60

- New American school site (Marge Sable)
- Superintendent urges local curriculum plan: "Great matrix in the sky"
- Beliefs about learning: ANE proficiencies
- John puts 100 acres in A&B book

- Bill, John & Nancy develop book on school change
- Superintendent urges local curriculum plan: "Great matrix in the sky"
- Beliefs about learning: ANE proficiencies
- John & Nancy develop unit design guides

- Partnership established with UVM
- Interns join the Otter Valley faculty
- Goals 2000 unit design grant
- Nancy designs standards-based unit planning format

- Unit design teams form
- ANE unit design project - teams interact
- Problem-based SDI's
- Course assignment: EDSC 215
- Ellie (mentor) & Bill (intern) form team
- Ellie & Bill design and field-test 100 acres
- New teams form
- $1000 for design teams
- Interns design units
- Six teams publish units
- Interactions with colleagues
- Publication

- Implement unit
- Chem unit: Stochiometry
- New Civil War unit
- Bio unit: Wild turkeys
- Units from all Social Study faculty
- Student Learning
hesitance in the school culture about either top-down or bottom-up change. The professional attitude at the school is best characterized by rugged individualism. A principal new to the school, and new to the state, is now in place, as is a newly appointed director of curriculum.

One of the important constants at Otter Valley throughout the changes of recent years has been the presence of the University of Vermont. Teachers who have sought innovation and professional links outside of their own classes or department have found a willing partner in the UVM Professional Development School and steady support in the ongoing School Development Institutes. The university partnership has continually provided graduate course work to all teachers, and offered mentor and university teaching positions to most who wanted to help prepare new teachers. Clearly, the inclusion of interns in the original invitation to write and teach a standards-based unit was an important consideration for many project participants.

However, in the absence of systemic interactions across organizational lines, separate elements of the school organization cannot generate or solidify a comprehensive approach to standards-based teaching and learning. Many different belief systems about teaching and learning still mark conversations among educators at the school. Without district-wide or school-wide momentum, teachers at Otter Valley Union High School will retain an incomplete view of the Vermont Framework of Standards and Learning Opportunities; some have yet to “crack the cellophane” on the original document. University partners can work only in ways compatible with the existing professional development school culture. Unless energy and information begin to move across the lines of school organization, Otter Valley is likely to retain a traditional high school curriculum and remain fragmented in its approach to teaching and learning.

Although collaboration is not yet characteristic of school-level interactions, collaboration remains the key to school reform at Otter Valley. As the unit design project began,
collaboration among design team partners began to generate the energy required for long-term change. As Ellie commented, “To sit down by yourself and say, ‘This is a great idea’ is just not the same as saying it to another person, who may say back, ‘That is a great idea!…And, we could do it this way….’ For me, talking with Bill is what really worked.”

Lessons from Standards-based Design

What can we learn from the unit-design project that produced Vermont Geography at Otter Valley Union High School?

1. Mutual learning between students and teachers generates new energy for a reform initiative.

In the end, the learning that teachers see in their students’ daily work and culminating projects fuels their commitment to developing innovative instructional design. Listening to Bill and Ellie’s stories—watching their eyes shine with confidence and the pride of success—I recognized the mutuality of deep learning for students and teachers together. In Ellie Davine’s words, “Kids helping other kids turned out to be an important part of the unit, of the learning going on for all of us.”

2. Collaboration and colleagueship sustain innovative drive among teachers.

For Bill Petrics and Ellie Davine, the core motivator to continue building occurs through collaboration with one another, supported by the partnership between Otter Valley and the university. As Bill Petrics said,

You needed the energy of an intern. We pulled the teachers into it. I think the best units I saw, judged by final products, were the units that were developed with the interns and the teachers together. The high-quality program units I saw were developed with collaborative efforts. If you’re going to publish a unit for other people to use—when it’s being designed and developed and written—what better thing to have than a partner?
3. Respectful professional development elicits active problem solving.

The project designed by Nancy Cornell respected the professionals she invited to participate in the project, giving them control over the problem and the process of generating solutions. Clear planning steps with deadlines, recognition for hard work and accomplishment, coaching throughout the year, sharing work with other teachers from across the district, and confluence with the work of the professional development school partners empowered teachers to improve their own professional work.


As Ellie and Bill applauded the products that their students created during the unit, the Vermont Department of Education—as well as teachers attending their workshops—applauded Ellie and Bill for creating the structure that produced high-quality student work. When a common vision for learning is being born, celebrating examples of high-quality work transforms both the people who are learning and the vision they are fashioning from their shared work.
Chapter 4
Adapting to Learning Styles at Essex High School

Brian Nelligan and Clint Erb

At 7:40 a.m., 35 students filed into room C-235 at Essex High School for their interdisciplinary English and social studies class, “Global Perspectives.” The students, whose abilities range from below to slightly above grade level, were talking excitedly in small clusters; two were preparing to present a song about ancient Egypt that they had created. Kevin Martell was bantering with members of the girls’ cross-country team he would coach that afternoon. Sue Pasco, Kevin’s partner, was engrossed in a discussion with another student about missing work, offering to help that student to study for an upcoming test.

As the double-sized class entered the double-sized classroom (actually a converted lecture hall), students could see examples of their artwork all around the room: African masks, sculptures representing different religious perspectives, timelines of Rome’s demise. There were mobiles depicting stories of creation from several cultures, Venn Diagrams comparing Mesopotamia and Egypt, and various poems about life on the planet from 10,000 B.C. until today. Televisions, VCRs, computers, compact disc players, and tape recorders filled corners of the room as well, ready to challenge student theories with fresh facts or capture student exhibitions of their evolving theories. Most students in this daily, 84-minute class regard Global Perspectives as their favorite course, the one in which they can be most successful, and the one in which they feel they learn effectively. Global Perspectives uses themes to integrate subject areas and allows students to gather and present information in ways that fit their learning styles.
Synthesizing Personal Perspectives

Many students who excel in Global Perspectives, a two-credit class that meets every day, have not experienced academic success in conventional courses. Those who have a difficult time with history find that literature often helps them to understand it better. Conversely, the students who struggle with literature find that putting the story into an historical context helps them see relevance. The Global Perspectives classroom has become an inviting place where students not only are expected to learn, but are also encouraged to express their own views in a wide assortment of media.

Once class started, it became difficult to see where English ended and social studies began. On the day of our first visit, the students were trying to identify the essential characteristics of all civilizations. Sue Pasco had introduced *Lord of the Flies*, a novel that can be used to explain the start of civilizations, while Kevin Martell had chosen Egypt and Mesopotamia as examples of the organization of societies in the ancient world. We watched the students work with one another, becoming increasingly excited with what others in the class had come to believe about the same array of “facts.” Sue, who teaches English, and Kevin, who teaches social studies, have worked together for three years to ensure that students use both literature and history to answer a series of focusing questions about change in the human condition over thousands of years.

How do the characteristics of the societies of Egypt, Mesopotamia, and the fictitious civilization developed by stranded British boys in *Lord of the Flies* explain the origins and components of social organization? As part of their homework, each student had created a representation of the three-way synthesis in either a poem, a song, or a work of art. Some students had drawn pictures of an orderly ancient society in contrast to the chaos in *Lord of the Flies*; other students had created poems comparing life in ancient and modern societies. As a class, they worked in groups to synthesize information from all available sources, including their own representations, into a conceptual comparison of two cultures.
As Sue Pasco and Kevin Martell proceeded from group to group, they encouraged, questioned, challenged, and retaught useful concepts to small groups of students. As a teaching team, they give the groups freedom to speculate wildly, knowing that presenting their conclusions to a whole room full of people with different views sharpens the focus of deliberation and pushes the groups toward a coherent stand.

As the student presentations began, it was obvious students enjoyed the teaching role. As they presented and explained their graphic comparisons to the class, differences in interpretation also became evident. Because Global Perspectives asks students to represent what they understand in various media, each student can represent the same content from a personal point of view.

Though students construct their own answers to highly complex questions in Global Perspectives, Kevin and Sue do use lectures to prevent students from settling on facile or simplistic conclusions. When each group had explained its findings, Sue presented new information about *Lord of the Flies*, relating her lecture back to the student presentations, while Kevin provided historical context for the development of civilization in different settings. Students again responded with questions, exhibiting a level of concern that translated into active involvement. As this class period ended, students discussed the criteria for a future project, illustrating Greek culture as represented by a collection of ancient Greek writers. Sue and Kevin negotiated assessment criteria with the students, and by the time the bell rang, all students had agreed upon the rubric for the next project. Rubrics for each assignment help ensure that students will return with products that they can use to teach each other.

When interviewed, Kevin and Sue described their course as a meshing of world history and world literature. It includes art, music, language, and other areas not normally covered in the Essex curriculum, which divides content into conventional disciplinary categories. For example, most Essex students study Greek history in a Global History
course and Sophocles in an English course at a different time. The Perspectives class combines history and drama with Greek language, music, and culture, both past and present. The unit culminates with a Greek festival in which students make presentations on some aspects of Greek life. In Global Perspectives, learning is not measured only by grades, but by visible student representations of knowledge and by student satisfaction with their own responses to intellectual challenge. An explicit expectation of the course is that students will feel good about the learning they have represented in both the writing and in the media they choose for themselves.

**Evolution of Constructivist Teaching**

Several teams of social studies and English teachers have been developing Global Perspectives for more than seven years, revising it yearly so that students with different learning styles can use information from many disciplines to create a personal perspective on both history and modern life. Since 1993, the course has evolved continually, gradually reforming itself to fit a steady stream of information on constructivist teaching and learning that comes from many different sources. Appendix A represents simultaneous timelines for events supporting the evolution of Global Perspectives between 1992 and 1997, with vertical arrows representing the force of influence among different events.

The events in Appendix A constitute a sequence of six separate adaptations to some aspect of constructivist learning theory, each of which extended earlier innovations and further transformed the course:

1. Unit design based on learning styles
2. Cross-disciplinary team teaching
3. Cooperative learning groups
4 Thinking strategies instruction
5 Projects based in multiple intelligences
6 Performance assessment based on rubrics

Selected state standards were gradually assimilated. As the course evolved to reflect the teachers’ growing sense of constructivist theory, it also adapted to external pressures toward standards-based instruction.

1) Unit design based on learning styles. Teachers in social studies began using the 4-MAT program more than ten years ago as their department chair began attending 4-MAT workshops and experimenting with learning styles instruction (McCarthy, 1987; Boyle, Walsh and Nelligan, 1997). The 4-MAT method provides a structure that teachers can use to adapt classroom activities to fit the learning preferences of students in their classes. Teachers design units that activate prior knowledge, introduce information in different media, ask students to extend or model that information, and end with a unique expression of individual knowledge in writing and other media.

Kevin and Sue adapted 4-MAT to fit the thematic organization of Global Perspectives, helping students make connections across disciplines and across the span of time. In the 4-MAT cycle, students activate what they already know to begin each new unit, then connect their understanding to new knowledge introduced by their teachers. Since no two people have the same background or the same perception of their world, each unit begins with a wide assortment of beliefs and ideas. Sue and Kevin can use differences in initial perception to drive further questioning. In the last two quarters of the 4-MAT cycle, students integrate old and new knowledge in different expressive media. For example, the collage activity in Figure 11 allows students to connect current knowledge with prior knowledge while rewarding creativity, a powerful source of student motivation.
Due: __________________

The United States has borrowed many traditions from the culture of ancient Greece. The list of U.S. attributes that can be credited to the ancient Greeks is extensive. To explore some of the attributes adopted by our society, select ten of the greatest gifts the U.S. received from the ancient Greeks and then create a system of ranking them in a collage.

There are a few rules to keep in mind as you construct your collage:

1. Rank the ten gifts in order of greatest to tenth greatest. The rankings must be clear.
2. Do not rank them by placing them in exact order or by using a numerical/alphabetic system.
3. Incorporate a title for your work and your name into the collage.

Creativity is encouraged and will be rewarded.

2) Interdisciplinary team teaching. “What does it mean to be human?” Because Sue Pasco and Kevin Martell have different perspectives on the evolution of culture, their course is organized around questions rather than a preordained array of facts. Teaming a social studies teacher with an English teacher forced both to look for large themes and common questions addressed by both disciplines, creating a rich dialogue between the faculty and raising questions of interpretation that students would struggle to answer for themselves.
Kevin and Sue started working together with divergent philosophies of teaching. Sue believed that direct instruction was the way in which students learn best. She was highly organized and determined to maintain the intellectual rigor of her course. Kevin believed that group work was the way in which students learn best; he spent enormous time and effort designing a book of learning guides from prehistoric times to the present. He was less organized, worked one-on-one with many students, and tended to overlook details in favor of the big picture. Like the students in their classes, Kevin and Sue have different strengths that complement each other. Kevin creates, Sue organizes. Sue loves content, Kevin loves process. Kevin’s creativity is tempered by Sue’s pragmatic approach, while Sue’s utilitarian approach makes Kevin’s grand designs workable. Their stylistic differences have produced a course that responds to the needs of students who also have different styles of learning.

As much as they differ in style of approach, they share a common belief that the work of learning requires us all to reconcile opposites and to develop a balanced perspective. Their partnership succeeds because their different approaches serve a common belief in the value that each student brings to understanding the complexities of the human condition. The Global Perspectives team uses differences to drive inquiry rather than trying to convey uniform answers to all. As Sue explained, “I thought I would try it for a couple of years and then teach something else, but it gets better every year.”

3) Collaborative learning groups. Sue Pasco and Kevin Martell both used cooperative groups before they joined the Global Perspectives team, but cooperative learning now enables the class to teach itself. As they move around the 4-MAT cycle, students learn how to collaborate with one another and their teachers when preparing group presentations. It is through group process that learning becomes generative and that students become excited about sharing their products with others who think differently about the question under study. Sue and Kevin act as resource guides for their student groups during the
planning stages of each project or presentation. Since the students share responsibility for teaching the class, Kevin and Sue can avoid some of the power struggles that occur in didactic teaching. Group presentations grow increasingly sophisticated over the year, becoming celebrations of learning rather than shallow performances enacted only for grades.

4) A focus on thinking strategies. In 1992, a school-based university course on thinking skills introduced the idea that the content areas could be fertile ground for developing critical thinking strategies. Since 1992, the continuing presence of UVM interns enrolled in a cognitively-based reading course produced a steady flow of learning guides that students could use to assemble coherent answers to focusing questions. As interns entered the social studies department, Kevin Martell encouraged them to design new guides for critical thinking for use in his courses, a collection that now fills a large file cabinet near his desk.

Over the past seven years, Sue and Kevin have developed graphic organizers to help students manage information in different ways and form new ideas as they learn to manage information. Concept mapping, Venn Diagrams, causal charts, time lines, inductive towers, and other visual supports for learning focus group activity in the classroom (Clarke, 1990). After practice with their teachers’ graphic guides, students learn to design their own representations of the information they gather, displaying the results in unique patterns on all four walls of the classroom, a reminder to all that there are many ways to make sense of information. For example, students created a concept map on Greek science and philosophy as they looked for connections between knowledge and belief in the ancient world.

5) Instruction based on multiple intelligences. In the Global Perspectives class, students are taught about Gardner’s seven intelligences while investigating the earliest evidence of human culture. Each student identifies the intelligences they rely on the most,
as well as those that they have not yet developed. Thereafter, the teachers create assignments that challenge students to complete projects that reinforce their stronger intelligences and help develop their weaker intelligences (Gardner, 1983).

Kevin introduced the idea of multiple intelligences after he began his master’s degree program at Saint Michael’s College, one of two partner colleges in the Essex Professional Development School. Increasingly, as he completed his own courses and projects, learning projects that engage all seven of Howard Gardner’s intelligences became the foundation of activities organized into the 4-MAT cycle. Throughout the year, students create songs, dances, debates, and graphic organizers to represent their learning. They reflect, draw, write stories, and act, generating celebrations of learning for others to see. Integrated multiple intelligences instruction further increased the range of media in which students could learn and teach each other.

6) Performance assessment based on rubrics. As teacher licensing began to depend on Vermont’s Framework of Standards and Learning Opportunities, school-based courses for prospective teachers introduced assessment rubrics to the Essex curriculum. Student performance initially reflects their preferred learning styles. However, Kevin and Sue want all learners to stretch so that they are also able to present in the learning styles which they need to strengthen. The same may be said for multiple intelligences. By creating rubrics that define the assessment criteria for each project, the teachers are able to guide students through the use of unfamiliar media.

Since they are teaching to different learning styles, Kevin Martell and Sue Pasco find it necessary to use varied methods of assessment in each unit. Tests, journals, drawings, graphic organizers, and performances are examples of how students are assessed not only at the end of the unit, but throughout. The final assessment often celebrates the different views students bring to the subject. One celebration that concluded their study of Greek culture through literature was comprised of a Greek festival that included a Greek play,
student presentations on the Greek philosophers, Greek music, an appearance by Pericles, and a Greek banquet. While assessments reflect all of the learning styles, rubrics focus assessment on common standards for performance.

As the six constructivist teaching methods entered professional practice at Essex High School, role distinctions between students and teachers began to fade. In Global Perspectives, each person becomes both a student and a teacher. The focus of all activity in the classroom is learning, no matter who happens to be at the front of the room. Both Kevin and Sue enjoy teaching much more today than they did ten years ago. They are both learning from, as well as with, the students. Using constructivist learning theory to design and adapt instruction lets them watch students grow increasingly aware of how they learn and develop strategies for learning better.

**Phases of Change at Essex High School**

Between 1992 and 1997, change occurred at Essex High School in four phases (see Appendix B). As the phase chart demonstrates, innovation in the Global Perspectives class followed this path:

- Began with interactions between students and teachers in social studies and English classes
- Gathered strength from a change to block scheduling and a program of faculty development supported by the university partnership
- Solidified a place for itself in a new faculty governance structure developed by teachers and administrators
- Became locally self-generating in connection with further developments in multiple intelligences and standards-based curriculum design
Experimentation proliferated in many parts of school life during this period, supported by the connections between the school and local colleges. Although Global Perspectives now “fits” into an assemblage of related school development programs, such as the Freshman Collaborative and a school-wide focus on climate, change at Essex High School has not become “systemic” because no coherent vision inspires separate initiatives to coalesce into a self-organizing movement.

Essex created internal mechanisms that could support change, but it did not develop linkages outside the school which would change the “vision” that guides school governance. Innovation at Essex now occurs under the guidance of a faculty group and a principal who supports team-based school development, but it does not engage the whole school in pursuit of a common vision. Significant change has occurred as students and faculty have interacted in classrooms. Experimentation within the faculty forced the school to adopt a block schedule and reduce tracking, but they have not derived focus from the statewide reform initiative represented by Vermont’s Framework of Standards and Learning Opportunities. On the contrary, change in teaching and learning at Essex appears to be occurring in isolation from statewide reforms. Protected within the confines of the high school, Essex educators and their university partners developed a self-organizing system that could support experiments with constructivist teaching within the school. They adapted their internal systems to support existing innovations. They remained largely disengaged, however, from district and state initiatives that would force the whole school to reconsider its purposes. Change at Essex occurred in four phases in which experimentation between students and faculty opened the door to a wide range of faculty development activities, forcing internal systems to expand and adapt, separating the school from its surroundings but leaving the original mission intact (see Appendix B).
Phase 1: Linking classroom experimentation and faculty development

Classroom experimentation with constructivist teaching techniques began long before the period under study, driven largely by pioneer teachers who remained doggedly independent of external influence. A Great Ideas course in social studies provided a model of thematic teaching; an American Studies program introduced team teaching and extended block scheduling. Both were influenced by Brian Nelligan’s discovery of McCarthy’s 4-MAT method as well as his subsequent preparation as a 4-MAT trainer. When graduate courses and university interns brought courses on thinking strategies to the school, Kevin integrated thinking skills with his existing courses, then proposed the integrated course called Global Perspectives.

In 1989, the relationship between the University of Vermont and the high school was not going smoothly. In fact, because the influx of practice teachers and university students and professors disrupted the pattern of teaching and learning at Essex, they were on the brink of being excluded from involvement with the school altogether. Negotiations to resolve the problem between the high school and the university took place at both the district and school levels, resulting in a partnership between the university and the high school, aimed at improving learning for all students. Essex students and teachers worked with university students and teachers to create a new tutoring center, the “Brain Cell.” Essex High had become a professional development school with a single purpose shared by school and university partners, improved learning for all students (Clarke et al., 1995).

Phase 2: Linking the partnership to school restructuring

In Phase 2, the school/university partnership began to shift its attention from classroom innovation to school restructuring. With 42-minute periods giving way to block scheduling and subject-based courses fusing into integrated courses, the conventional structures organizing the school experienced pressure to change. School development institutes had helped the faculty to imagine a unifying purpose for their collective work,
which the principal then organized into cross-departmental “clusters” of teachers working on school improvement. When he asked a block scheduling committee to examine longer block options, the professional development school steering group helped arrange faculty development programming, including another round of school development institutes. In 1994, university interns joined the SDI block-scheduling team, conducting background research and presenting their findings to the whole faculty. The faculty vote for block scheduling on an alternate-day model passed with a 4:1 margin. The pattern of teaching and learning at Essex had begun to shift, forcing administration and faculty to organize themselves to support continuing change.

Phase 3: Linking faculty governance to faculty development

Armando Vilaseca became principal of Essex High School with the purpose of continuing his predecessor’s initiative in school change. He converted the cross-disciplinary “clusters” into smaller problem-solving teams. To accommodate a team-based approach to school improvement, the district director of curriculum and instruction, Steve Sanborn, joined the university site coordinator to redesign the school development institutes. Under the new format for the institutes, faculty teams of two to ten members would earn graduate credit for working together to solve a problem. The problem would focus on teaching and learning specifically related to the new block schedule. Working over a full school year, problem-based teams received funding from university tuition to support a planned program of action research (Clarke et al., 1998).

Simultaneously, Armando Vilaseca developed a new governance structure that allowed a faculty senate and faculty council to focus attention on school-wide improvement plans. Kevin and Sue, like other teaching teams, now have a common planning period to develop their courses. The PDS steering group took responsibility for monitoring the funds received by the school/university partnership: stipends received from the university for each intern, SDI funds returned to the school to support faculty projects, stipends for
adjunct professors teaching university courses, and some small grants from Goals 2000. Not coincidentally, the partnership suffered a loss of momentum during 1996–1997, visible in Figure 12. Existing accounting systems at that time proved unable to manage funds coming from university sources, and several thousand dollars in team-support was lost. The faculty senate, faculty council, and school climate committees then formed a management structure for school-wide development.

**Phase 4: Refocusing on performance standards**

Because interns are required to create standards-based units for their preparatory courses, their presence in classes at Essex influenced the Essex teachers to begin adopting Vermont standards and rubrics for assessment. Early in the partnership, interns began formulating unit plans for Kevin and Sue to use as part of the course guide Kevin was developing for his students. Interns take several teacher preparation courses at Essex High School, taught by university and Essex faculty, which require them to create unit plans based on Vermont standards. As a result of the partnership, a steady stream of standards-based units has been flowing into Essex classrooms, extending a performance-based curriculum into performance-based assessment. As they reflected on what was necessary for the success of their course, Sue Pasco and Kevin Martell pointed to administrative support from the principal, the guidance department, and department heads in English and social studies. This support resulted in a well-equipped classroom and permission to design their course creatively.

Global Perspectives has become greater than either the English course or the social studies courses from which it was formed. Since both Sue and Kevin believe that the program should never duplicate itself from year to year, they are always looking for new ideas, new ways to teach. Kevin Martell’s graduate program at Saint Michael’s College, university courses taught at the school, school development institutes, and a yearly supply of teaching interns hoping to field-test their standards-based units create more useful ideas
than they can accommodate. It is not uncommon for Kevin and Sue to have four partners working with them in their classroom: two interns, a practicum student, and a university professor. In a class where each person is a student and a teacher, everyone can get involved.

Having created a positive climate for learning among their own students, Sue and Kevin have also helped create a school climate in which continuous improvement is the norm. Essex High School began 1998 with a structure that could support internally managed change. Development of courses such as Global Perspectives had made it necessary to redesign systems and faculty development programming so that Essex teachers could participate in a school-wide change process. Reform in the Essex social studies department, however, has been influenced only indirectly by state and district initiatives. The district approach to school development has been intentionally “bottom-up,” shifting resources and responsibility to the school to support site-based management, and designing problem-based faculty development that is team-directed.

Climate Promoting Mutual Renewal

Change has not occurred coherently at Essex High School. Before 1992, change occurred when individual teachers made adaptations in their own classrooms. Kevin Martell, for example, began to create explicit standards for his classes before the Vermont Framework of Standards and Learning Opportunities was developed. Although change was occurring actively in Essex classrooms, the school had no way to connect teachers in ways that would result in school-wide instructional improvement. Like others, Kevin Martell and Sue Pasco were working to improve learning for their own students, but they had little exposure to school-wide needs. Few external influences permeated the boundaries of department and grade that were used to organize school programs. Without some engagement and support from outside the school itself, changes in learning, teaching, and faculty governance could improve school climate, but they could not generate sustaining momentum.
As Figure 12 shows, change at Essex began with energetic interactions between students and teachers in social studies and other subject areas, forming pockets of active experimentation within the school that were supported by a wide array of faculty development opportunities. Because these classroom experiments did not fit neatly into an eight-period day, the administration and university partners began to explore alternative block schedules. Block scheduling put pressure on the decision-making structure, forcing the faculty and administration to consider forms of school organization and governance overarching the conventional departmental structure. By 1996, the administration and faculty had assembled a school-wide council and senate, empowered to develop a school-based vision of teaching and learning. In mathematics, science, and English, the influence of state-level planning has been considerable. In social studies, where no high-stakes tests yet exist, SAT scores remain the only available target. Rather than joining the standards movement promoted by the state’s Department of Education, Essex consolidated control and influence within the school itself.

The potential for change at Essex existed in classroom-based experiments being conducted long before Essex teachers began to respond to the movement toward common standards. In 1992, however, there were no formal systems in place to ensure that a successful change process could occur. Early faculty development programs created a structure in which isolated experiments in teaching could become visible throughout the school and through which different innovations could begin to influence each other. Today governance systems exist to support teacher innovation. Also, flexible opportunities for faculty involvement have reduced faculty resistance to change. Both teachers and administrators are discovering that the quality of faculty-initiated proposals has significantly improved.

As Figure 12 shows, Essex teachers remain largely unconnected to the state-wide standards movement that began in 1992. It was not until UVM and Essex partners began experimenting with standards-based units that the classroom teacher began to be affected by the Vermont Department of Education. Change at Essex High can now occur in an
Figure 12
Pattern of Energy Flow: Adapting to Differences at Essex Junction High School

State Policy Initiatives:
- Planning
- Adoption

District Development Initiatives:
- Priorities
- Funding
- Leadership

Systems Adaptation:
- UVM Partnership

Faculty Development:
- Courses
- Teams
- Individuals

Student Experience:
- Project Design
- Course Design
- Student Learning

Student Perspective


Green Mountain Challenge

Common core of learning

Math & Writing Portfolio

Vermont School Report implemented

Board adopts Framework of Standards & Lng Opps

System-wide Focus Forums

School Development Institutes

Partnership develops problem-based SDI

P. Henry forms faculty clusters

Armando encourages team formation

PDS steering group forms

New governance structure: faculty senate and faculty council

2 x 2 block scheduling introduced

Block scheduling committees

School-based teacher preparation, with adjunct faculty: undergraduate

Faculty development workshops/courses; thinking skills, 4MAT

SDI teams form

Kevin’s MEd on multiple intelligences

Post-bacs contribute 4MAT, thinking skills, multiple intell. & standards-based units

American Studies course forms

Units designed in 4MAT structure

Performance-based assessment with multiple intell.

Mike designs interdisciplinary course: great ideas

UVM undergrads and Essex Honor Society create “brain cell” tutorial service

Sophomore global studies course

Kevin & Carol

Kevin & Sue

Post-bacs join PDS: courses on site

Faculty forms school-wide climate committee

New governance structure: faculty senate and faculty council

Kevin’s MEd on multiple intelligences

Post-bacs contribute 4MAT, thinking skills, multiple intell. & standards-based units

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Units designed in 4MAT structure

Performance-based assessment with multiple intell.
orderly manner, but it still responds more readily to local rather than state influence and lacks the coherence that would lend sustaining strength to a change initiative. What seems to be important is that systems are now in place that allow change to be examined, discussed, and acted upon by all the individuals at Essex who have an interest.

No doubt, the vast standards movement created an environment that favors the innovations that Essex put in place, but the Essex faculty created internal systems that could protect local innovation from direct influence. The governance system now in place creates a voice for Essex teachers, but it also tends to isolate the school from external influences at the state and district levels. Over six years, Essex High School developed a process for change based on the needs and potential of the whole school, rather than the needs of component parts or the talents of individual teachers. Kevin Martell and Sue Pasco do not see the state as an active partner in their innovation. The school district has actively developed curriculum, but Kevin and Sue have followed an eclectic national model for curriculum, based in constructivism rather than district guidelines.

The change process at Essex has been bottom-up—that is, teacher-initiated and teacher controlled. Essex teachers have based their change efforts on needs they recognize among their own students, rather than needs described for larger populations in the state. Perhaps because Essex teachers regarded earlier state initiatives as disruptive and divisive, the faculty at Essex consolidated control over teaching and learning within the school. By consolidating control within the school, Essex teachers preserved their ability to base change on needs and opportunities arising in Essex classrooms, fueled by the lively interaction between teachers and students. But they did not develop a vision for learning that would tie them to related efforts in other schools or the state. Without connection to district and state resources, their efforts may prove self-limiting.
As an early exercise, Tim Comolli challenges each student in his Imaging Lab to create a visual representation of the Tennyson quotation that hangs on the classroom wall. In his vision, the Imaging Lab is a place where students learn about technology while applying their new knowledge and skills to real work situations. Using state of the art computer animation equipment, his students produce advertising products for local businesses and public service organizations. He teaches three main courses in the lab: electronic arts, video production, and advertising. The Imaging Lab currently includes a large classroom equipped with more than 20 computers, office space, editing and storage rooms, and a television studio. After four years of development, the Imaging Lab has begun to transform both student and staff development at South Burlington High School. In it, students create personally meaningful projects while learning to work toward the high standards of performance described in the Vermont Framework of Standards and Learning Opportunities. Development of the lab helped clear the path for a technology curriculum based on standards in the South Burlington curriculum.
Learning in the Lab

On the early fall day of my first visit, the air conditioning that keeps the computers in the lab from overheating was on overdrive—and it was cold! The room was darkened so that the only light came from the multicolored computer screens and some well-placed track lighting. A student sitting at the computer across from me was shivering in his cotton T-shirt as he patiently used the mouse to drag the first part of a sentence into a cartoon. He moved each letter, one at a time, from standard sentence format to an invisible arch; it made the transferred words appear to flow out of a glass of blue water.

Early in the school year, students in the video production class learn to use the editing equipment to match selected sound tracks with prepared videos. The practice can be fun. For example, one student matched the facial expressions from Sesame Street characters with lyrics from a recent rap music selection. From early explorations with sophisticated machinery, the students move on to create actual commercials they can sell to local businesses.

For students such as Anthony, the Imaging Lab allows a childhood computer hobby to be retooled, earning money and respect (Baker, 1996). A first-year student in Tim’s advertising course, he is creating an animated art project on the Amiga computer using a program called D-Paint IV. He picked South Burlington High School over the local private high school solely because of the Imaging Lab and Mr. Comolli. “The private school doesn’t have anything that comes close to the exciting opportunities afforded students at South Burlington,” Anthony told me. “You really get to express yourself.” By expressing themselves and being heard and valued, SBHS students establish their identity and practice adult skills in an adult-like environment. Anthony’s goal is to learn about careers in animation, aiming for a future in a studio such as Disney.

All three courses are heavily subscribed by male students, but girls are taking notice, especially those who are interested in arts and entertainment careers. Nicole, a senior
preparing to enter a professional art school, enjoys the opportunity to enhance her two-dimensional art portfolio by adding works she is creating using the D-Paint program. Bridget is a video production student with three years of experience in the lab. She is combining a video script she wrote with skills she learned in public speaking to produce a video of commercial quality. As a student in the Imaging Lab, she sees a connection between her coursework and plans for becoming a television anchor. “Unlike other teachers,” she says, “Mr. Comolli understands the way we think and understands the gap between high school students and the adult world.”

Sometimes unpredictable effects come from engaging underachieving students, giving them self-respect and new goals and preparing them to recognize the next necessary phase of their education. Programs such as Alias/Wavefront’s Power Animator and SoftImage first captured Mike’s imagination, allowing him to find a place where he could become successful in school. He is completing a post-graduate year at the high school, taking some regular classes and serving as Mr. Comolli’s teaching assistant. Mike also runs the video camera during public speaking and assists with PowerPoint training for faculty and staff in the high school. He confessed that he had been a marginal student with personal problems when he discovered the Imaging Lab and found his niche. “Before I got in here, I didn’t have any direction. I thought school was a big joke. Now I realize this is what I want to do with my life. I want to be a computer programmer.” As Robert Pasco, Director of Guidance at South Burlington High School, explains, “Some kids relate better to machines than people. They use the medium of machines to have a close relationship with a faculty member. The Imaging Lab is one of the soft spots in our school where students can go and be nurtured. Once their skills are established, they go on to teach others.”

According to Darlene Worth, the South Burlington School District’s Director of Curriculum and Instruction, “Students from the Imaging lab, as teachers of teachers, have transformed the way staff development is delivered in our district. In 1992, one of the first
student-experts volunteered to help train teachers from several districts at a summer Professional Development Institute.” He then worked with the local university technology consultant to help teachers use electronic communication to share their professional work with other teacher groups across the state. Over one holiday break, Mr. Comolli and three of his students taught a workshop for district administrators on the use of presentation software, helping teachers and other participants prepare materials for classroom use. Comolli’s student-experts regularly teach their peers, community members, teachers, administrators, and university interns how to employ media technology in their daily work. In the Professional Development Partnership between the University of Vermont and the South Burlington School District, the Imaging Lab has sparked an increasingly intense discussion of how to connect high school teaching with student performance.

The history of the Imaging lab helps to explain how the development of one innovative program can shape events that affect an entire school community. When a vision matches a need, powerful things happen. According to Tim Comolli, the students look at him not as a teacher, but as their employer, in an environment that resembles little typically seen in today’s high schools. His influence now extends beyond his work with the students, helping other teachers find new ways to teach. Indeed, the success of this innovation is changing the image the members of this Vermont community have of technology. More flexible structures of work organization will be needed to achieve these goals for teachers and students.
Growth of Technology Innovation

An innovation cannot be separated from those who hold an idea in their mind’s eye for an extended period of time and who remain slightly off balance while engaging in an ongoing exchange of ideas and actions with other innovators. To understand how the Imaging Lab first emerged and then grew to shape South Burlington’s technology curriculum, I conducted interviews with the people in the system who had played a part in its development. Interviews with members of the South Burlington School District included Sheila Mable, chair of the English Department; Claire Buckley, head librarian; Ed Darling, English teacher; and Tim Comolli, English teacher and director of the Imaging Lab. Also interviewed were Bruce Chattman, superintendent; Darlene Worth, director of curriculum and instruction; Robert Pasco, director of guidance; Mike Simpson, assistant principal; and Tom Sargent, director of media services. Tim Comolli, Ed Darling, and Tom Sargent have been colleagues since the late 1960s. Their collective stories provide a vision of how multiple influences can flow together to expand a small idea into a school-wide curriculum initiative.

The time-line map in Appendix A includes the events between 1992 and 1997 mentioned as important during the interviews, connected by arrows that represent sources of influence among those events. At the heart of this innovation, as Robert Pasco observed, “…is the rebirth of an English teacher—how Tim Comolli revitalized his career by finding a special niche with students that is part social and part academic.” Tim has spent all of the last 33 years as a teacher at SBHS, first as an English teacher and then as director of the Imaging Lab. Before joining the faculty in 1965, he had worked as a disc jockey and production assistant with a local television station. He has recently been selected the high school’s Teacher of the Year. In the fall of 1997, he was honored again by Technology and Learning Magazine as Vermont’s Technology Teacher of the Year. Over the past 12 years, he has gradually transformed his early fascination with media into the Electronic Arts program at the high school. As others became involved in his work, the story expanded,
finding its most recent form in the new technology standards for South Burlington High School.

The Imaging Lab did not begin as an attempt to introduce technology into the curriculum. Instead, it evolved from a need for improved student writing in English courses. In 1968, a professor at the University of Vermont created a project, co-funded by Simmons Precision, that brought several area high schools together to discuss ways to improve the teaching of English. Components of the “The LaMancha Project” included writing, drama, and film. According to Ed Darling, it was the use of film that drew Tim Comolli to the project. “Back then, film making involved using 8mm film cameras. Once the films were made, the next challenge was to edit them. Eventually, video tape improved this process and allowed the students to learn more sophisticated editing techniques.”

“Prior to 1984, computers were not really used in the high school,” recalled Tom Sargent, now the director of media services in the district. “Then a course was offered to show teachers how to employ technology in their classes.” This introductory computer course was a big breakthrough for many teachers, especially Tim Comolli. Sargent continued:

Tim was a person intrigued with media, whether it was radio, TV, film, video, or computers. He was ready to explore any innovation that created an outlet for kids who had a bent for seeing their world projected in a studio on a screen or monitor. He was also willing to work on grants and partnerships to fund these innovative ideas and his life-long fascination with media.

Tom still works closely with Tim, teaching editing skills to the students in the Video Production class. All of Tim’s students receive training in the use of the editing equipment and video cameras. The lab’s wide screen capability is needed throughout the schools. Once the schools make something available and students and parents become interested, a small innovation can drive the budget and the demand for further change.
In 1984, Sheila Mable joined the English Department at South Burlington High School, soon becoming chair of the department. “As chair I received support from the school district superintendent and the high school principal to create a writing lab at the high school,” Mable explained. The Mac Lab was the first of its kind in the school, designed to support students and teachers in using word processing in their instruction of writing.” In 1988, Sheila organized a computer workshop for English teachers, and in 1991, the South Burlington District hosted a “Mac Academy” for neighboring districts. Mable continued these workshops and offered technical support each year to encourage and support the use of technology in the school by teachers and students. Included were Tim Comolli, members of the English department, the principal, and guidance counselors. Tim emerged as a technology leader among members of the English department and began to integrate more and more work with computers in his advertising and video productions courses.

By 1992, several students had become so adept in the Mac Lab that they were hired to train teachers in the use of word processing, desktop publishing, and other related technology activities. Craig Lussier was one of the students who assisted in that summer’s School Development Institute by helping a professor from the University of Vermont to get teachers working on the Wintemute system, a precursor to the Internet. The summer of 1992 also featured a Summer Technology Academy, leading a few more members of the school district to see that technology could have an increasing role to play in public education. At the high school and middle schools, technology committees were formed to support growth and to respond to the need for policies to support the changes rapidly occurring in the district.

Prior to the inauguration of the new Imaging Lab in 1994, Tim Comolli had been conducting his English/media classes in a community classroom in the library. According to Claire Buckley, the current school and community librarian, “Tim converted a small
room adjoining the community room into a little computer lab. This ‘closet’ space held about five personal computers which often overheated due to limited ventilation. With both Tim and the A/V director, Tom Sargent, occupying space in the library, the place became noisy and filled with non-library users—and many students anxious to check out Mr. C’s new lab.” Student interest kept the momentum going in terms of computer use in his English classes, spurring him to further develop three courses with clear emphasis on language in media.

As electronic arts, video production, and advertising courses gained popularity with students, Claire explained, traffic increased in the library and created space conflicts. There was a clear need for new space for the growing numbers of “techies.” Before long, there was an appeal to attach this request to plans for major capitol improvements in the whole district. Electronic Arts, the academic course first associated with the Media Lab, grew from one section in 1993 to three sections for the 1997–98 school year. At the same time, the library was going through its own technology renaissance, replacing the card catalog and Dewey system with online systems. The superintendent received a request for these additional resources to help move the Imaging Lab into a space that could serve all the students interested in the courses offered by Tim Comolli. In the fall of 1995, the new space was created for Comolli’s Imaging Lab, drawing students to this new area of the school.

Tim’s innovative lab is the result of his active pursuit of outside patrons. There is still no operating budget for the facility. Ninety-five percent of the funds used to create the lab came from gifts, grants, and the sale of student-produced videos. In 1994, Tim Comolli, Sheila Mable, Mike Simpson, and others received a Road Ahead Grant from Microsoft and the National Education Association. This was a major turning point for the Imaging Lab facility. Superintendent Bruce Chattman also traveled to Seattle with the lab team to speak about the work being done in South Burlington through the Road Ahead Grant. As the
district’s leader, he tried to model a positive attitude toward technology in public as well as in his own day-to-day work. Bill Gates also donated $3 million to a nationwide initiative to reach traditionally underserved students, ensure equal community access to new technology, and use these tools across disciplines to tackle problems (NEA Today, 1996).

The Henderson Foundation also provided major funding to support the purchase of Silicon Graphics Workstation, enabling Tim and the students to have the state-of-the-art graphics equipment. When the lab began to operate in its new facility in the summer of 1995, local companies such as Hallam Associates and Resolutions of South Burlington gave financial assistance to Tim Comolli’s program at the high school. According to Tim, the Imaging Lab was then fully operational, with 13 workstations utilizing popular platforms for graphics and video. Within a span of only four years, it had become the premier high school graphics facility in the state. Comolli’s Imaging Lab had become a project that turned students into problem solvers and pushed learning far beyond the classroom walls. Tim has often been asked to present his work “on the road,” accompanied by SBHS students and their work.

In the summer of 1996, several of the students designed special effects as seen on TV, using specialized software packages. Three stars of the Imaging Lab were invited to join a local computer graphics company, Polhemus, at its national trade show in New Orleans, presenting their work in animation with professionals in the field. Polhemus gave the three students space to share their work. “We are in a unique position to be able to help with this program and are proud to do so,” said Polhemus president Philip G. Cooper. “Not only does it highlight our technology, but it could also stimulate the development of these young people into accomplished professionals in a rapidly growing industry.”

More and more careers are evolving that require the skills SBHS students develop in the media courses offered at the Imaging Lab. The current technology boom is forcing all learners to become proficient with computers, with their spin-off tools, and with the
Internet. As the technology boom continues, Tim’s students are strengthening their connection to the external world. They know they have something special going for them. David, a first-year student explained, “I appreciate that we have all this great equipment. My dream is to create a new software idea and sell it to Microsoft.”

Phases in the Change Process

The Imaging Lab and similar projects provided much of the impetus for school-wide technology standards instituted for all school courses in 1997. How did this occur at South Burlington High School? Teachers such as Sheila Mable and Ed Darling became lab supporters, first because they were committed to improved English writing and publication, and then because they were attracted by the promise of technology. Collaboration with a business partner is a theme throughout the history of this technology innovation. Whether it was Simmons Precision or Microsoft’s Road Ahead Grant, the program at South Burlington owes as much of its growth to outsiders as to local partners such as the town Recreation Department and teachers in the district who wanted to get involved. On at least two occasions prior to 1992, the University of Vermont had a pivotal role in advancing the innovation from one phase to another, first with the LaMancha Project in 1968, and again with the Mac Academy in 1991. External funding has helped the South Burlington School system enact its Strategic Plan for technology integration. Technology, business partnerships, and public relations funds from the business community support staff-development trainings, classes for students, and outreach programs for the community. The Imaging Lab also began to receive recognition through the local media and other innovators in graphics.

The major force throughout the period of innovation, however, is Tim Comolli. The Imaging Lab that began with one teacher and a select group of students soon provoked a discussion of the nature of teaching and learning in an Information Age that now includes
everyone in the school district. As standards-based instruction began to evolve in Vermont, models of improved instruction were needed that could illustrate the process of teaching to standards. The SBHS technology standards, designed by the technology committee, formed a bridge between the local initiative and the statewide standards movement. Thus, an unplanned interaction between a local initiative and a statewide reform effort has allowed policy and practice to grow together, strengthening as they merge. The “innovator as artist” can provide a starting point for systemic change.

**Phase of Technology Development at SBHS**

How did components of the “system” interact to support the movement toward systemic change? To obtain the Phase Map in Appendix B, we placed circles around clusters of events from the timeline, using the arrows to express influence among events, representing what appear to be four main phases of this change process.

**Phase 1: Student/faculty interaction.** Daily interaction of students and teachers creates energy for change.

**Phase 2: System adaptation and planning.** The change process becomes dynamic when the administration works to support the initiative as part of its technology plan.

**Phase 3: Expansion and recognition.** As system plans organize a district-wide technology initiative, students and teachers receive recognition and support.

**Phase 4: Merging with the standards movement.** State policy emerges to shelter innovations and align them with the statewide initiative.

Over six years, innovation between students and teachers at SBHS engendered curriculum change and systems adaptation allowing standards-based reform to continue in the high school.
**Phase 1: Energy from faculty/student interaction**

Tim began integrating technology with teaching in 1967, two years after beginning his job at SBHS. Just telling a story with words was not enough for him; he wanted pictures and sound bites as well. For the next 20 years, he and his students found that their shared love of technology carried them forward in their work. To enhance their vision, they expanded their productions as new machines were invented.

However, as Tim and his continuous cohort of “techies” tinkered with the future, what was once arcane knowledge slowly became the standard expectation for anyone wanting to design a presentation. As business and education turned to computers to design presentation materials, media courses were not just for a select few anymore. “Teaching,” says Tim Comolli, “has never been as exciting as it is now, and the invigoration comes from the students.” What started with a passion one teacher had for media was transformed into a nationally recognized program where students use state-of-the-art technology to design their own vision of the future.

In the Phase 1 cluster of events, faculty development programs provided a medium in which teachers interacted to build new ideas. The central purpose of faculty development during this period was not to promote technology, but to improve student writing through word processing and the Vermont Writing Program. Teachers and administrators used the early writing workshops for different purposes. However, the major aim was to train Vermont teachers to become writers, and thus, better teachers of writing. The participants in this program worked with well-known masters Donald Graves and Don Murray. Sheila Mable recalls that a number of staff members of the SBHS’s English Department participated in this program for several summers. The early connection with the Vermont Writing Program spurred the local school system to place a high value on writing, to make time to teach the writing process, and to look to new technologies to facilitate its application throughout the district. One such technology was desktop publishing.
French teacher Ann Sorrell saw technology as a way to connect her students with French-speaking students in France using e-mail. She received a Christa McAuliffe grant for her work. Sheila Mable saw technology as an aid in helping students become aware of their writing. Claire Buckley saw the growing technology as an invader of the space she needed for the library to expand. Steve Barner, a technology teacher, and Mike Simpson saw technology as a means to train teachers to become effective mentors for students. As more and more people became involved with technology, the insular work of the Imaging Lab received more attention. More attention led to new ideas for using technology and the need for the district to expand the program, making a technology-driven curriculum accessible to all students, not just the few who found their way to the Imaging Lab. “He grew as far as he could,” colleague Darlene Worth said of Tim Comolli, “but then he needed the district to support the equity issue.”

**Phase 2: System adaptations and formal planning**

As student/faculty interaction increased between 1993 and 1996, the school and its surrounding district experienced increasing pressure to adapt their systems and plan for the future. Increased pressure produced a long period of committee work, an intensified effort to improve funding, a surge in renovations and facility improvements, and increased interaction with federal and state agencies. SBHS joined New American Schools. It also linked with the Vermont Institute for Science, Math and Technology, and with the town’s Recreation Department. Finally, it helped form a countywide consortium for school improvement. At the same time, the school established its connection with the University of Vermont as a professional development school, stabilizing a relationship that had been steady but largely *ad hoc*. “I feel strongly that to make a change last, it must become part of the system,” Darlene Worth said. “Change can begin with the teacher, students, or the district, but you need the whole system to change to make it lasting.”
Superintendent Bruce Chattman feels it is important for the district to support change by providing faculty with access to resources. He began as superintendent in 1993, when the school budget was facing some major cuts and the district had no master plan. In 1993, he and the school administrators began looking for ways to respond to the call for more computers. With the district’s business manager on the team, they developed a plan for presentation to the school board. During the 1993–94 school year, the district developed and adopted its strategic plan, supported by a bond for increased capacity for technology, including facility upgrades that accommodated the Imaging Lab. Without district-wide planning, the technological innovations initiated by Tim Comolli and his colleagues would have starved. Mr. Chattman sees the technology bond in South Burlington, calling for access to technology for all, as another step toward educational equity.

The district developed a strategic plan, initiated yearly action planning, and formed steering committees for several school-based projects such as the Imaging Lab. By this point, Tim Comolli was hoping to receive release time to develop the lab. While this has not happened with district funds, Comolli continues to use grant funds to travel around the country talking about his innovative programs at SBHS.

Simultaneously, Bruce Chattman and the school administrators took steps to focus funding and engage the faculty in the process of integrating technology in all SBHS courses. In 1996, the district’s technology committee formed, charged with determining how collected funds were to be disbursed. Support for technology, which is also part of current teacher negotiations, includes major funding for conferences and workshops. Chattman believes, “The system’s support of teachers’ and students’ work provides recognition that their efforts are valued. When Donna Moyer, the high school principal, takes time to learn to use PowerPoint with one of Comolli’s proteges, it sends a powerful message to the whole community.”
Phase 3: Expansion and recognition

System adaptations led directly to a second period of energetic interaction between faculty and students at the high school, supported by more external funding than was available during the first phase of innovation, and accompanied by increased recognition across the country. A district technology aide has received funds from a “Change of Course” grant to train mentors to help others apply technology to curriculum. Ann Sorrell, the French teacher who had been experimenting for many years with student-to-student e-mail exchanges between France and South Burlington, now found her work part of a coherent school-wide effort. As Bruce Chattman explained, “These three teachers are in different corners of the school building. Their work represents unique adaptations to the changes brought to schools through the technology revolution. Ann’s work represents use and application of software, Tim’s represents the building of a hardware environment that allows students to create software applications, and Steve’s work provides increased training in technology for teachers.” Though formed largely in isolation, these three pieces now offer an organized and concrete image of diffused technology usage at the high school.

Achieving wide recognition for cutting-edge imaging has had a profound effect on student learning. As Clark Baker, another SBHS alumnus, reflected, “Because this form of art was new to everyone in the school, we all had to learn to work together to learn from and teach each other.”

Phase 4: Merging with the standards movement

While Tim Comolli, Ann Sorrell, and other pioneers were developing their craft, Vermont’s move toward standards also gained strength. The Vermont Common Core provided the basis for the Vermont Framework of Standards and Learning Opportunities, (Vermont Department of Education, 1996) a document that includes several technology-related standards and a strong emphasis on performance-based learning. SBHS
administration and leaders among the faculty were active in the process of exploring and developing standards for learning. During the first four years described in this study, however, standards-based design and technological integration existed as separate but parallel efforts. In Phase 4, the movement toward standards at the state level began to interact with technology standards at SBHS, guided largely by the work of teachers such as Sheila Mable and Tim Comolli. As Darlene Worth pointed out, “Technology is just one good way to deliver standards-based instruction.” The organizational changes supporting technological innovations in Phase 2 and the recognition students and faculty received in Phase 3 also created a context in which standards-based education could be developed—and systemic, self-organizing change could emerge.

As Figure 13 illustrates, change at South Burlington High School flowed from individuals through a planning process to the larger system. At SBHS, the Imaging Lab and related innovations originated from energy derived from a teacher, some students, and their mutual fascination with learning in a narrowly focused area. The Imaging Lab began with one innovative teacher’s efforts to respond to the needs of his students. His creative drive attracted the interest of other members of the faculty, then internal sponsors such as Sheila Mable, and finally the long line of external sponsors and funding agents who funded different variations of the same idea. As the innovation grew, it destabilized surrounding systems, underscoring the need for further innovation. Strategic and action planning established a process for change to gain support. Finally, systemic adaptations were brought into line with Vermont’s standards, which have been outlined in a document that promises to change the process of teaching and learning for all Vermont students. The confluence of these forces cannot be viewed as coincidence. Movement in a common direction occurs because related elements of the system are responding to the same conditions—the needs of students in an age of rapid change.
Figure 13
Pattern of Energy Flow: Integrating Technology at South Burlington High School


State Policy
Initiatives:
Planning Adoption

District
Development
Initiatives:
Priorities Funding Leadership

Systems
Adaptation:
UVM Partnership

Schedules, Curriculum
Development

Faculty
Development:
Courses Teams Individuals

Student
Experience:
Project Design Course Design Student Learning

Student
Perspective

Green Mountain Challenge
Common core of learning
Math & Writing Portfolio
VISMT School partnership
New American Schools
Strategic plan adopted
Vermont School Report implemented

State Policy Initiatives:
Planning Adoption

District Development Initiatives:
Priorities Funding Leadership

Systems Adaptation:
UVM Partnership

Schedules, Curriculum Development

Faculty Development:
Courses Teams Individuals

Student Experience:
Project Design Course Design Student Learning

Student Perspective

1. James Moffett, Sheila Ed do Vermont Writing Project
Sheila goes to New Am Schools, Phoenix & Indian Wells
Tim's Road Ahead grant
Alias wavefront funding

2. Bruce Ladeau supports tech
Tim in library with AV students, training faculty

3. Tim's students train faculty and others

4. Intern joins Tim
Tim opens imaging lab

Board adopts Framework of Standards & Lang Opps
EEO Act 60
CVEC Consortium forms
Mac Lab opens
Intern joins Tim

Dick Roy becomes Adjunct SBHS becomes PDS Steering Committee formed

Tuttle and Elem. join PDS

Vermont School Report implemented
district technology committee forms
district technology standards

Henderson funding community education

School renovations & tech. upgrades

Henderson Foundation course

National Geo. video

Students produce video, Road Ahead

Henderson Foundation course

Students receive award-New Orleans

Students to MA & NJ

Board adopts Framework of Standards & Lang Opps

EEO Act 60

CVEC Consortium forms

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Students produce video, Road Ahead

Henderson Foundation course

Students receive award-New Orleans

Students to MA & NJ
Pioneers and Partnerships

On the surface, it appears that at South Burlington High School, an innovative individual with unique interests interacted with A/V-crazed kids to create a model for school-wide technology well before its time. Below the surface, two more interesting forces were at work. First, the creative drive of many individuals was seeking expression; second, people who shared a general vision of the future were forming partnerships to support their own movement toward shared ideals. Dynamic creativity and systemic relationships are not easily paired. In the South Burlington case study, it seems unlikely that systemic change would have become a possibility without dynamic interaction between individual creativity and collective organization throughout the evolution of the Imaging Lab.

Tim and his first students were pioneers at the onset of a revolution, using technology to do things that no one else had done yet. Getting to the cutting edge did not happen quickly; it grew from a shared view of learning that evolved among the pioneers over time. Tim and his students began to see learning as work. They viewed work as expressive production and production as an authentic avenue to self-respect and self-efficacy. By creating excellent work, Tim and his students could gain self-esteem, a goal that cannot be achieved in isolation. Self-esteem is achieved through being valued by partners, such as Sheila Mable and staff from Polhemus, or the University of Vermont. Partnerships require organization, reliable arrangements bringing resources as well as recognition. Creative production requires an organized setting to the same extent that organization requires a valued product. Pioneers and partnerships thus coexist in uneasy symbiosis.

Reliable partners sustained the drive toward technology integration. Sheila Mable has played a developmental role as primary partner in all four phases of the innovation under study. During the first phases, she helped to introduce the Vermont Writing Program to SBHS and many other high schools in the Northeast, becoming an adjunct university instructor. As a member of the original technology committee, she helped to establish the Mac Lab, first as a way to improve writing and then as a vehicle for technological literacy.
During the first phase, she also became Tim Comolli’s sponsor, a department chair who dared support English courses related to advertising, video production, and later electronic arts. Two of the three special courses offered in the Imaging Lab still remain parts of the English department curriculum. During the second phase, Sheila invested her effort in the New American Schools Project, the nationally based organization that gave rise to the standards movement in Vermont and promoted strategic planning. She remained active in New American Schools through 1995, when she visited sites in Phoenix and Indian Wells. Sheila, who helped guide the professional development school as it came into existence, teaches university courses at SBHS. Currently Sheila, Tim, and other English teachers are adapting their curriculum to the Vermont Framework of Standards and Learning Opportunities, developing rubrics for assessing students in all areas of work, including work done in the Imaging Lab. Sheila continues to encourage Tim to attend national technology conferences and to present at them. Early on, she went with him. Now, she says, “There’s no stopping him!” The current Imaging Lab students are helping the English department to create their own Web page.

Much as an artist finds a patron, Tim Comolli sought and successfully found outsiders to share his vision for advancing learning for his students in the Imaging Lab. Sheila Mable represents the value of partnership to the same extent that Tim represents the force of individual creativity. The partnerships that supported the evolution of the Imaging Lab in South Burlington included ongoing relationships with students, colleagues, interns, businesses, community members, funding agents and the university. Partners in the SBHS innovation looked for and rewarded innovation and the use of new media for teaching. These same partners supported an environment of dialogue about best practices. Professional development schools support and encourage lifelong growth and development. The links made with partners create and strengthen an environment in which a community can think together about teaching and learning. Partners recognize and support innovations as “…points of departure or catalysts for change, rather than as things to be implemented” (Bennet and Rolheiser, 1990, p. 14).
In a complex human setting such as a school, there is no such thing as coincidence. Innovations occur or emerge in the interplay of subtle forces interacting throughout the school and the district. Wheatley (1994) observed that in organizations where innovations take place, “a capacity to respond with great flexibility to external and internal change is developed. Expertise, tasks, teams, and projects emerge in response to a need. When the need changes, so does the organizational structure” (p. 91). Through dialogue among partners, change becomes part of the fabric of a school culture. The Imaging Lab grew in response to service to students. At its earliest points, change is self-organizing and self-sustaining. Partners may share their ideas, not impose their ideas on one another. As the innovation becomes more energetic and more complex, it may reach out beyond its boundaries to engage the lives of others, increasing equity of access to new and vital resources. In this respect, systemic change responds to a mission that is recognized as global but must be implemented case by case.

Technology is a teaching tool and also an art form. As a teaching tool, computers allow students to deal with many variables related to a complex issue, forcing them to manage multifaceted relationships. Technology involves using communication skills effectively to carry on a cycle of dialogue, guiding a process of literacy that allows students to meet new criteria for knowledge and skill proficiency. Technology allows students to think in layers, to make learning interactive, and to express their own learning. In the Imaging Lab at South Burlington High School, technology is also an art. As such, technology has become the metaphor for change at SBHS, from its complex roots to its increasingly public expression. As Tim and his students “dipt into the future; far as the human eye can see; saw a vision of the world; and all the wonder that would be,” they succeeded in changing more than their own futures. As these pioneers and their partners found: “The real voyage of discovery consists not in seeking new landscapes, but in having new eyes” (Proust).
Chapter 6
Growing Toward Systemic Change: Developing Personal Learning Plans at Montpelier High School

David Gibson

In an era when lasting reform seems elusive to many, one school offers a glimpse into the messy process of growing a self-propelling program.

Carl and Nate are night and day. Nate is tall and fit, a respected member of classes and sports teams. Carl is small, shuffling through life with his head hanging just below shoulder line, eyes cast down. Nate is affable. Carl is hard to draw out in conversations or classes. Nate smiles. Carl smirks.

An enthusiastic and athletic twelfth-grade goalie for the Montpelier High School soccer team, Nate is not exactly the student teachers had in mind when the Community-Based Learning program first got started. They were thinking more of students like Carl, who has a tough time relating to classwork and doesn’t get involved with after-school sports and activities. Yet both boys seem equally motivated by their off-campus learning programs. “I never thought I’d be doing this with my free time,” says Nate, who reads to a small group, tutors one-on-one in math skills, helps plan group activities, and shares some of the responsibility of teaching in a first-grade classroom. “Who would have thought I’d be playing games and having fun with kids a third my age?”
And Carl isn’t simply grateful to get away from school during the hours he spends assisting an elderly man who can’t leave his home without major assistance. Even his Saturday mornings now include a home visit to his adopted grandparent, Charlie. “Some of my friends don’t get it,” says Carl. “They think I’m just wasting time sitting there quietly watching the clock. But Charlie needs me, you know—for food and medicine and stuff like that. Little things, but they matter.”

Nate and Carl are just two of about 150 students—one third of the pupils at Montpelier High School—who now take part each year in community-based learning. It was success with a few students in the program’s early days that built a foundation for the more systemic personal learning plan in place today. Now recognized nationally as “the Montpelier innovation,” the program offers individualized educational plans for all students, rooted in self-directed inquiry and supported by the district at all levels.

When it began in 1992, the Community-Based Learning (CBL) program was originally intended for about 20 students who needed alternative learning options. But before the first year was over, 70 students had become involved. That figure has since risen, creating upward pressure for systemic change and leading to the development of the more comprehensive and inclusive Personal Learning Plan (PLP) program that has superceded it. In the coming years, Montpelier High School will expand personalized learning to include independent studies, individualized reading and writing courses, and off-campus community service and career explorations, creating a wide array of learning options for all students.

What does it take to move a traditional public high school and its system of lockstep classes within a conventional schedule into such an innovative structure? It is a process of learning for everyone involved.
Growing Systemic Change

Current faculty development, school district initiatives, and state and federal policies are just some of the forces that help shape the climate of a school. The student experience, along with systems changes like the introduction of block scheduling or transfers in leadership, also influence a school’s capacity to function smoothly—and, thus, to maintain the status quo.

As researchers studying Montpelier’s rippling changes, our strategy was to trace the flow of events across these organizational levels over a period of six years, searching for patterns of activities that supported growing reform. Our goal was to create a visible form for the invisible dynamics of change. Using graphic images to chart the district’s fluctuations and innovations, we managed to create a kind of “moving picture” of the flow of energy inside Montpelier High School.

To get the full story of how community-based learning for a few students laid the groundwork for what was to eventually become personalized learning plans for all, we interviewed students, teachers, and administrators in the high school and district. Most had played a part in implementing either or both the CBL and PLP plans.

Figure 16 includes timelines of events that were regarded as influential by at least three people interviewed, with connecting arrows indicating the exchange of influence between any two events. To aid in analysis, the timelines have been separated into five levels, each representing one of the major spheres of influence in and around Montpelier High School. To ensure the accuracy of this representation, I double-checked drafts of Figure 16 with others at the school in a second round of interviews, adjusting times, events, people, and sources of influence to fit an emerging picture of the events connected during the period of the PLP program’s development.
The resulting images were revealing. They showed that successful changes at Montpelier had actually survived and flourished in flashes of instability in the existing system, each of which created an “in” for further innovation. The implied lesson was that successful change occurs when unpredictable events suddenly connect and point toward an opportunity or problem typically ignored during the pressures and commotion of everyday classroom work. As the commitment of a few had turned into a program for all, people at every level had provided feedback and guidance that increased their own capacity to carry out innovation in an expanding framework.

**Roots of the CBL program**

The simultaneous timelines also illustrate how teachers at Montpelier High School have been developing their capacity for working with individual learning since the late 1980s. That was when the University of Vermont first became involved in the school’s development, helping staff to implement inclusionary practices in special education; for this a well-known, individualized planning process was used. Special educators at the university were strong advocates for personalized learning plans for all, and as a result, Montpelier teachers developed increased awareness and use of individual planning. In response to this initiative, the high school regrouped its faculty for problem-solving and personal support for individual students across disciplines; teachers integrated school-to-work strategies with academic programs and learned to make good use of specialists in teams conducting case management.

In the years between 1992 and 1997, thanks to the experimentation of a caring faculty, community-based learning blossomed into a program requested by practically all students. The innovation grew by word of mouth, from student to student, parent to parent, and the business community to the community agencies. This healthy upward pressure steadily built for a system-wide change. What began as an effort to engage reluctant students percolated up into a community vision, then became validated by district...
policy in a strategic plan, and finally returned in the form of a system-wide program for everyone.

**Connections beyond the classroom.** During the first year, an informal faculty group began to meet over lunch, practicing what they had learned at a conference about team-led innovations. They employed a new team-brainstorming method that helped organize their explorations and led them to imagine program changes. The group included staff in varying roles, among them Cary, a guidance counselor; Nerissa and Owen, school-to-work specialists; Glenna, a special education and work counselor; Bill, a social studies teacher; and Phyllis, the school media specialist.

Cary recalls, “I remember a group of us getting together and talking about ways to make school more relevant, and that’s when we developed the Mentor Program—trying to get adults in the community to mentor our students and trying to get them to help students see the relevance of what they were doing in school to the rest of the world.”

At first, the team’s desire to learn about alternative programs led them to seek outside information. Visits to other schools offered models. After considering the key issues for several months, the group decided that when students asked, “Why do I need to know this?” teachers at Montpelier High School should be able to show how learning connects to the world beyond their classrooms. Glenna counts the team’s decision to focus on this aspect as a seed of the innovation.

In the same span of time, the administration instituted a modified, long-block class schedule that extended class periods from 43 to 80 minutes on two days per week. The newly emerging Mentor Program joined a growing number of similar efforts that could clearly benefit from longer blocks of time. These included school-to-work internships, a weekly late-start day devoted to professional development, a program called Jobs-for-Vermont-Graduates, service learning field trips in social studies, and natural resource planning studies in science. The new schedule also put subtle pressure on the role of
faculty advising, which until then had been allotted only enough time for announcement-reading and attendance-taking. In retrospect, it became clear that early discussions about how to improve faculty advising and relationships with all students, aiming “to make better use” of the increased time, became an important factor in building the school’s commitment to personalize learning for all students.

Planning an internship

The fact that Nate had some unscheduled time due to the school’s new “long block” structure of class periods led him to seek out a member of the school’s CBL team. When he met with Bill Haines, a veteran social studies teacher and curriculum leader, Nate announced, “I’m interested in becoming a teacher, and I want to learn more about how schools work. What I can do?” Bill handed Nate an application form; plans for a CBL were accepted only after a lot of thought and effort were put into them. Then Bill contacted Lanie Nicholson at the elementary school, who said she would consider being Nate’s site coordinator. Thus began a three-way dialogue with Nate about goals and expectations. When could Nate come to the class? How long would he stay? Did he have any experience with younger children? What did he hope to learn from the internship? Several students had worked at the elementary school over the previous six years, providing Nate with useful information and easing the way toward setting up the placement.

A CBL internship couldn’t be fully established without a face-to-face conversation among the three main players: in this case, Nate, Bill and Mrs. Nicholson. Bill helped Nate to prepare. “We like to make sure the student knows that after the interview, he or she might decide against it, and that it’s okay to change your mind. We want Nate to question his fit with the site just as Lanie is judging his fit to her classroom. So they can both still say ‘yes’ or ‘no.’ We build in a ‘think-it-over’ period of a few days just to make sure everyone feels positive and secure about the plan. These experiences are a long-term commitment.”
At the interview, Nate was feeling good about his plan. “I was pretty sure about what I was going to say in the interview, but it was really different from what I expected,” he recalls. “Because Mrs. Nicholson and Mr. Haines had some thoughts too, and that changed what I was thinking. I’m glad I didn’t have to decide right then, because I might have said ‘no’ just out of fear of the unknown. I mean, how could I know ahead of time what I would think of as success?”

Together Nate, Bill, and Lanie settled on the timing and sequence of the primary facets of Nate’s CBL plan: experience, reflection, and evaluation (see Figure 14). They shared the plan with Nate’s parents, who, along with the key partners, signed off on an agreement to help Nate succeed.

“Goals and assessment are the hardest things,” says Bill Haines, “because even traditionally successful students like Nate just haven’t had many opportunities to plan learning experiences, to think about their goals, and to actually write things down which they will be held accountable for. Hopefully, as personal learning takes hold throughout the system, K–12, we’ll see students who have done this sort of thing a few times, who know themselves better, and who have tried out their wings long before their senior year.”

*Paths converging*

The intensified faculty interest in making learning relevant filled the city with students and teachers exploring experiential placements. “The MHS teachers,” says Nerissa, “were all bumping into each other and crossing paths downtown while trying to make placements.”

Glenna remembers the resulting desire for a cohesive plan. “With mentoring beginning, we looked at all these other small programs at the high school, and we saw that all of them had some community resources,” she says. “This started people thinking about how things might be coordinated.” At this point the school principal, also a member of the
Initial Idea

- Expression of interest by either a student or community member
- Application form for student planning
- Site development for a community organization

Development

- School supervisor either directly acts on community contacts or seeks assistance from the CBL team to develop community connections
- Placement possibility is found
- Interview with a site supervisor: student and school supervisor are present; student explores what he or she wants; site contact states expectations; a “think-it-over” period follows
- Student and school supervisor continue to work on a CBL contract and statement of learning opportunities and goals
- Decision is made
- Coordinator is recontacted to determine final arrangements and schedules

Experience

- Two to three weeks later, school supervisor makes contact with site coordinator to “see how it’s going”
- School supervisor visits site

Assessment of Learning

- As the marking quarter draws near, about eight weeks into the CBL, the student and site director assess the CBL using an evaluation form based on Vermont’s Framework of Standards
- A “pass/fail” mark is determined by the CBL team
team, helped support a team-planning event facilitated by the University of Vermont. It was during this summer experience that the Community-Based Learning program was born, with the formal goal of bringing order to the urge to involve students in active learning.

Individual learning by teachers also played a role in the growth of the innovation. During the same time the summer session was being developed, Glenna began taking an administration course at the university. As part of the class, she wrote a “Systems Change Plan,” designed to coordinate business, community, and educational partnerships at Montpelier High School. Her one-year plan became a report to the school board and helped define and focus the issues around the continuum of student services and the need for coordination between the school and the community.

Then in 1993, from the base established by special education grants and consultation, a professional development school (PDS) was incorporated at Montpelier High School. Part of a rising trend in teacher training and professional development of veteran educators, PDSs can be likened to teaching hospitals, in that they are intended to be centers of learning for those entering the field and also places where experienced practitioners can share their knowledge while being enriched by current research and theory.

In Montpelier, this development brought a cadre of interns in teaching, counseling, and social work to the school to earn licenses—a good match for such an innovating culture. As with the personal learning plan program, the professional development school was invented step by step. Year-long and semester-based programs were developed, through which interns experienced the work lives of teachers and followed the calendar of the high school rather than that of the university.

Advised and monitored by a team of teachers and administrators, the interns encountered a diversity of ideas about practically every aspect of the school. They were involved from the beginning in all of the ongoing committee work, placing them at the heart of
decision-making about new structures and programs like the learning plans. Research projects, required in their coursework, often helped to fill out or extend the action research projects of the experienced school staff. In this way, university faculty came to serve as informal advisors on all aspects of school change for both the interns and the school staff.

**Emergence of a new plan**

District-wide strategic planning began in 1993, providing students, faculty, and community members with a comprehensive framework for new ideas. The advent of new state standards and assessments, together with the still-new central office administration, led to a good opportunity for the community to reconsider its vision for education. “You are cordially invited to attend an evening session to discuss the future of the schools…” began a letter from Superintendent Brian O’Regan at the start of that school year, and more than 200 people showed up.

Most continued to attend for four months of evening study and planning sessions. People were divided into nine “action planning” teams, one for each of the major goals identified during a strategic planning summit with representatives of the community. Readings and discussions, arguments, agreements, and cost-to-benefit ratios fed the imaginations of the designers. Teams of lay people then stood in front of their community peers to present and defend their plans. From this process a five-year plan coalesced, bringing with it abundant energy and a high set of expectations from parents, students, and community leaders.

In the midst of celebrating the plan’s completion, many commented that nearly half the long-term actions in the final document supported personal learning. The focus on individualized learning was a remarkable commitment, but perhaps not a surprising one—given that many students like Nate and Carl, and their parents, were also the late-night designers of the long-range plan.
The blueprint asked that the school system provide sustained adult attention—a “navigator”—for each student, to assist with efforts to fulfill his or her aspirations and potential. The community designers also envisioned a coordinated K–12 program for personal planning and community learning opportunities. In this way, a new concept was born, at first dubbed “IEPs for all students”—borrowed from special education’s “individualized educational plans”—but soon to be renamed “personal learning plans.”

**Expanding team, expanding program**

During the first years of the strategic plan that began in 1994, the school district turned attention to high priority needs for teachers. These included developing standards, establishing a leadership team in standards-based teaching, and building the staff’s assessment skills and its ability to work in a system oriented toward improved student results.

Meanwhile, the community-based learning team at the high school kept working, offering hundreds of students off-campus learning opportunities. A new planning group formed to consider how to move forward with the personal learning plans. Its members, the PLP planners, attended a conference sponsored by the University of Vermont, the school’s ever-present partner, at which other schools showed how they were researching and developing variations on the theme of personal learning. This spurred CBL and PLP team members to form a nucleus which began to develop a vision of expanded possibilities.

A year later, in 1995, a larger team was formed. The PLP organizational team, which included students and community members as well as school staff, arose to carry the possibilities forward or, in the words of Owen, the group’s facilitator and cheerleader, to “plan and reorient the journey.” While the CBL team continued to help students with off-campus learning, the new PLP team was given status as a standing organizational committee of the school, on a par with groups handling curriculum and operations. As such, Owen became a member of the school’s management team, occupying the same level
as a curriculum area director. This legitimized the effort as a major program of the school. After more than a year of PLP design efforts, introductory sessions, and long open discussions by the staff, a whole-school program emerged.

**Need for protocol**

To stabilize the emergent innovation, the PLP organizational team published materials articulating the purposes, processes, and training issues which they had either invented or gathered as data from full staff meetings. More importantly, they designed and built the support structure for the program—policies and procedures for the use of time, arrangements of faculty into paired support teams, and development of multi-aged student advisory groups—which still sustains the innovation. According to Owen, the reasons for the plan’s success are clear. “Staff members became champions of the initiative,” he says. “Everyone in the group took on a leadership role at some level.” Each month the PLP organizational team trained the full staff, and its members created a manual that would be used for future staff communications.

During 1996 and 1997, extended weekly and monthly conversations took place between the PLP organizational team and the faculty as a whole. The team continued to carry out its roles as the faculty’s self-selected leadership group and as the design team for the personalized learning plans. With each interaction between team and faculty, energy and momentum grew, and the program design became increasingly fine-tuned to the strengths, interests, and needs of the faculty—a living model of the very process desired between students and teachers.

**Give and take**

By this point, the benefits of sending students out into the workplaces of the community had become clear.
When he first entered the elementary school to begin his internship, Nate felt a bit uneasy. He recalls wondering: “Am I ready for this? What am I going to do here? What have I got to offer?”

The classroom teacher, Mrs. Nichols, introduced him to the first-graders.”Children, this is Nate, who was a student in this school,” she said. “How many years ago, Nate?”

“Let’s see. Probably six or seven,” Nate mumbled, red-faced.

Giggling, shrugs—and wide-eyed faces that showed these youngsters couldn’t believe that from their little bodies such a big person could grow. Nate had expected to be a “big brother” for one student but soon all of the children requested him for their tutor. The children, too, had much to offer. They “adopted” him and made him feel that he was an essential part of their lives.

Three weeks into Nate’s internship, his advisor, Bill Haines, took time out of his regular teaching schedule to visit the elementary school. In one first-grade classroom, Nate juggled wool hats off the rack and tossed them, frisbee-style, onto the heads of the children standing in line for recess. Later, he morphed into a careful storyteller for the enthralled group of youngsters.

“I’ll never forget how the kids hung onto Nate. He was so big, sitting in those tiny chairs, reading the story. And you could tell he loved the attention. I think it reminded him that he used to be a big brother to a little one, too,” says Bill, noting that Nate’s sister Liz would be entering Montpelier High School the following year.

Within the month, Nate brought to the high school a sense of excitement that attracted others to working at the elementary school. By the end of his first semester, six fellow soccer team members had found their ways into the little ones’ classrooms. Some helping at recess, some helping at reading, all found ways to give of themselves.
In return, the teens had something tangible to show for their enjoyable work—passing grades in self-directed electives, an array of evidence showing important growth in personal communications skills, and journal entries that included reflections about teaching in the future. These students had also documented many work-related competencies: arriving on time, taking initiative, showing responsibility, and performing careful work.

Such varied learning experiences are at the heart of community-based learning, explains Glenna Copeland, who helped design the program. “When students without community-based learning experience walk downtown to and from school, they look at buildings and do not know what goes on inside,” she explains. “Their learning is at the school, in a separate building. With internships, students are put into the buildings. They learn what makes a community and they gain an increased sense of belonging.”

Moreover, the students must be interviewed, write weekly reactions to the experience in journals, and meet regularly as a group. Says Glenna: “They learn how to sell and pitch for themselves. They go somewhere. They learn about who they are. “

A different kind of success

Inasmuch as the structure of community-based learning reflects the structure of any self-directed learning experience, it is not so much a separate program as an integrating process. It helps to tie Nate’s learning experiences together for him around his interests. Further, academic subjects such as writing, math, and science can all become visibly part of his experiences within the community. When he works one-on-one helping a child to understand a fraction, for example, he practices and solidifies in his own mind why dividing by zero is not just “against the rules” in algebra. Through an opportunity to lead the youngsters’ daily science lesson, he becomes, for a time, an expert, a planner, and a communicator. In preparing his folio and documentation for evaluation, Nate writes from both academic and personal points of view as he attempts to answer the questions “What did I learn?” and “What did the experience mean to me?”
As part of Nate’s final reflection, Haines and Mrs. Nicholson join him at a public “roundtable,” where they talk about how the program worked for everyone involved. Nate rates himself on key standards related to his internship, completing both limited and open-ended responses on the assessment form shown in Figure 15, and then writes about his experience. Lanie discusses the ratings and participates in the assessment. Depending upon which he had selected at the outset, Nate may now receive either academic credit or recognition points for a school community service award for his permanent record.

Other questions help round out the picture of what has occurred. Would Nate recommend the experience to other students? Would the supervisor take another student in the future? Did the planning design and support work? Improved communications and problem-solving abilities—identified as vital student results in Vermont’s Framework of Standards and Learning Opportunities—are integral to success in community-based learning.

Looking back, Nate has found value in his elementary school experience from many perspectives. “The whole class surprised me on my last day,” he said. “They had found out a whole lot about me. They did a ‘This is Your Life’ skit that was too much! I was supposed to be done after that, but I just keep going back to see how they are doing, you know. And they keep writing me, so I stay in touch. It’s amazing how much they have changed since I first got there.”

Clearly, it is not only “they” who have changed in six short weeks, and growth can be measured in such moments. Nate’s insight—in a moment during which he might have been too busy and “successful” to notice in his traditional schedule—is that he needs others.

He explains: “I thought I was going to help them, but they taught me more.”
### CBL Assessment Rubric

**Student ___________________________________________________ Date _________________**

**Community Supervisor ______________________________________________________________**

**Learning Site _________________________________________________________________**

---

**To the student:** Please rate yourself on the following criteria and provide additional comments below. Tell what you will do to continue to improve in this area.

**To the community supervisor:** Please compare your ratings with the student’s on the following criteria, then have a talk with the student about both positive and negative differences.

**Rating:** 1 = Never, 2 = Seldom, 3 = Some, 4 = Usually, 5 = Always

<table>
<thead>
<tr>
<th><strong>Communication</strong></th>
<th><strong>Student Rating</strong></th>
<th><strong>Supervisor Rating</strong></th>
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</thead>
<tbody>
<tr>
<td>1. Listens attentively for directions</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Seeks new information when needed</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Makes needs and concerns known; states opinions</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Uses appropriate language</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
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<table>
<thead>
<tr>
<th><strong>Problem Solving</strong></th>
<th><strong>Student Rating</strong></th>
<th><strong>Supervisor Rating</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Shows initiative, openness, &amp; persistence in solving problems</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Asks questions to clarify and help with finding solutions</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Chooses and uses effective problem-solving methods</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Can apply math, writing, and creative approaches as needed</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
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<table>
<thead>
<tr>
<th><strong>Personal Development</strong></th>
<th><strong>Student Rating</strong></th>
<th><strong>Supervisor Rating</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Accepts constructive criticism</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Maintains a positive attitude</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Makes healthy choices</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Develops productive relationships</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. Demonstrates dependability and productivity</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
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<thead>
<tr>
<th><strong>Social Responsibility</strong></th>
<th><strong>Student Rating</strong></th>
<th><strong>Supervisor Rating</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Maintains acceptable attendance record</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Respects the rights of others and appreciates their roles</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Works cooperatively with co-workers</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Uses safe workplace procedures</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
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Personalized Learning for All

Like many others who experienced the Community-Based Learning program in its early days, Nate and Carl have graduated and are now pursuing higher education or work. But not all of their high school peers had the energy, time, or opportunity to pursue learning outside of school. This is a primary reason for applying the practical lessons of the CBL plan to development of the Personalized Learning Plan program, an innovation with a focus and reach that are decidedly broader.

Asking tough questions

As a ninth-grader, Nate’s sister Liz is already involved with the PLP program. Though she is not yet ready for learning in the community, she has already taken part in two parent conferences and several meetings at school about her personal plans. To meetings like these, Liz brings drafts and sketches of her ideas. She has a neighbor who is a surgeon. As she has done babysitting for his children for years, she has spoken with him extensively and even been invited to visit him during his work at the hospital. Through the PLP process, Liz has begun a supportive, sustained dialogue about how she can build on her interest in learning about medicine. Already, in just the first few months of her high school career, Liz is better known and perhaps better understood by key adults in school than is her sports-star brother Nate…and her story is just beginning.

What makes the PLP program distinctive is that it places Liz’s personal aspirations at the center of a quest. What is she doing here, and what is she learning and preparing herself to do? PLP development is not merely a beefed-up advising program, nor is it a single-event, community-based learning experience. Rather, it represents the beginning of a four-year conversation between Liz and her teachers about her hopes and dreams for the future. This conversation will aid in the creation of a personal folio in which to keep her reflections about her purpose and her learning. And it will provide Liz with access to caring adults who will help her to navigate her way.


**Synthesizing experience**

Because the PLP conversation is sustained over the course of four years and dips into all aspects of Liz’s life, the program differs significantly from single-event designs like the community-based learning experience. Liz meets her advisor daily for a brief check-in, along with a cadre of fifteen friends she will get to know well over the next four years; each year, four twelfth-graders in her advising group will graduate and four ninth-graders will be added. Next year Liz will help to mentor the newcomers.

Liz’s PLP group meets weekly for an extended period, giving her time to work on her plan. Other group members help her prepare for parent conferences, give her new perspectives on her activities, and assist her in solving problems as they arise. Once a month, the group has a significantly longer block of time, if needed, to go somewhere together, play a game, hold meetings with parents, or to be creative. Liz’s advisor has built in several periods during the week to work with other teachers on advising issues, ask for and give personal support, and converse about next steps in her own plan.

According to Owen Bradley, who directs the Personal Learning Plan program, individualized learning can now provide *all* students with a wide range of ways to show that they have met Vermont’s educational standards. “Students learn to synthesize their learning,” he says. “They learn how to perform. They learn application, not theory by itself.”

Indeed, a student in this program may manage a radio station, design a course of independent study, produce public service announcements, decide on courses for the following year, file documents, and learn to stitch five different sutures. How are such things connected? According to school staff, it all comes back to students like Liz developing a deep desire for learning. The PLP program connects students to all of their classes and experiences, wherever they may go. It encourages more applied learning in the high school curriculum, and it provides a personal context for learning core academic subjects and skills.
As an umbrella plan, the personal learning program shelters and brings together a number of pre-existing program efforts that were previously uncoordinated. In sync with the strategic goals of the community, the process helps all students raise the most important question an individual can answer: *What am I doing here?* Liz’s answer, as it arises in her plans via dialogues with friends and advisors over the course of years, is flexible yet clear. Her plan is team-supported, built around her own interests and ambitions, and nourished by a group of people who help her gain from personal learning experiences in the classroom and in the community.

**Phases of Change at Montpelier**

As shown, “the Montpelier innovation” came about as a team coalesced for the benefit of one group of students, enlarged its vision to accommodate all students, and sent a wave of influence into district policy. This activity then returned to the school as a system-wide commitment to offer opportunity to all students.

In general, what can be said about the underlying dynamics that fueled the motion from school to community and back to school again? The movement toward personal learning plans seems to have been built and sustained by at least three simple, yet powerful, principles:

- asking individuals and groups what they are good at, what interests them, and where they want to go with their lives
- responding with creative openness to all possibilities for learning and developing plans that allow individuals and groups to pursue their dreams
- sharing and providing resources that can help individuals and groups achieve their goals
These three principles describe the motivating forces of all the interactions within the system—between students and adults in the personal learning plan program, between a committed school team and the administration of the district, and between the district leadership and the community. The principles fueled the formation of self-organizing patterns which then became capable of sustaining change, and their repeated application at every level of the system helped give rise to the four phases of change we see on the timeline in Figure 16. The following paragraphs summarize the four phases of the innovation at Montpelier High School and then describe a few key conditions which were essential to the success of each phase.

**Phase I: Building team and individual capacity**

The first phase in the history of Montpelier’s movement toward personal learning plans was the “bottom-up” creation of local capacity in an enriched environment full of energy, experimentation, and faculty learning. Faculty leadership emerged in this phase, remaining active throughout six years of development. Owen Bradley and Bill Haines reflect some of the diversity of Montpelier’s faculty leaders: the first exudes the fervor of a new leader, fueled by a commitment to reach every underserved student with new opportunities for learning, while the latter brings a quieter level of thought to the dialogue and a more circumspect approach to action. For well over twenty-five years, Bill has been “doing things a little differently” every year. He extends ideas carefully to others, saying “Here’s what I’ve been finding helpful.” In addition, he takes into consideration the stance of teachers who resist change, the ones most likely to ask what the teacher’s union thinks about an innovation’s impact on the Negotiated Agreement.

An established culture of inclusion and experimentation provided a foundation for the early, “bottom-up” phase of the innovation process, guided by the administrative staff, university helpers and faculty at the center. During this early stage, several independent faculty initiatives allowed a significant number of students like Nate and Carl to leave the
building to learn in their community, both giving to and learning from it. The growth of an inclusive culture sparked entrepreneurial faculty subgroups to extend service-oriented opportunities to more and more students, resulting in crowds at the doors of community businesses and agencies where students wished to volunteer. The flow of students into the community started a chain of structural adaptations within the school aiming to coordinate resources, purposes, and approaches. The Community-Based Learning program was born, enabled by extended block scheduling which allowed Nate and Carl longer blocks of time to get out into the world and back to school as necessary.

The following circumstances supported bottom-up change.

- A culture of experimentation and innovation grew; administrators listened and were responsive to the staff; many took risks
- Informal problem-solving groups took effective action
- Structural changes opened new possibilities for everyone
- Individuals developed a sustained commitment to personal achievement

In addition, Montpelier, unlike most Vermont communities, does not rely on buses for transportation. The entire community is within walking distance of the school. Not having to overcome geographic constraints eliminated a significant barrier to the development of personal learning plans.

Phase 2: Shaping community vision

In the following “top-down” phase of PLP development, the faculty innovations and discussions became institutionalized by the community and school board. Accumulated years of community experience with students coming and going in Montpelier businesses, schools, and homes guided the strategic planning process, by providing concrete examples of a complex idea. The Community-Based Learning program showed how a broader program could look and work. Nearly half the long-range plan, designed with input from
hundreds of people, seemed to call for “more of what the Community-Based Learning program was doing.” The existence of the successful model reduced resistance to the novelty of the ideas being discussed. But a particularly critical factor was that when the mandates of the plan became evident, teachers were not pressured to implement the plan immediately. In the phase that followed the shaping of the community’s vision, faculty leaders were developed in groups that held the controls of implementation. These groups were able to follow a flexible timetable of their own design.

The following conditions and situations supported top-down change.

- A small but diverse group, representative of the community, constructed a vision, a mission, and a set of broad strategies, then invited others into a sustained critical dialogue
- The theme of student involvement was developed into specific actions, with broad and diverse engagement in the study and design of agreements
- The key theme was supported by several strategies, ensuring that it would be addressed within a broad, integrating approach

Also, the state’s emphasis on increased strategic planning by broad stakeholder groups may have influenced the superintendent’s decision to try a similar approach with the community, for two reasons. First, the Montpelier district sits in the state capital, and many parents of the high school students are also state leaders in public education, higher education, and social services. Second, the district leadership engaged in a highly interactive policy discourse with “the state” on a continuous basis (Hasazi, 1994). The broader public in Montpelier got involved in building a vision and engaged in the hard work of long-term planning because some members of the community recognized and understood strategic thinking.
Phase 3: Structural alignment and adaptation

During the third phase of PLP development, the faculty and administration developed support structures linking the vision derived from community involvement with the early program models such as community-based learning. This development process shared features with the earlier models, but the idea of personalized learning now permeated the whole school and much of the community, creating resonance among disparate aspects of a general reform. Open support for experimentation was expressed at faculty meetings, and many people spoke of the value of the school’s growing commitment to provide excellence in learning for all students.

A creative, informal team gathered to solidify procedures and guidelines—this time backed by the strategic plan, as the team had a mandate from the whole community. Individuals and teams could now plan without seeking authority from external sources. “Planning-with-leadership-responsibilities,” augmented by weekly meetings, allows a staff and faculty to lead themselves into the future. In Montpelier, a diverse group of staff members—faculty like Bill, school-to-work specialists like Nerissa and Owen, guidance counselors like Cary, media and library staff like Phyllis—along with students like Nate, Carl, and Liz, studied the issues, then led the rest of the faculty in exploratory design sessions where problems came to light and solutions were developed.

Team members were confident that the school system would eventually need to address the personal learning aspects of the long-range plan, and they trusted that their ideas would eventually be heard. Supportive administrators, while juggling other priorities, urged them on and found time and money for implementation. Research studies by interns from the University of Vermont, who were also members of school development teams, kept helpful information flowing to the design team.
The following situations supported alignment and adaptation.

- A “bottom-up” leadership team designed and led school-level planning
- All faculty engaged in the design and adjustments of the plan, and they set the timeline for implementation
- Community partnerships increased the research and planning capacity of teams
- A common language developed through faculty discussions

**Phase 4: Systemic resonance**

During the final phase of the system change, personal learning became available to all students, and it was maintained by an ongoing conversation at every level of the organization. To prepare and support the faculty, university partners offered new perspectives and models, working side by side with school-based educators. Intensive faculty involvement over a full year of planning led to a multi-leveled approach to implementation which is still moving forward. At the same time, weekly faculty meetings and in-service training sessions led by staff members focused on the types of teaching techniques that would allow personalized learning to thrive at Montpelier. As faculty became involved in individualized planning, particularly through teacher advisories, they needed time to discuss the kinds of problems that arise with such an approach and to share solutions that fit a variety of challenges. A continuous feedback cycle, rejuvenated each month with new discussions, gave the leadership team information they could use to make adjustments. The ongoing dialogue across organizational levels influenced the evolution of support systems and gradually delineated the future of the program.

The following represent the key conditions under which systemic resonance occurred.

- Innovation was led by faculty
- There was a benefit to all participants: students, teachers, parents, and community members
• Time within the teaching week was dedicated to faculty discussions of problems and solutions in daily work with students
• A model of continuous improvement guided action and reflection

Incremental Expansion

What the Montpelier story demonstrates is that resonance in relationships in one part of the system can stimulate positive, sustainable changes in another part of the system (see Figure 16). When Liz announces that she wants to be a surgeon, and she has already spent time observing doctors in an operating room, she presents her adult mentors with a new set of challenges. That is, how can her teachers impart knowledge, skills, and abilities relevant to her growing commitment? When her teacher Bill Haines asserts that his strengths lie in “making things happen,” he presents a challenge to the teachers’ union, the school board, and the superintendent: How can the administration find ways to creatively accommodate his leadership goals, thereby allowing him to fulfill his own ambition while enhancing organizational efforts at the high school? Similarly, when members of an entire school and its surrounding community say they are willing to place personal learning at the center of education, their commitment may influence state and national educational bureaucracies.

Though it is no easy task to build a personalized curriculum in today’s policy-laden environment, we can learn from this story where change began with a student voice. When a pupil like Liz asks, What am I doing here? we need to know that she wants to propose her own answers to that question, whether or not the larger system is attentive or responsive. And if we listen and respond, a new energy source for school reform can be triggered by our response What are you personally planning to do? When a student hears a respected adult say that her dream of being a surgeon is possible, she develops faith that her energies and interests might find a vehicle. But beyond encouragement, she needs external resources as well as words to help with her preparations—a teacher who will show her how algebra is
**Pattern of Energy Flow: Developing Personalized Learning Plans at Montpelier High School**

**State Policy Initiatives:**
- Planning
- Adoption

**Green Mountain Challenge**

**District Development Initiatives:**
- Priorities
- Funding
- Leadership

**Community-wide Strategic Planning includes IEPs for All**

**School Board adopts strategic plan**

**District Leadership Cadre**

**Community Forum:**
- Standards

**EEO Act 60**

**Vermont School Report implemented**

**UVM interns join all school teams**

**Modified Long Block Schedule creates flexible time**

**PLP Team formed to plan program**

**UVM interns conduct research projects**

**School visits**

**Monthly staff-led PLP in-service**

**Faculty Discussions:**
- meaningful TA’s

**Brainstorming Lunches IEP Training Inclusion**

**SDI on CBL SDI on School Change**

**Faculty Awareness Discussions**

**UVM Conf. PLP**

**PLP Support System designed**

**Community-based learning open to any student**

**School-to-work initiatives and other efforts to meet student needs**

**Student Experience:**
- Project Design
- Course Design
- Student Learning

**Student Perspective**

**UVMTA**

**UVM Special Ed Studies**

**Manuals and guides designed**

**PLP Team formed to plan program**

**Board adopts Framework of Standards & Lng Opps**

**EEO Act 60**


**1992**

**Common core of learning**

**Math & Writing Portfolio**

**Project Design Course Design**

**Project Design Course Design**

**Community-wide Strategic Planning includes IEPs for All**

**School Board adopts strategic plan**

**EEO Act 60**

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**Student Experience:**
- Project Design
- Course Design
- Student Learning

**Student Perspective**
used to model the resource use of blood in a hospital emergency room, a history teacher who will guide her to the first anatomy book ever printed in English, an art teacher that develops her medical illustration and graphic representation skills. Whether she eventually settles on medicine, mathematics, or art, the student needs steady support as she finds her own way.

The same attentiveness and responsiveness is needed by her teacher Bill. The intrinsic rewards of teaching are, for many teachers, what move them through their daily challenges. But they too need external support at key times, particularly if they are developing an idea that can improve a school. Faced with barriers and lack of appreciation, any good spirit is likely to tire. Luckily for Bill, and for the system where he taught, he received part of the recognition and a few of the resources he needed to work with community-based learning until personal learning plans were ready to be born.

The notion of providing learning opportunities for all students, based on a personal learning plan, has not reached the level of a state initiative. Essex and Mount Abraham high schools in Vermont have expressed interest in testing the fit between their ongoing reform efforts and personal learning plans. If the innovation does spill over the local boundary of Montpelier schools and become a sustained innovation in other systems, it would likely occur within a pattern similar to the one shown in Figure 16. Bottom-up pilot sites for variants of “personal learning and social responsibility” will be encouraged and watched.

When the pilots look promising, top-down policy will then attempt to validate the good practices, encouraging their spread to other local school systems. Measures of the policy’s success, as others have reported in policy implementation (Fuhrman, Clune & Elmore, 1991), will reflect the degree to which local systems have developed the capacity to enter into the conversation with self-selected leadership and bottom-up adaptations of the policy.
Growing Forward

The last phase of Montpelier’s innovation—where there are mutual benefits and a balanced exchange at all levels of the organization—reveals what might be called systemic resonance. In the same way that a vibrating string can be brought into accord with another, a vision that lets individuals understand how their own efforts resonate with the whole sets the key for a school-wide change. When time for communication is available, resonance can occur across any boundary in Figure 16—between Nate and Carl, between Liz and her teacher Bill, between Bill and the superintendent, and between the superintendent and the state board of education. If the interactions across boundaries produce mutual benefits, their resonance will increase the prospects for further growth and development within other parts of a school.

Personal learning plans created a general format for the whole school community to use to resonate and amplify their separate efforts. Students thinking about their lives inside and outside of school, and parents thinking about their work lives and home lives, could all benefit from helping each other to clarify visions, set direction, and take action. Teachers developing themselves as leaders and as life-long learners, interacting with school and community leaders reflecting on where they are taking their organizations, could also benefit from mutually beneficial relationships. It seems clear that even government officials could use the central vision behind a local innovation to take stock of state policies and to adapt with creative openness to the learning patterns of the communities they serve.

The boundaries separating members of the educational system—learners, teachers, parents, and community members—can easily suppress change. However, when a common vision supports systemic resonance, the boundaries flex and allow people to come into dialogue and synchronize in unexpected ways. When the community-based learning team continued working year after year, its positive effects attracted more and more people
to take notice. The team’s method, which was to link individual interests to new places for learning and support it in new ways, was readily transferable to learning for all students though the personal learning plan. The same process can also be extended to adult learning for other members of the school community—through individual professional development plans, school-wide strategic planning, and action planning processes. The difference in age and knowledge between Liz and her teacher Bill is great, but Liz knows more than Bill does about medicine. Because he is much older than she is, he can help her to set a realizable path toward the future. In harmony at different ends of the keyboard, both may be pleasantly surprised to learn something new about themselves in dialogue with one another.

These days, faculty at Montpelier High School set aside two of their weekly staff development meetings each year to hear students and community members tell what personal learning experiences have meant for them. Videotapes of Carl working with Charlie and of end-of-year presentations are later shown to parents and teachers to promote awareness and understanding of the program. Those who have undertaken such experiences receive special recognition at awards ceremonies for their achievements. It is then, perhaps for the first time, that struggling students appear on the same stage as their academically successful peers. Both are lauded for their accomplishments in learning and serving, giving shape and substance to the abstract idea of self-directed learning.

If the Montpelier story had stopped with one strong interaction between a student and a teacher, or even among a few of them, it would be a heartwarming thing, but would it merit study? Not if it remained confined to a small region of the larger system. But we are fortunate that Montpelier’s innovation spilled over several boundaries and became locally systemic. In this example of positive systemic change, success breeds success, not only for those directly involved but for all members of a school. The Montpelier innovation shows that regardless of where mutually beneficial interactions take place in the
system, they can generate patterns which organize and lead to positive systemic change, influencing system behavior at all levels. That’s what we need to have more often if we want to see learner-centered change reverberating from students to the state houses.
Chapter 7
Developing the Capacity for Systemic Change at Mount Abraham Union High School

Mary J. Sullivan

The exterior of Mount Abraham Union High School in Bristol, Vermont, has a conventional look—yellow buses, an American flag waving in the air, a parking lot filled with a collection of aging automobiles and trucks. But in October of each year, Mount Abraham’s soccer fields become a battleground, a microcosm of an uneasy world where contending armies clash and world domination hangs in the balance. Tom Tailer’s “Armed Aggression” unit in physics, one of several interdisciplinary units that has grown in concert with the standards movement at Mount Abraham, developed so that students could test Tailer’s proposition that “the study of physics is the study of war.”

The Armed Aggression unit begins by focusing on physics, but it quickly expands to include history, geography, English, philosophy, economics, political science, and anthropology. Each year, students use an integrated approach to mathematics and science to develop an arsenal of non-lethal weapons. They then use information from history, political science, economics, and geography to enact global conflict and divide wealth among the world’s nations. After the war has ended, they meet as a physics class again to assess the meaning of what they did on the battlefield in light of their understanding of real global conflict.
Since 1983, Tom’s goal has been for his students to experience the dynamic relationship between science, society, and technology, in a setting where they can experience the complexity and turmoil of global relationships. As a laboratory experience in both science and social studies, the global simulation of armed aggression illustrates how focusing on large concepts and practical challenges can help students understand and meet the National Council of Teachers of Mathematics (NCTM) Standards and National Science Standards, as well as social studies standards from the Vermont Framework of Standards and Learning Opportunities. Ongoing development of the physics war and related initiatives throughout the mathematics and science department have provided impetus for school-to-work programs and a new “graduation challenge.” Early progress supports continuing progress. Mount Abraham is using ten years of experience integrating its mathematics and science programs to develop “Challenge for All!” throughout the high school curriculum.

The Physics War

I visited Tom Tailer’s physics class as his students were preparing for a “war” that he had scheduled for October 29 at 8:00 a.m. With war imminent, the upstairs hallway in front of the physics room was vibrating with the noise of electrical tools and hammers, as students designed and built what they hoped would be world-class artillery. Tom’s students were each designing and building an apparatus that could project a tennis ball—out-of-the-can or customized with lubricants—over the greatest possible distance, with the greatest possible accuracy. All were eager to share with me how they felt about their strategy. During the war itself, wealthier countries feasted on pizza, while poorer countries had to survive on rice. As students Scott and Katie explained to me, “We’re going to blast them away and get their pizza.”

The grassy patch under the American flag had become a military test range, a place to measure and remeasure trajectories and distances. The hallways showcased posters for
peace, and classrooms sponsored debates. Both weapons and posters have a place on the October battlefield, enabling students to experience both causes and results of aggressive warfare. Tom Tailer first developed the physics war as a medium for teaching Newton’s laws of motion, but the unit now helps students meet Vermont standards related to scientific method, measurement, estimation, and math modeling. It also helps students meet social studies standards in conflict resolution and macro-economics. Tom Tailer’s students learn about both violence and pacifism through simulated involvement in global aggression. Armed Aggression is one example of several integrated units in the newly merged mathematics and science departments at Mount Abraham.

Wood, surgical tubing, bicycle wheels, drills, jig saws, and other electrical tools cluttered the classroom where students were building their war machines. During 84 minutes in a long-block schedule, Tom Tailer was moving constantly from student to student, offering advice, lending support, helping to drill PVC pipe, and explaining the “whys” of various methods of launching tennis balls. With the onset of war in the near future, refined “guns” began to appear on school grounds. I watched two students pull into the parking lot with a 10-foot slingshot carefully resting on a trailer. The two-by-fours that supported the surgical tubing had been notched at specific intervals from the base to top, allowing the boys to calibrate distances at different pre-measured angles. While testing their creation at Ryan’s house, they had propelled apples and tennis balls 300 feet across a pond. The boys asked Mr. Tailer if the length of their PVC pipe were related to the distance they could achieve. They theorized that shorter pipe would send the ball a greater distance. Mr. Tailer agreed, cautioning them about shooting apples toward the trailer park across from the school parking lot.

To calibrate their weapons, students must shoot projectiles many, many times, looking for degrees of central tendency and endlessly measuring variation. Accuracy and reliability mean they will join a “first world” army. Before the war begins, students calibrate
their weapons at every five degrees from 0° to 90°. For each degree, they measure, record, and analyze distances traveled at different levels of force. They practice at least 15 times for each measured degree, estimating their error rate across trials. Students make a frequency distribution, or histogram, of accuracy at different ranges. When weapons are tuned at last, Mr. Tailer examines student laboratory data and asks each team to shoot a final projectile on the test range. If students have calibrated to 150 feet, he may stand at 86 meters and ask them to land a tennis ball at his feet. Students have to review their charts and pick an angle that they believe will give them the right trajectory. As Tom points out, an integrated mathematics and science curriculum based on simulation does not let one say, “At the end of this unit each student will be able to…” Instead, the results must be measured on rubrics that fit Vermont’s standards.

The physics war includes students from Tom Tailer’s general physics classes as well as those from his advanced classes, who use different rubrics to meet slightly different standards for performance. Students in his math-based physics class, which uses a college-prep curriculum, must compare actual distances with theoretical distances, using trigonometry and trajectory equations to target their projectiles. Students without trigonometry can graph their tests without equations. Tom rejoices in the knowledge that the 120 students participating in this year’s Armed Aggression represent heterogeneous abilities, and that his special education students will be fully involved. The simulation is designed so that students with different learning styles and beliefs can participate meaningfully, challenging each to reach high levels of performance.

Although most students are eager to create a world-class weapon, others are disturbed by the bellicose mood of their peers—and even by the concept of staging a war. I asked Ceci, a young woman who called herself a pacifist, what would happen to dissidents during the conflict. She was returning from the library with two books, The Handbook On Non-Violence and Portraits of Nobel Laureates in Peace. She and three other students were hoping to design a way to convince their classmates that war is wrong. Assisted by a
University of Vermont intern who shared their views, they decided to focus on the horror of historical atrocities and then to feature alternatives to war. To fulfill the scientific aspects of the course assignment, they had borrowed a design from an avalanche-control cannon and built it on a peaceful scale, measuring trajectory and distances to meet required specifications. Thereafter, they lobbied energetically for peace.

Prior to battle, each student assigned to a warring country was required to swear a technocratic oath, design a flag, and help write a national anthem. During a class in which students shared their oaths, flags, and anthems, Heather and Karen offered me a copy of their pledge:

*We, Heather and Karen, will not provoke hostilities upon the other countries of the world. However, if those countries do decide to use hostile actions on us, we will use every bit of our great knowledge of math, science and technology to retaliate. We will also remain truthful and committed to those alliances that we have made. Once again, though, if those countries whom we have made an alliance with so choose to break that alliance and attack us, we will go at them with full force.*

Heather and Karen’s flag showed a piece of cake on a plate with a fork next to it.

For their national anthem, Heather and Karen had chosen Wagner’s “Magic Fire,” by the Boston Symphony. When the class delightedly pointed out that Wagner sounded like war music, the girls took offense, regretting that they had selected a song that had been used in the film “Apocalypse Now.” They argued that “Magic Fire” symbolized the power and strength of working together in a world where sharing is the norm.

Facing the onset of war, these students also had to address the concept of an armed race, deal with dissent, factor in the uneven distribution of power, and work with fellow citizens who manifested values different from their own. For most students, Armed Aggression becomes a powerful lesson about peace, non-violence, and the intricacies of negotiation—as well as the physics of war.
On the final days before combat, students learned that there were two sets of rules: safety rules and simulation rules. In the name of safety, students were required to shoot tennis balls with nothing inserted into them. They had to fight within two meters of their country’s flag. Chemical weapons could be made only of clean flour, water, tempera paint, and vegetable lard. All systems were inspected prior to use and rendered non-functional at the war’s end. Head and eye protection had to be worn at all times. Additional rules specified distances between countries, limited the amount of surgical tubing on a weapon, and started or ended the simulation.

Simulation rules mimicked global realities. All students not working for the U.N. were assigned to a country based on the calibrated range of their weapons. Rich countries received the most reliable long-range weapons. Poor countries received a few less-reliable, short-range weapons. Resource buckets filled with tennis balls were distributed in proportion to a country’s economic resources. If one country wanted to seize the wealth of guns and food of a conquered neighbor, U.N. representatives (both teachers and students) could stop the simulation to negotiate terms of surrender or alliance. Conquered countries turned their arsenals over to the victors for use in further conquests. Members of the United Nations Security Council, usually seniors with established influence, could levy sanctions against any country that shot noncombatants or U.N. observers. Any country employing weapons of mass destruction was cited for crimes against humanity, infractions that had to be brought before the United Nations or NATO for action. NATO and U.N. observers, both students and teachers, refereed the battle zone, calling for a truce when necessary to impose sanctions, certify alliances, or settle disputes.

Tom Tailer fairly represents the span of experience of teachers active in reform at Mount Abraham. Like most of the other pioneers in mathematics and science integration, he has remained steadily active in classroom experimentation, faculty development, systems adaptation, and district curriculum deliberations for all of his years teaching at Mount Abraham. Having received his certification through the University of Vermont’s
post-baccalaureate program, he has remained involved with the interns as a member of the Professional Development School Steering Committee and also as a cooperating teacher. With university interns providing support for interdisciplinary teaching, Tom has been active in school development institutes. Full-time interns free teachers to interact with their peers, allowing them to share materials and ideas across the lines of discipline. The presence of interns allows Tom and other teachers to expand their roles in developing curriculum and testing new ideas.

**Crossing Boundaries to Support Change**

Why have Tom Tailer and his colleagues crossed the boundary dividing science, mathematics, and social studies when no one forced them to change? In short, over the course of 15 years of experimentation, teamwork, focused faculty development, and movement toward a standards-based curriculum, the Mount Abraham science and math faculties developed a shared vision of how academic learning works best for kids. At Mount Abraham, that vision has grown in tandem with changing practice and steadily evolving systems, creating a network of pressure that allows change to gather its own momentum.

Curriculum integration has depended on the interaction of many innovators over many years, but it has also depended on teacher-leaders who can excite others about change, when change invariably means more work and longer hours. Over a period of more than 10 years, John Vibber, now chair of the merged science/mathematics and technology department, redirected a long career in conventional teaching toward an integrating vision of science and mathematics instruction connected to the emerging standards movement. Supported by an administration that actively protects its risk-takers, John Vibber helped his faculty develop a collective vision of integrated learning for high school students that is slowly infusing the whole Mount Abraham community.
Appendix A represents a synopsis of six years’ worth of math/science integration at Mount Abraham, derived from interviews with teachers, students, and administrators in Addison Northeast Supervisory District in Bristol, Vermont. During these six years and before, John Vibber has been active at all five levels of school organization, investigating science and mathematics standards at the state and national levels while encouraging faculty development and experimentation in the Mount Abraham classrooms. Active with the National Council of Teachers of Mathematics (NCTM) and the National Science Teachers Association (NSTA), John helped organize the district committees that reframed new learning goals for all Mount Abraham students. After gathering his faculty to look critically at their subject-based curriculum, John actively promoted structural changes such as heterogeneous grouping and block scheduling. He also arranged or exploited a wide array of professional development activities for his faculty, supporting wide experimentation until performance-based teaching, public exhibitions of student learning, and rubrics that measure achievement had taken hold in the culture of the school. By moving from one level of school engagement to another, John helped Mount Abraham weave student learning, faculty development, systems change, and district initiatives into a coherent movement with the potential for reorganizing learning throughout the school community.

In the fall of 1992, John Vibber wrote an article titled, “Some New Trends in Science Education,” published in the Vermont Geological Society Newsletter (Vibber, 1992). In that article, John discussed the science standards developed by the National Council of Research of the National Academy of Science, which include the idea that “less is more.” Science teachers should cover far fewer topics, he argued, but in greater detail and with greater emphasis placed on “process skill.” John argued that students should learn science by doing science, that teachers should develop assessment methods that honor many different talents and styles of learning, and that schools should integrate the sciences with each other, with math, with pertinent contemporary issues, and with the other subjects students are learning.
No one at Mount Abraham believes that John Vibber has directed the change process at the high school. Instead, they have watched him work steadily as an agent who can cross institutional boundaries to connect initiatives at one level to related initiatives at other levels. Everyone I interviewed referred to John Vibber’s role as that of a change agent. His involvement with state and national initiatives made the school faculty aware of experiments in teaching on the “cutting edge” of change. John attended NSTA conferences and encouraged others in his department to attend. When a district is willing to send a teacher off to a conference, it implies that the teacher is valued. John Vibber has made sure that people throughout the school are involved. The Mount Abraham school board and administrators showed their confidence in John and his colleagues by actively supporting the changes being implemented in the classroom.

Over a period of 10 years, John Vibber carried energy and ideas from one level of school organization to another, connecting parts of the system to support integrated learning. After encouraging innovation among the faculty and students, he used energy from the interaction between students and faculty to clarify and promote policy changes related to standards. When policy and action were aligned, he helped turn the focus of faculty development and district development activity toward systems adaptation—a block schedule, heterogeneous grouping, and the partnership between school and university. He gathered his faculty in cross-disciplinary groups to design an integrated mathematics and science curriculum. Finally, he helped support a member of his faculty in designing student-directed learning options. Essentially, John made connections between people, ideas, and resources, weaving a coherent image organizing their separate efforts. “If you get people out of their humble work setting, feed them well, listen to them, and treat them as important,” John commented, “you don’t need to lead change at all. I just stirred things up!”
Phases in the Change Process

The movement of Mount Abraham Union High School’s mathematics and science departments toward integration has occurred in five major phases. As Appendix B shows, phases 1 and 2 are nearly synchronous. The first is a cluster of interactions between faculty and the students in experimenting classrooms, and the second forms a cluster of early policy initiatives related to the standards movement at the state and national levels. Although phases 1 and 2 occurred separately, John Vibber played a central role in both policy development and exploratory action—and in the systems adaptations that have allowed change to continue. Phases 3, 4, and 5 developed and then consolidated connections between evolving policy and practice, creating structural supports for standards-based learning and expanding the concept of student-directed inquiry throughout the school. By the time the school had reached phase 5 in 1996, Principal David Royce could require all faculty to publish course syllabi based on the Vermont Framework of Standards and Learning Opportunities. Student inquiry, guided by rubrics toward common standards for all students, had also become the basis for a graduation challenge and several school-to-work programs. David Royce formed a new academic department that would allow any student to design independent studies for Carnegie credits. Mount Abraham had developed the capacity for systemic change.
The five phases represent a process of coalescence that has grown to engage all five levels of school organization.

**Phase 1: Exploration and experimentation**
An intense period of faculty development activities and school visits lends support to experimentation with integrated teaching.

**Phase 2: Policy and standards development**
With strong community involvement, national, state, and local initiatives in standards-based curriculum coalesce in a locally designed vision for school reform.

**Phase 3: Systems adaptation through focused in-service**
Faculty development efforts shift from instruction toward structural change: department reorganization, block scheduling, and team formation.

**Phase 4: Curriculum alignment and problem-solving**
Faculty begin to work in teams to solve the problems that accompany the structural changes that have occurred.

**Phase 5: Policy and practice reciprocate**
Alignment at all levels allows new initiatives to begin, particularly a graduation challenge for all students in a new academic department specializing in interdisciplinary inquiry.
What has been accomplished at Mount Abraham? The school has successfully integrated math in grades 7 through 12. In science, they have identified relatively few, relatively large concepts and designed activities to fit those concepts. Textbooks have been relegated to the status of supporting documents, instead of being the curriculum they once constituted. Math and science teachers have changed their method of delivery, enhancing subject matter through the use of inquiry strategies. Block scheduling has created time for integrated teaching. The tracking system has been eliminated or reduced in all academic areas. Standards-based assessment lets teachers and students evaluate learning without resorting to tests that misrepresent the scope of student learning. Much of this success can be attributed to an ongoing program of in-service training that supports a common vision about what is best for kids. Experience with a standards-based curriculum has provided the foundation for a new academic department that offers credit for students working within the community. Personal learning plans for each student will soon guide student advising for all six years of a Mount Abraham education.

Phase 1: Exploration and experimentation

Both phase 1 and 2 began prior to the six years of this study, creating a conceptual orientation at the policy level and several models of inquiry-based learning in Mount Abraham classrooms. An intensive and rich program of faculty development, beginning before 1990 and extending throughout the six-year period of this study, generated the sustaining drive for instructional reform at Mount Abraham. In the early 1990s, UVM and the school district set up a three-year master’s degree program, with classes meeting at the high school. Course topics ranged from heterogeneous grouping and multiple intelligences to collaborative negotiations and cooperative learning. The number of faculty involved in course work soon led to a flowering of experimentation in the classroom, focusing on interdisciplinary teaching and academic “hands-on” experiences.
Having seen how mathematics could support biology in an AP course in New Hampshire, John Vibber then persuaded a group of his colleagues to enroll in a School Development Institute (SDI) an action research course offering three credits from the University of Vermont. The Math SDI team from Mount Abraham attacked the question: “How should the math program for grades 7–12 at Mount Abraham change?” The math teachers began a long dialogue around reasons for change and continuity in their program, from elementary schools through high school. Historically, the math program had included algebra, geometry, and trigonometry for college-bound students and basic computation for the majority of other students.

Four influences compelled the mathematics teachers to look seriously at changing their practice:

1. Tracking raised equity issues, relegating many students to watered-down “college prep” courses with little applicability in their lives.
2. The NCTM Standards proposed a higher-order purpose for instruction, focusing on reasoning and problem solving.
3. Employers were calling for applicable math skills, rather than achievement in the conventional sequence of math courses.
4. Advanced science courses required higher math skills, particularly in statistics and modeling.

For John Vibber and the mathematics faculty at Mount Abraham, connecting math to science could provide a context in which all four problems might be solved together. Integration would allow the faculty to work together with a shared purpose.
David Marshak joined the district administration as curriculum coordinator, bringing a view of learning as inquiry and a thorough understanding of learning-centered teaching. Although David’s point of view on educational theory was quite different from John Vibber’s at the time, John enrolled in several of Dave’s one-credit courses. The study of multiple intelligences, heterogeneous and multi-age grouping, and Bernice McCarthy’s 4-MAT were offered throughout 1992 and subsequent years. John found himself being converted to what he now refers to as “the right way.” He adds, “When you’re in the middle of a revolution, you don’t recognize it.” Dave Marshak’s view of performance-based learning became John’s yardstick for personal change. In his discussions with the school administration and the school board, John Vibber then focused on teaching mathematics that would make students employable in technical jobs and mathematics that was needed in the sciences.

In the fall of 1992, John Vibber arranged an all-day retreat at Middlebury College for all the science and math teachers as one group. Jan Willey, curriculum coordinator for the district, facilitated the math portion, and John facilitated the science portion. As math teacher Ed McGuire recalls:

*This was a watershed experience for all of us. Never before had this group of teachers been able to just talk—to vent, complain, share ideas—and have colleagues listen. A year earlier they may not have gotten past the complaining, but that day their minds were open to change. They were on a journey together. Math is the language of the sciences! This fundamental principle is the thread that John has used to keep his flock together.*

John doesn’t believe anyone would have been ready for new ideas if they hadn’t been working together already.
Phase 2: Policy and standards development

While the Mount Abraham faculty was looking at ways to improve teaching for their students, the Vermont State Department of Education issued the Green Mountain Challenge and began advocating for high standards for all students. The state initiative ran parallel to local efforts already under way. In the Mount Abraham School District, a Reinvention Advisory Council had been working for three years developing four common goals that helped form the basis for change at Mount Abraham—and later for Vermont’s Common Core of Learning (Clarke, Willey and Maynard, 1994). Addison Northeast Supervisory Union also developed the first Vermont “School Report Night,” which encouraged community members to witness what students were learning at the high school. State and town enjoyed a reciprocal relationship, supporting each other in the direction of standards-based reform.

Simultaneously, the state math and writing portfolios were being implemented at several schools in Vermont, one of which was Mount Abraham. John Vibber had been following the evolution of standards in mathematics and science, but “got lucky” when he was invited by the Vermont Department of Education to participate in the New Standards project. For this, he traveled to Utah and California to work on standards and assessment for science, mathematics, and technology. John’s involvement in the New Standards project afforded him the opportunity to bring ideas about standards-based and authentic assessment back to Mount Abraham.

At the same time that NCTM proposed its new framework, major changes were also being proposed by NSTA. John had first heard about integrative science in 1987 from NSTA President Bill Aldrich, who had pointed out that the traditional pattern of science instruction—biology in one year, physics in another, then chemistry in another—actually came out of a committee in the late 1800s having nothing to do with how science is learned. John started following the progress of Project 2061, a scope and sequence coordination project being developed in several states.
Because knowing what was going on in other parts of the country had supported the first round of mathematics experimentation at Mount Abraham, John started attending national science conventions, where he met leaders of NSTA and tried to get Mt Abraham to be a test site for the new integrated science curriculum. In April of 1992, Mount Abraham received a NSTA grant to hold a conference entitled “Why Change?” that provided a medium for community discussion of changes envisioned for science instruction at the high school level. At this gathering of representatives from business, industry, higher education, and state government, Floyd Mattheis, professor of science education at East Carolina University, described the NSTA’s “Scope, Sequence, and Coordination of Secondary School Science,” introducing a curriculum model with a “learning spiral,” integrating many areas of science each year. The learning spiral provided a structure for integrated science and mathematics at Mount Abraham.

**Phase 3: Systems adaptation through focused in-service training**

Activity at the policy and classroom levels put continuous pressure for change on the systems Mount Abraham was using to organize school life. Standards-based assessment and integrated teaching did not fit well into a 42-minute teaching period. Common standards were inconsistent with assigning students to different “tracks.” Because long-term change could not be accomplished through a varying menu of short-term workshops and courses, the sustained university partnership introduced a yearly schedule of School Development Institutes. Systems changes evolved without an organizing plan and responded to pressure that pushed separate aspects of the system into new configurations. Responding to the same array of pressures from policy initiatives and classroom experimentation, different aspects of school structure were reorganized to align with newer models of teaching and learning.

At a department meeting in 1993, science teachers began to talk about the direction they wanted to go with the ideas that were coming simultaneously from state and federal
policy initiatives, the district’s restructuring goals, and ongoing faculty development courses. John asked the science teachers to list the major sub-topics, or concepts, in their field. Then he had them identify other sciences that they referenced in their curriculum (for example, teaching scientific notation in chemistry, social issues in biology, or water pollution in chemistry). Soon teachers were saying things such as, “Oh yeah, I teach math in my science class.” The department produced a matrix of science concepts that connected their separate efforts. The matrix also allowed the entire department to view the whole curriculum, letting the chemistry teacher change her plans because she could see what others were doing in biology. The curriculum matrix brought coordination to disparate or redundant courses. When duplication occurred thereafter, it was by design and not by mistake. The veteran science faculty at Mount Abraham was not interested in revolutionary change, but the matrix let them work with confidence from what they already knew.

By 1994, the prevalence of inquiry learning and student projects integrating curricula was forcing adaptations of the school’s organizing systems. David Royce stood before the faculty dressed in protective hockey gear and proclaimed that the school would move to an extended block schedule for the coming year. He also began to consolidate the diffuse departmental structure. From more than 10 departments based on separate disciplines, three large departments emerged, emphasizing applications of knowledge across subject area lines. With two integrated math/science courses in motion, the cross-disciplinary retreats continued, proving vitally important to the environment of change and the continued collegiality of the science and math faculty.

With change initiatives going on in both policy and practice, both school and university needed a graduate course structure that would allow small groups of teachers to work over a long period of time on the issues that arise when a whole school structure begins to change shape. School Development Institutes changed from large thematic gatherings
during a summer week to small, team-based projects carried out over a full school year. The school and university developed methods for feeding tuition funds back to school improvement teams, rather than to university coffers, to support action research based on collaborative brainstorming, evaluating positions, prioritizing, and goal development (Clarke et al., 1998). In-service days were set aside for continued work, grants encouraged additional study, and the creation of discussion time allowed teachers to continue collaboration during the school year.

**Phase 4: Curriculum alignment and problem-solving**

By the 1995–1996 school year, many new programs were in place at Mount Abraham, giving people such as Tom Tailer further license to continue developing their innovative ideas. The integrated math program and “less is more” philosophy of the newly coordinated science curriculum lent itself well to the physics war—and to new proposals for student-directed learning for credit, such as school-to-work internships. Block scheduling was in place, giving teachers the opportunity to work with students for extended lengths of time. Moving toward heterogeneous grouping allowed students once banned from taking courses such as physics to benefit from a shared challenge. Tom Tailer’s motion unit expanded to include all students in a global struggle.

**Phase 5: Policy and practice reciprocate**

As Figure 17 indicates, the educational ideas emanating from policy discussions and simultaneous experiments in Mount Abraham classrooms during the early 1990s remained ongoing throughout the six years of this study. School and district leadership continued creating the opportunities for change, state policy initiatives were gradually introduced to locally defined standards, and Mount Abraham retained a faculty willing to interact with each other and develop new ideas for teaching. As a result, systems began to adapt and early experimental programs for students solidified and further developed. At the same
time, Vermont State Standards merged with early initiatives of the NSTA and NCTM to create the common Framework of Standards and Learning Opportunities.

In recent years, John Vibber served on a statewide VSMIT committee that aimed to come up with an integrated math and science assessment. Marge Petit, deputy commissioner of education in Vermont, was instrumental in moving several initiatives from policy discussion to active experimentation, including standards-based assessment in science and mathematics. As John Vibber interacted with the Vermont Institute for Science, Mathematics and Technology (VISMT) team, the district became actively engaged in providing team-based professional development for the faculty. The University of Vermont’s presence strengthened through a professional development school partnership and yearly School Development Institutes, the faculty remained committed to progress, and the student experience was designed to challenge all.

David Royce, principal of the school, insists that “Challenge for All!” is the new ideal that he uses to guide decision making in all school areas. In 1996, he asked Ed McGuire, who had been a member of John Vibber’s department, to integrate mathematics in grades 7–12 and organize a new academic department that would assist all Mount Abraham students in designing their own learning plans; the graduation challenge for seniors, school-to work program, home-school partnership, and entire guidance department were involved. A localized effort to make mathematics and science meaningful had become a system-wide initiative focused on student-directed inquiry.
**Figure 17**

*Pattern of Energy Flow: Integrating Math and Science to Reach Standards at Mount Abraham Union High School*

- **1992**
  - Green Mountain Challenge
  - Board adopts Framework of Standards & Lng Opps

- **1993**
  - Common core of learning
  - Vermont School Report implemented

- **1994**
  - NCTM Standards introduced
  - ANE develops School Report Night

- **1995**
  - NSTA promotes integrated science
  - ANE develops RAC goals

- **1996**
  - ANE joins New Standards project
  - ANE joins Addison/Rutland Consortium to sponsor courses & SDIs

- **1997**
  - John V. joins VISMT Assessment Group for new science standards

* indicates national trend or influence

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State Policy Initiatives:
- Planning
- Adoption

District Development Initiatives:
- Priorities
- Funding
- Leadership

Systems Adaptation:
- UVM Partnership
- Schedules, Curriculum Development

Faculty Development:
- Courses
- Teams
- Individuals

Student Experience:
- Project Design
- Course Design
- Student Learning

Student Perspective

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*ON-site MEd Program courses*

D. Marschak's short courses: Mult. Intell., 4MAT, Thinking, heterogeneous grouping

*AP Course Conference

NH Speaker Yearly retreats for math and science faculties

Bill Connor, Max, and Tom begin School-to-Work integration
Systemic Evolution

Figure 17 assembles the events and influences from Appendices A and B into a general model for change at Mount Abraham between 1992 and 1997. In this figure, early initiatives in the classroom and in policy development flow together to force changes in the school curriculum. With the curriculum in flux, driven by both policy and practice, the school community gathered to change basic systems: the schedule, tracking procedures, and relationships with the university. Interacting with the state Department of Education, the school then began fitting disparate parts into a more cohesive whole, using the Vermont Framework of Standards and Learning Opportunities as a vehicle. Finally, alignment among parts of the system created the energy for new initiatives in other areas of the school. By 1997, simultaneous effort at all five levels of school organization was pushing the school in a common direction, toward personal learning plans for each student.

With the flow diagram for Montpelier High School, Figure 17 represents a close approximation of systemic change. It illustrates how human energy generated by students and teachers can flow together with a strong policy development effort to drive systems adaptation. The final phases of the diagram show how systems adaptation becomes self-generating. Small changes in schedule, curriculum, service, and departmental organization interact to force the whole district to adapt in ways that are internally consistent, but responsive to continuing pressure from the outside world, especially from state government. In Figure 17, human energy flowing freely across organizational lines may allow the whole system to continue growing as the environment continues to change.

Interactive leadership

Change has gathered its own momentum at Mount Abraham, not because John Vibber made it happen, but because John’s interactions with others across organizational lines supported the emergence of a vision for student learning that now permeates the
school. John engaged the whole span of organizational life. He experimented with his own AP students and then involved his colleagues in a wide array of faculty development activities over many years. He kept the idea of student performance in front of the administration, creating many opportunities for the community to see student work based on standards. He joined state-level committees and projects exploring issues of policy and practice related to standards, engaging local and national leaders in the Mount Abraham initiative that eventually became “Challenge for All!” Over many years, he played an inconspicuous but central role in weaving people together around a single vision that then grew in proportion to the numbers of people involved. Leading-by-interacting at each level of school organization has allowed the whole school to evolve to the point that student portfolios and learning plans are evidence of organic extensions of what already exists, rather than innovations.

When I met with David Royce, principal of Mount Abraham, I learned that faculty commitment had been a centerpiece of the school for much longer than the last six to nine years. In 1969, “School started without a bunch of naysayers,” David Royce remembered. “The teachers were willing to go the extra mile for their students. They weren’t satisfied with the status quo then and I don’t believe we are today.” David Royce believes that student questioning and faculty questioning are mutually reinforcing. When students are asking questions, teachers are also asking questions and looking at concepts in a different light. When I asked David Royce what he felt his role had been in supporting change, he replied, “Nothing. I just stay out of their way!” Like John Vibber, David creates a context in which people can solve the problems they face.

Tom Tailer had a different response when I asked him about Principal Royce’s involvement in developing the physics war. Tom admires David’s willingness to let the war take place at all, but he also feels ongoing support when David stops by classes to see how
things are going or takes public “heat” when disruptions or problems occur. David Royce is a principal who protects his risk-takers, making positive public statements throughout the year to board and community members. John Vibber agrees that at Mount Abraham there is a prevailing attitude of saying “yes” unless there is a good reason to say “no.” The community and school board have been responsive to teacher initiatives and have supported change in a positive way.

Turning toward performance standards has encouraged diversity in teaching and learning. Tom Tailer believes the paradigm of a clean and orderly classroom has given way to a messier model of learning in which student questions drive exploration and exploration drives learning. Although the faculty may hold different views about what constitutes “good teaching,” they respect one another as professionals. Beyond respect, an internal dialogue among colleagues prevents anyone from getting stuck in one paradigm. Tom Tailer sees the faculty at Mount Abraham as having a high degree of ownership of the curriculum, a document that many faculty have been directly involved in writing and rewriting.

John Vibber has galvanized change at Mount Abraham by freely crossing the geographic and conceptual boundaries that divide conventional high schools into fiefdoms. He has been equally active in the classroom, in organizing faculty development, in redesigning schedules and curriculum, and in statewide policy deliberations. While John Vibber has been a catalyst for change, he points out that credit for the change needs to be given to the faculty who dared suspend their established beliefs to begin working with students in novel ways. Vibber stated, “When people care about others, when they do things because they have ownership and vested interest, they are more apt to have success. When they create a vision together, and as colleagues work toward their goal, they bring a sense of value to their task and derive satisfaction from the results.”
During a period of organic growth, individuals interact constantly across organizational lines. As they interact, each individual in the system operates independently, but in response to interaction throughout the system. Melanie Stultz-Backus, a member of the PDS steering committee at Mount Abraham, adjunct faculty at the University of Vermont, and cooperating teacher for numerous interns, summed up the feelings of many about innovation at Mount Abraham: “Change has been allowed to occur because pressures for innovations have been accepted and viewed as important for student growth by teachers, administration, and community.” The next challenge is to redirect the energy created in the early 1990s to generate the re-creation and re-telling of new stories.
Conclusions:
Human Energy and Organic Growth

John H. Clarke

We have taken science for a realistic painting, imagining that it exactly copied the world. The sciences do something else entirely—paintings too for that matter. Through successive stages, they link us to an aligned, transformed, constructed world. We forfeit resemblance, on this model, but there is compensation...

Bruno Latour

In each of the five chapters that precede these conclusions, we have told the same stories five times, revising our presentation in every case to develop a new perspective on school-wide change. Each iteration has transformed the original information we gathered from interviews and observations, bringing us closer to useful meaning, though at the cost of verisimilitude and at an increased risk of error.

First, to capture the educational value of teaching innovations, we observed students learning in unusual ways in high school classrooms. Our descriptions all involved student engagement and control over projects that were to be judged by an audience beyond the teacher.

Second, we interviewed protagonists in the schools to develop a six-year story describing how change had occurred, folding the recollections of different actors into a coherent narrative. Our narratives tried to capture the human drama of change in a high school setting, showing that successful change always depended upon the doggedness of a “pioneer” who found
support from reliable “partners” in the school and beyond, and from visible or invisible co-conspirators whose influence allowed the innovation to elicit nourishment from the school and continue growing.

Third, we represented each story on a visual grid with five levels, showing that simultaneous attention from different levels of school organization was necessary to support the spread of innovative ideas. Increased interaction across organizational lines increased the rate and depth of the change process within the schools.

Fourth, we clustered related events into phases of change for each school, showing that promoting reform within any high school depends on expanding existing patterns of growth in that school, rather than on a unitary version of how change should occur in all settings. Growth occurs as people at one level exchange energy with people at other levels of the organization.

Finally, we transformed the phases of change into flow diagrams, visual representations of human interaction across organizational lines within a school. We conclude that systemic change depends upon high levels of energy exchange among all levels of school organization, self-organizing to actualize a shared vision of student learning within that school.

We tested our conclusions by representing the same interview information one more time, as aspects of a dynamic system. Chapter 9 includes additional representations of the high school stories, converted into dynamic form through a systems modeling program called STELLA, which allowed us to assess complex interactions among factors contributing to change.
In view of all these representations, we have concluded that change in high school teaching proceeds from existing strengths within a school program, gaining momentum through connections with related ideas that are also forming within a particular school. Movement toward “systemic” change results from frequent interaction among individuals at different organizational levels who do not share specific tasks, but whose interactions around separate projects generate new energy. This in turn supports school change and helps shape an organizing “vision” that inspires further ideas. Across and within organizational “levels,” human interactions generate sustaining energy in a direction that becomes increasingly clear as new innovations become part of the change process. Partners engaged in a reform initiative continuously adapt to each other, changing in ways that allow the initiative to “grow” in strength and coherence.

When change began to generalize within a school, interactions among many individuals occurred in increasingly complex patterns. In these interactions, no individual or system component could remain stable while others changed. The change process could not be controlled from any single vantage point. Growth in classrooms, programs, schools, and school systems must be mutual growth, we concluded, providing all participants with the sense that they benefit personally to the extent that others benefit from their work (see Figure 18). Systemic change therefore depends on increasing the energy of interactions across organizational lines so that growth occurs among many connected efforts. This then supports the evolution of a common sense of direction at all levels of the organization.
Increasing Energy Flow

Figure 19 defines seven concepts that emerged in our discussions as we tried to explain the people and ideas that exert influence in our work with different Vermont high schools.

Innovation as Adaptation. In our high schools, change did not occur by a process of addition, but through adaptive growth. We found more educators skilled at improving the good things they were doing than inventing new projects. The people in these stories did not create new ways to teach as much as they changed what they were already doing to fit changing needs and sensing what was possible in the schools where they worked. Rather than inventing new solutions to old problems, people pursuing change in our five high schools were adapting old practices to newly discovered opportunities in their work with students and each other. These opportunities emerged as new ideas entered into discussions. Words such as “authentic tasks,” “assessment rubric,” and “performance standards,”
**Innovation as Adaptation**
High school reform results less from creating new practices than from adapting existing practice to fit new conditions and actualize an emerging “vision.”

**Self-organizing Growth**
Systemic change is a process of growth in which people develop and clarify a shared purpose through interaction with each other.

**Confluence of Energy**
When individuals are moving in a common direction, their interactions bring energy into confluence, empowering both parties, extending the initiative, expanding the reform, and clarifying their shared “vision.”

**Convergence of Resources**
Successful adaptation at any organizational level occurs when people in neighboring levels bring resources and support to that level.

**Mutual Empowerment**
Change occurs when individuals benefit mutually from their interactions.

**Organizational Reciprocity**
Energetic interaction among individuals across all levels ensures that balanced growth occurs.

**Leadership Density**
Density of activities at any level create opportunities for change at other levels. (When density drops, opportunities disappear and growth diminishes.)
derived from the standards movement, did not drive the change process; they gave educators a new way to discuss and understand their changing work. This allowed a shared “vision” to emerge slowly within the school community, a vision that connected disparate aspects of adaptation. High school reform depends on people at all levels of school organization adapting what they already do to fit purposes that evolve as individuals across the school interact with each other. **Systemic change is a process of growth in which different people develop and clarify a shared purpose through their interactions around specific projects in school reform.**

**Confluence of Human Energy.** Change spreads and strengthens in a school through confluence. This is the tendency for different initiatives with a shared purpose to flow together, gathering strength as they merge, and putting increasing pressure on surrounding parts of the organization to adapt in response. Confluence is most visible in the map of energy flow at Mount Abraham, where a policy initiative at the state level, and classroom innovation within the math and science departments, flowed together to create schoolwide momentum. But confluence is active in each of the maps, with different kinds of effects. At Otter Valley, change flowed from the top of the organization to the bottom, gaining specificity at each boundary crossing. At Otter Valley, however, there was not enough confluence to create momentum toward systemic integration. At Essex, a group of early classroom experiments gradually forced a block schedule and faculty governance system into being, providing a foundation for further experiments—but leaving much of the district’s superstructure unaffected. *Confluence of energy across all five levels of organization creates systemic change.*

**Leadership Density.** In our study, the most energetic periods of adaptation occurred when individuals from different areas of school life were actively interacting around a shared set of ideas. Ray Proulx, coordinator of LAB projects at the University of Vermont, considers “leadership density” an optimal condition for school change (Aiken, 1998).
When leadership is dense and interactive, decisions are made through a process of mutual discovery; they are not delivered from one level of organization to another. When different people are doing different things for the same kind of purpose, their efforts combine to increase the momentum of school change.

**Reciprocal Empowerment.** In this study, individual teachers and students were not empowered by others; they empowered themselves through interaction with one another. Different actors offered different kinds of value to projects, and the exchange was mutual. Mutual empowerment often crossed organizational lines in both directions at once. Empowered by teachers to pursue their own learning, students who gained recognition by creating unique expressions then empowered their teachers to continue innovating. Empowered by administrators to adapt their teaching, teachers provided administrators with evidence supporting a district initiative. In this study, change was both bottom-up and top-down at the same time, occurring through reciprocal interactions across organizational levels. Reciprocal empowerment spreads leadership across the organization, challenging conventional concepts of authority and blurring conventional divisions of responsibility. *Reciprocal interactions across school lines ensure that the whole organization can remain balanced as it grows, adapting to accommodate the pressure that falls on all people in any system when growth is occurring organically.*

We settled on the conclusions listed above because they are consistent with our understanding of the settings where we work, internally consistent with each other, and consonant with research and theory in organizational complexity and change (Senge, 1990; Wheatley; 1993; Perkins, 1992). Each of us is a participant observer, privy to the drama of daily work with students and biased by our exposure to local myths and preconceptions. We tend to write down facts and ideas that are consistent with our understanding of the schools where we work. We have compared the experience of change in different schools, aware of the special reputation each school has in a small rural state. As our
research continued, we checked our findings with each other, looking for commonalities but also aware of differences that would mark our experience in different schools. In the end, our conclusions emanated from the dialogue we conducted among ourselves over nine months of interaction.

Clearly our schools were not blessed equally with the ability to adapt to the standards movement. Unpredictable disruptions in any part of the system could disrupt the exchange of energy and stall or derail the process of adaptation. Bomb scares, budget cuts, leadership changes, new mandates or directives—any could divert energy from growth to concerns unrelated to the “vision” emerging through interactions across organizational lines. Disruption at one level of organization might deprive adjacent levels of the energy they need to continue adapting. On the other hand, schools such as Montpelier and Mount Abraham gathered systemic momentum during the six years under study. This was characterized by rich periods of simultaneous activity at all five organizational levels, woven together by interactions across all organizational boundaries. Once attained, systemic momentum may prove to be durable, robust—and unpredictable. High levels of human interaction in a high school generate new adaptations that cannot be planned, because they are developed by individuals with a unique understanding of the opportunities for adaptation available in their daily activity.

Implications for educators at different levels

In a changing school, each individual has to come to accept destabilization as part of the process of growth. Innovation at the classroom level, for example, generates dynamic tension among the other levels of school organization, creating a state of disequilibrium that is necessary to sustain the process of school change. As elements of the system adapt to changes in each other, they do not settle into a steady state, but they engage in a cycle of mutual destabilization, which creates an endless struggle for the people who are teaching
and learning in the schools. Schools such as Montpelier and Mount Abraham can change all their systems at once because the organizing “vision” for student learning assures each person that the direction of change is legitimate. Participants in change engage in mutual accommodation; people forced to change engage in resistance. *People at different levels of school organization can accept destabilization only if they feel that they control change within their own realm, shaping what they do to fit patterns that emerge only gradually as change progresses.*

Still, destabilization is a different experience for people at different levels of school organization. Our conclusions have different implications for people who work at different levels (see Figure 20).

**The students: Personal learning and student engagement**

Learning is personal. That observation should bring no surprise to people who work with young adults. Still, in these five schools, the young adult drive to assert a unique identity to the world at large was readily apparent in each of the innovations that succeeded. In each of the five classroom innovations, students had a personal stake in the process of learning. They knew that the results of their work would become public, first with their classmates and then with the larger community. Each student was responsible for producing a unique representation of the subject matter from a unique perspective. Part of the image of student success for all five projects is the same: students used their knowledge to create a unique expression of their understanding, which was then examined by an audience beyond the teacher. Teachers and parents may have used common standards to assess performance, but the products of student work were unique to each individual. Student performances at increasing levels of sophistication had a transformative effect on the emerging “vision” in a school, pushing supporting systems toward accommodation.
Reform of high school teaching depends on supporting the evolution of existing innovations toward a common vision, one that gains increasing clarity and power as exemplary innovations grow and coalesce.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Implications for Practice</th>
</tr>
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<tbody>
<tr>
<td><strong>Change occurs in an energized climate.</strong></td>
<td>Policy formulation creates tension between aspiration and actuality, allowing a collective “vision” to emerge that celebrates and encourages new innovations.</td>
</tr>
<tr>
<td><strong>Continuity must be emphasized.</strong></td>
<td>Celebrate innovations that reflect the vision over a long period of time, connecting different examples to the emerging vision (grants, rewards, conference presentations).</td>
</tr>
<tr>
<td><strong>Interactions drive change.</strong></td>
<td>District initiatives connect innovators to resources within a school community, letting all members see how their own efforts connect to a shared vision and how further adaptations are required.</td>
</tr>
<tr>
<td><strong>Increased flexibility is necessary.</strong></td>
<td>Feed resources to emerging innovations, expanding and changing district plans to accommodate examples of improvement in structure and practice.</td>
</tr>
<tr>
<td><strong>Change creates pressure.</strong></td>
<td>Systems changes that adapt to active innovations also pressure static educators to begin adaptive change.</td>
</tr>
<tr>
<td><strong>Teams should be focused on problem-solving.</strong></td>
<td>Organize teams of educators to examine the strain on existing systems and recommend system adaptations to the school community.</td>
</tr>
<tr>
<td><strong>Innovators direct their own growth.</strong></td>
<td>With continuous interaction among teachers and others in the educational community, faculty innovation tends to grow toward an organizing vision.</td>
</tr>
<tr>
<td><strong>A rich and continuous menu is a must.</strong></td>
<td>Allow individuals to pursue their own development plans, connected to larger teams that report progress to the whole school community.</td>
</tr>
<tr>
<td><strong>Improved learning fuels adaptation.</strong></td>
<td>The needs of students drive teachers to respond; interactions between students and teachers drive the change process.</td>
</tr>
<tr>
<td><strong>Teaching and learning should be celebrated.</strong></td>
<td>Publicize student work that reflects the emerging vision of the school community.</td>
</tr>
</tbody>
</table>
In each of the five classrooms studied, the students were deeply engaged in tasks they had defined for themselves, yet their success depended upon interactions with others within and beyond the classroom. Otter Valley students designed a land-use plan for their own 100 acres. Yet the success of their plan depended on persuading others that their land-use plans conformed to general rules. Essex students gathered information from a variety of sources and presented it to their classmates in their own unique way, yet their presentations were designed to help all students in the class answer a common question. Students in the South Burlington Imaging Lab all pursued independent projects, but their audience was the community at large. Montpelier students were developing personal learning plans within a structure of common expectations. Mount Abraham students designed individual weapons for maximum effect, but measuring their success occurred collectively on a global battlefield. Exhibitions of student work representing both the unique talents of the individual and the achievement of shared vision had a galvanic effect on the whole school community, fortifying the emergent “vision” while inspiring others to express their own perspectives.

All five innovations contained what seemed like a paradox: individualized learning occurred most powerfully in an intensely interactive, social context. The explanation for this central paradox could lie in our selection of classrooms for the study, or it could lie in the Vermont Framework of Standards and Learning Opportunities, where each standard refers to both an individual expression and a common standard that must be applied socially, using a larger group to assess progress. The term “performance standards” signifies the binding of individual achievement to a larger social context. Student motivation, which was high in all five classrooms, may depend on the tension that results from granting autonomy to high school students and then subjecting them to collective judgment in light of shared standards. Since not all classrooms were affected by the standards to the same extent, the explanation for this commonality may lie elsewhere.
How would dynamic tension between individual performance and social interaction contribute to the success of a school change initiative? Recreating knowledge for an audience beyond the teacher may appeal to the adolescent need for autonomy and recognition in the adult world (Ericson, 1968). Motivation results from having control over tasks and recognition for achievement within a group (Herzberg, 1962). Cooperative learning increases student motivation and task completion (Slavin, 1990; Johnson and Johnson, 1987). Even when carried out in a single classroom, the innovations in this study have the look of authentic (Wiggins, 1989), open-ended challenges inviting solutions that cannot be specified in advance (Resnick, 1989). We would not expect to see the same level of student energy in classrooms where all students were expected to arrive at the same result through the same process.

The teachers: Pioneer and partner educators

Each innovation in this study was driven into being by an individual whose hardy independence kept the innovation moving and growing. These pioneers were supported by at least one partner; a person or group weaving the innovation into a larger fabric being developed within the community. Ellie Davine and Bill Petrics in Otter Valley, like Sue Pasco and Kevin Martell in Essex, developed their innovation as a teaching team. Tim Comolli kept his students producing images, but a series of partners within the school—from department chairs to funding agencies—fed resources to the project and connected it to related initiatives in other departments. In both Montpelier and Mount Abraham, partnerships gradually extended throughout the school. As the innovations in these schools grew, they gained recognition as expressions of the collective “vision.” In schools approaching a level of systemic change, growth of the innovations depended not as much on the persistence of the pioneer as on the expanding sphere of partnerships. Within these five schools, the wider the partnership spread, the more durable the innovation became.
**The administrators: Adapting systems and adopting systems perspectives**

In these schools, success of a specific innovation depended on the readiness of surrounding systems to make room for anomalies and to change shape under pressure from different parts of the school organization. In relatively stable schools such as Otter Valley, most surrounding sub-systems—tracked classes, subject-based curriculums, large departmental structures—remained intact, and change was restricted to a single department. In schools such as Montpelier and Mount Abraham, structures were changing throughout the period of innovation, driven not only by pressure from the innovation, but also by a collective vision that gradually expanded to accommodate new practices. Successful innovation depends on communication among levels of the organization so that large-scale changes can emerge as small scale innovations grow. Complementarity among different efforts depends on developing a “systems perspective” among all members of the school community—the recognition that the school is growing in a particular direction (Senge, 1990). As change becomes systemic, no aspect of school structure can remain isolated from the process of growth.

**The community: Envisioning and revising**

The five schools studied included no instance in which a “vision” for learning that developed at one level of organization directed the process of change at other levels. Instead, the process of creating a collective vision for the district interacted with specific classroom innovations to create ongoing reciprocity between an evolving district vision and models of that vision in daily teaching and learning. At Otter Valley, the focus of curriculum development switched from the RNE “Proficiencies” to the *Vermont Framework of Standards and Learning Opportunities* when a significant number of teachers instituted units based on the *Vermont Framework*. At Mount Abraham, “Challenge for All” was a motto first used to describe isolated experiments. It then influenced the development of school-to-work programming and finally came to represent a school-wide constellation of related reform efforts.
The purpose of district personnel in systemic reform is not to lead people toward a common purpose, but to gather people together so their interactions generate a common vision. Communication is difficult in schools where classrooms, offices, and public spaces are rigidly divided from each other and time is strictly scheduled. Leadership in such a setting must be interactive, occurring simultaneously among people working on different tasks at different levels of organization. Feeding resources to people who share a common problem both solves the problem and contributes to the continuing growth of an organizing vision.

Policymakers: Organic adaptation vs. mechanical alignment

Systemic change in this study occurred as an organic process of mutual adaptation among people at each level of organization. It did not evolve in response to a single source of influence, but in response to multiple forces interacting daily across the lines of organization. The complexity of these interactions throw into question techniques of school reform based on mechanical or linear models (Cohen, 1996). The data representing the need for change in these schools did not come from test scores or other assessment results, but from “pioneer” teachers interacting with their own students and other members of the school community to develop a sense of student needs. They were then able to respond to these needs with increasingly multi-faceted teaching techniques. Goals were not determined in advance; goals evolved as programs and students succeeded, heavily influenced by ideas under development in other schools and in general professional discourse. None of the projects described here measured their success against an established array of performance standards. Mechanistic or prescriptive models for managing change do not seem to apply to these projects.
Change in the five schools appeared to grow organically, responding to interactions between local influences and the larger environment, within a context noticeably heated by national reform rhetoric. An organic process of change appears to depend less on structural imperatives and mandates than on the availability of free energy within the system, and the exchange of energy from one part of the organization to another. Professional development school partnerships, to the extent that they support reform at all, provide “free energy” in the form of school-based interns and professors, while simultaneously increasing the flow of energy across organizational lines through School Development Institutes and similar events. As change took hold in these schools, it became increasingly complex and multifaceted, reducing the extent to which it could be controlled from any particular part of the organization.

Human energy and school change

Change requires energy. In organizations such as high schools, virtually all energy that matters to learning is human energy. In high schools not yet engaged in reform, most human energy remains largely confined within organizational levels. In changing high schools, human energy escapes its organizational boundaries and begins to interact with energy from other parts of the organization. A shared vision of purpose may promote energy exchange among organizational levels, but the vision also grows and changes as different “levels” of high school organization become engaged. As Figure 21 shows, patterns of energy exchange during reform may be idiosyncratic to particular schools and shaped by patterns of prior growth in those schools. By definition, systemic change cannot occur without the full involvement of all levels. It is not likely that systemic change in high school teaching will leave the divisions between academic subjects or layers of authority intact.
How can we say that the flow diagrams represent the exchange of human energy in an organization? Our focus on human energy is speculative, but reasonable for an organization that produces nothing but human learning. We have no reliable measure for human “energy.” Each representation of the same interview data yields a different interpretation, risking different kinds of misrepresentation and misinterpretation. Do the descriptions of student involvement in academic tasks misrepresent the level of involvement necessary to learning? We initially selected projects that were recognized in their schools for eliciting involvement rather than passivity. Do the stories of change overstate the influence of hidden “partners” because we contacted those partners to fill out the story lines? Do our simultaneous timelines simply reflect the success of a single researcher in penetrating different organizational layers? Do the phase charts, obtained by circling “clusters” of influence exchange, simply represent the selective memory of both researchers and their subjects? In any case, we are ending this project with the sense that the things that make a difference in high school reform cannot be directed from any vantage point; they must be developed collectively by members of a high school community who develop energy for their own teaching projects through interaction with others across the boundaries of organizational levels.

Successful school reform appears to depend on the ability to guide the flow of human energy in the general direction suggested by an emerging vision of student learning. Figure 21 compares the flow of human energy, derived from interactions across organizational lines, in the five high schools studied. The most “systemic” patterns of development—at South Burlington, Montpelier, and Mount Abraham—occurred when early interactions between faculty and students gradually expanded to involve system change, district initiatives, and state policy. The less systemic patterns, at Otter Valley and Essex, crossed organizational lines in a linear sense. However, they did not form a pattern of sustained expansion by gathering all levels into simultaneous interaction. Systemic momentum
appears to occur when people in a school organization get involved and remain involved while other parts of the organization gradually become engaged. At Mount Abraham and Montpelier—the schools with the greatest momentum toward systemic change—interaction in the final year of study crossed all five boundaries of organization, with influence moving “up” organizational levels at almost the same rate that it flowed “down.” The more systemic an initiative becomes, the more complex the sustaining interactions appear to be. Systemic change may depend on a dense web of interactions that is essentially self-organizing (Wheatley, 1993).

None of the schools studied achieved systemic change, a condition in which all five levels of school organization interact appropriately to support change in a common direction. Instead, different schools achieved different degrees of systemic momentum. At Otter Valley, most of the change occurring over six years was limited to the social studies department. At South Burlington, change involving several departments produced a school-wide technology initiative, but not comprehensive curriculum reform. At Essex, cross-departmental collaboration helped the faculty develop governance procedures supporting reform, but without resources represented by the district and state. At Montpelier, experimentation with community-based learning helped drive the idea of personalized learning plans into place as a model, but much of the academic program remains unaffected for most students. At Mount Abraham, active experimentation in science and mathematics helped create a foundation for performance-based teaching throughout the school. However, diverse experiments with both standards and authentic learning projects have not yet produced a coherent standards-based curriculum. Still, comparing the patterns of change in the five schools suggests that systemic change may be possible only when all levels of school organization are interacting with intensity over a long period of time.
Figure 21
Five Patterns of Change
from low to high systemic potential

A. Top-down Change
Interactions between the school district and the standards movement at state and federal levels produce a unit design process that focuses on student performance.

B. Adapting Systems
Student/faculty interactions trigger systems adaptations and a district-wide focus on technology and standards.

C. Organizing System Change
Student/faculty interactions drive a school community to adapt its systems and prepare for school-wide change.

D. Systemic Evolution
Two separate initiatives, one in student/faculty interactions and the other in policy and community development, merge to form systemic momentum.
Growth in a human system

As much as we would like to abstract principles and postulates from our stories in order to make high school reform a manageable enterprise from this moment on, the stories of change in these Vermont schools remain human stories. They result from interactions between people who are different from one another, but who have come to share a common sense of purpose for their work through interactions with each other. Successful change requires the influence of partners as much as pioneers. The most powerful interactions driving the change process cross organizational lines, but it is the people, not the organizational lines, that carry force and influence from one sphere to the next. In thinking about high school reform, we cannot separate the people from the complex process in which they are engaged.

We have tried to present visualizations of change in high school settings so people can “see” their own work in light of how others are working. If energy is indeed flowing across system boundaries in our high schools, that energy is human energy, subject to vicissitudes of fate and time. It is not a constant. It can be constrained, it can be lost, it can be wasted. It can be frustrated. As Figure 21 shows, increasing the level of human energy in a school may increase the rate of change, but not in a predictable pattern. Instead, human energy structures itself to fit existing conditions, growing most noticeable in parts of school life where growth is already occurring. Expanding change to systemic levels depends on increasing the energy flow between parts of the system that are already changing and parts that are not yet engaged.

In concluding our study, we cannot assert a set of principles that will make high school reform manageable, or even predictable. In developing pictures of high schools in motion, however, we can try to make the process of change more comprehensible so that the people involved may better understand the complex process in which they are engaged.
If people involved in high school reform can see their experience through a useful lens, they may be better prepared to take advantage of the opportunities for innovation that arise in their interactions with one another.
In Chapter 2 we described our strategy of using visuals to analyze the process of school change. In the intervening chapters, we discussed individual schools we had studied, showing how timelines, phase maps, and flow charts allowed us to identify and cluster related activities and show the movement across the levels of change over time. While the timelines, phase maps, and flow maps reflected the patterns of energy flow over six years, they were not particularly useful in developing general propositions about how change occurs during high school reform. Consequently, we applied a secondary level of analysis to each map to identify patterns of interaction associated with movement toward systemic reform. Phase portraits showed the relative influence of activity at different organizational levels. STELLA maps described the interplay of influences as change progressed. Both let us compare one school with another and generate explanations of how successful change occurs.
**Phase portraits**: Graphic analysis of timelines obscured patterns in the vertical flow of influence, restricting our ability to compare the force of influence flowing from one organizational level to another. Consequently, we developed “phase portraits” that removed the influence of time and represented only the hypothetical forces flowing from one organizational level to another. As Figure 24 shows, the phase portraits emphasize the variability of influences and direction of force in different schools. Some levels receive but do not exert influence. Some levels do not exert direct influence on other levels. Some levels exchange influence in a reciprocal pattern. As we discussed our maps and chapters as a research team, the general conclusions described in chapter 8 emerged.

Our discussions of the phase maps led us toward a common language we could use in explaining the evolution of our separate innovations.

**Reciprocity**, as used, signifies an exchange of influence between any two levels.

**Mutual empowerment** signifies an equal exchange of influence between levels.

**Confluence** signifies influence flowing through one level, then on to another.

**Convergence** signifies two influence arrows from different levels coming together in a third level.

**Leadership density** refers to a complex web of influences moving among all the levels of organization in both directions.

**Systemic momentum** refers to a phase in which all five levels are interacting, with influence flowing “up” as well as “down.”

Repeated patterns in the phase portraits led us directly toward the conclusions we have included in chapter 8. In our study, increasing complexity would directly reflect increasing capacity for systemic reform.
**Dynamic modeling via STELLA**

Neither timeline maps nor phase portraits, however, let us manipulate the dynamics of the relationships among initiatives at different organizational levels. From the phase portraits alone, we were not able to answer “what if” questions. Therefore, David Gibson converted the timelines and propositions we derived from phase portraits into dynamic representations or “systems models” of change in the schools, using STELLA, a systems modeling program (Richmond, 1995). Using STELLA maps allowed us to develop new propositions about the interactions of human energy expended at different organizational levels. For example, we were able to ask questions such as, “What happens when policy development decreases?” Chapter 9 employs STELLA maps to extend the conclusions we proposed in chapter 8 (Gibson, 1999).

**Modeling learning organizations**

Systems thinking, derived from complexity theory, gave us a new way to think about change in places such as schools. Richmond (1995) defines systems thinking as both a paradigm and a method of learning that represents an organization as a synergistic whole. Since the early 1990s organizational thinkers have been developing a new approach to change in organizations, which borrows as well as develops ideas from complexity theory. Writers such as Senge (1990), Wheatley (1994), and Fullan (1993) are early examples of many who are now applying ideas from complexity theory to individual and organizational learning. In the past, the research on school change emphasized policy development and implementation control: Research based on complexity theory admits that causal linkages, the cornerstones of control, are difficult to trace (Senge, 1990), or they disappear altogether in complex systems such as schools (Stacey, 1992).

To recognize the dynamics of change, we could not use research techniques that obscure the complex relationships through which change evolves. Rather than reducing the
flow of reform to a sequence of factors, we needed to view the increasing complexity of interactions that appeared to accompany a successful reform initiative. We wanted our maps to replace linear cause-effect chains with representations of dynamic interrelationships, what Lambert et al. call “reciprocal processes” (1995, p. 36). We also wanted to replace static, one-shot statistical images with pictures of processes that move and change over time (Senge, 1990, p. 73).

Based in complexity theory rather than determinism, our maps could not produce transferable generalizations, but they could allow educators to “see” invisible forces at work. Fullan asserts:

*It is no longer sufficient to study factors associated with the success or failure of the latest innovation or policy. It is no longer acceptable to separate planned change from seemingly spontaneous or naturally occurring change. It is only by raising our consciousness and insights about the totality of educational change that we can do something about it* (p. vii).

Fullan (1993) came to believe that “…educators must see themselves and be seen as experts in the dynamics of change” (p. 4). On the way to becoming those experts, educators need a new, non-linear system language that gets them into the habit of “experiencing and thinking about educational change processes as an overlapping series of dynamically complex phenomena” (p. 21). Then educators will have the capacity to “learn to influence and coordinate non-linear, dynamically complex change processes” (p. 74).

Though educators may not be able to control patterns of energy flow in a school setting, recognizing the patterns of interaction that support change may allow them to shape the process of growth. With the whole system in view, we can choose to feed energy to the most active elements of the school organization. We can also begin to seed areas of the organization where little interaction is visible, knowing that each level of organization must be active for systemic change to occur.
An increasingly diverse body of literature on complexity records a significant shift in perspective that took place in the late 20th century. As the century came to a close, elements of chaos and complexity theory became increasingly influential in scientific discussions, changing the way science viewed the world. In their analysis of evolution in science and the humanities, Schwartz and Oglivy, as cited by Egon Guba (1985), identified seven ongoing transformations in the way researchers view the world they are trying to understand:

1. From viewing the world in simple, probabilistic terms to viewing the world as made of complex systems
2. From seeing things in terms of hierarchical order to a heterarchy of orders
3. From expecting a mechanistic universe to one which is holographic and knowledge-embedded
4. From a determinate universe to an indeterminate one
5. From explaining relationships in terms of direct causality to a more complex mutual causality
6. From seeing whole systems as an assembly of small parts to thinking about the morphogenesis of systems
7. From an assumption of the possibility of pure objectivity to an awareness of a perspectival (multiple views) nature of reality

The shift represented by these seven characteristics reflects the impact of 20th century thinking on 19th century ideas, stretching and pulling those ideas into a new millennium of thought. Newtonian mechanics has become quantum reality; strictly deterministic causality has prepared the ground for chaos theory and multideterminism. The 20th century marked the end of certainty as the purpose of research and the reemergence of wholism.
Limitations of interactive systems research

Clearly, a method of research that is allowed to emerge through the interaction of six professional development school site coordinators has limitations. We chose our innovative projects somewhat arbitrarily, seeking five that were recognized as moving toward standards-based reform without a standard referent to justify our choices. Some of us were probably more rigorous than others in following leads from one level to the next. Different narratives included events with unequal “grain size,” making some timeline maps appear richer than others. Initial predispositions probably led us to focus differentially on some favored aspects of an innovation. Turnover in school personnel prevented us from contacting people who played important roles in a project’s development. All of us are accustomed to promoting our own professional development school, competing gently with each other for development funding, graduate interns, and recognition for achievement in reform. Nevertheless, by cycling each phase of the research back through our respondents, we gained confidence that the final representations of energy flow in each school were accurate enough to allow some comparison across the cases. The conclusions we derived from all five cases appear to be consistent with each other and with the narratives from which they emerged. Figure 22 lists the five projects we chose to study, arranged to reflect the extent to which reform had approached systemic levels of engagement—involving all five levels of organization—by 1997.

Our work together was exploratory. Educational research into school reform has not yet exploited modeling techniques developed to study complexity in other fields. No articles or books that are keyed to “chaos theory and learning” are found in the ERIC national educational database before 1989. After that date, all of the related terms, such as nonlinear dynamics, dynamical modeling, and systems models turn up the same 23 articles. An almost equal number of journal articles (12) and ERIC documents (11) have been cataloged. It is interesting that the number of journal articles has shown no growth
since the first articles appeared in 1991. Our research aimed to create a picture of whole school systems engaged in reform, revealing the processes that drive both natural and planned growth. Change and complexity are not problems that get in the way of the realization of our intentions. They are the essence of learning, lying at the heart of the educational enterprise.
Limitations of qualitative inquiry

The qualitative research we report does not aim toward generalizability in a conventional sense (Kennedy, 1997). We were not seeking a finite array of paths representing all the options available to a reformer. Crites (1986) has warned us against the "illusion of causality." A sequence of events looked at backwards has the appearance of causal necessity and looked at forward has the sense of the teleological, intentional pull of the future. Our maps of change represent networks of interaction rather than causal models. We have refrained from distilling the data into a single map representing a single view of high school reform to avoid the conclusion that reform must proceed in a singular way. Instead, we have assumed that reform may proceed in multiple ways, responding to the unique context and constitution of different high schools. Our research has been an extension of the collaboration that marks our relationship to our professional development schools. We have chosen to build our analysis from narratives related by participants in these schools, working from interviews with primary actors to other teachers and administrators who shaped the path of the main story. Because collaboration continues from beginning to end in narrative inquiry, plot outlines were continually revised as consultation took place over written materials and as further data were collected to develop points of importance in the revised stories (Connelly, 1996). We hope that our stories and visual representations will help other educators to recognize the breadth of their own choices and develop paths of their own.

We have not been motivated by a positivist interest in reducing high school change to a general model. As others have pointed out, however, abandoning positivism does not entail abandoning standards of objectivity and rationality in research; it proposes instead that such standards be understood in a non-positivist way (Connelly and Clandinin, 1990). The data collection processes must "fit" the research questions (Howe and Eisenhart, 1990). As Leiberman suggests, we are conducting our research not as objective outsiders, but as members of a community who want to learn from each other, build
further trust, and even challenge our own frameworks (Leiberman, 1992, p. 9). As our conclusions show, the process of looking at high school reform forced us to set aside the relatively simple assumptions with which we began the project.

In working together, we gained vastly increased respect for the ability of human systems to adapt and grow in response to growth in neighboring systems. High schools can change. These stories demonstrate how it can happen.

**Analytic maps from narrative maps**

The first time our research team met, early in the fall of 1997, someone raised an inspired question: Could we use a visual modeling strategy to show the patterns of activity and the growth of the innovations we were about to document and describe? Our aim was to create a kind of “moving picture” of the flow of energy inside a growing school. Over the life of this project, we discovered the answer. We could convert narrative information from these interviews into different kinds of visual representation, and different representations opened different perspectives on the schools we were studying. Two forms of visual representation, phase portraits and STELLA maps of systems dynamics, let us look for patterns in the interactions among levels of school organization in our five schools. The secondary analysis of our timelines (Appendix A) and phase maps (Appendix B) allowed us to develop the general propositions about change in high school that constitute our conclusions.

**Phase portraits**

A few days after the mid-point research meeting, we met at Otter Valley High School, where Carol Spencer was the site researcher. On a piece of paper, David Gibson drew five circles representing the five organizational levels, leaving room for drawing lines of interaction among them, arrows representing influence exchange. David made notes as we interviewed Carol, labeling each line of influence with the year under discussion. At home
later that night, David arranged the circles like a fireside circle, all equidistant from the center. This display greatly clarified the flow of energy among levels, helping us spot parts of the system engaged in reform—and other parts that remained aloof.

David stated his belief that if we lined up fireside circles as points in time along John’s linear sketches, we might have rough or symbolic phase portraits of the system’s dynamics. The phase portraits, or fireside circles, let us “see” the interactions across boundaries in a sequence of six years, so we could begin to imagine how one year led to another. The phase portraits start with the state policy sector and arrange the five sectors counterclockwise from there. Our first phase portraits for Otter Valley and Montpelier high schools did not assign a spatial meaning in the arrangement of the five sectors, but they served reasonably well to show the major interactions from year to year during the change process. (All five phase portraits are included in Appendix D.) Reading the six phase portraits in order from 1992 to 1996 allows us to observe the waxing and waning of influence within a school’s history and draw inferences about the conditions leading toward systemic engagement, or simultaneous interaction among organizational levels.

The phase portraits in Figure 23 show, year by year, the positive influences crossing boundaries between the five sectors. At Montpelier High School, the Community-Based Learning program became the Personal Learning Plan during the six years of the study. In 1992, a change in the roles, time, and responsibilities of teachers helped provide focus and support for professional development. In the following year, several moderate influences converged at the district and teacher levels. Teachers continued to be positively influenced by system changes in that year and were also influenced by students who began to participate in the innovation. In 1994, a second strong set of influences at the school level positively influenced teachers to continue developing personal learning plans. Beginning in 1995, new reciprocal relationships featuring ongoing dialogs and mutual beneficial actions began to occur between teachers and the school structure, as represented by the school
administrators. These reciprocal relationships continued and deepened for the next three years, fueling the drive toward personal learning plans for all students.

To obtain a summative portrait of interactions in each school, we extracted influences from each “fireside phase portrait,” summing up exchanges of influence among all levels for all six years of the study. Summative phase portraits provide a composite picture of influence exchange for all six years, letting us assess the extent of systemic interaction in our five schools, so we could rank them from most systemic to least systemic. We continued to muse about the meaning of the “system” as viewed through these various lenses—the continuous linear timelines and the slice-in-time “phase portraits.” The portraits constitute a diagnostic picture of influence exchange within a particular school. By creating interactions where none have existed, they help educators identify opportunities
to speed the development process. Figure 24 depicts summative phase portraits of our schools for all six years under study. We derived our conclusions about “what makes a difference” in high school reform from the summative phase portraits. Did the representation produce the conclusions? No. Different representations allowed us to “see” our stories from different perspectives, thereby producing inferences with different kinds of usefulness.

The summative portraits allow some comparison among schools. They allow a quick assessment of the relative strength and distribution of influence exchange. The strongest ongoing reciprocal relationship between students and teachers, for example, appears in Essex Junction and Montpelier high schools. The strongest involvement of all sectors appears in Mount Abraham. All three sites were judged to be more successful in sustaining their innovations. South Burlington, in contrast, appears to be relying on the institutionalization of expectations for learners, because several influences converge on the student experience from several levels. Few reciprocal relationships appear at South Burlington, suggesting that the technology innovation may prove more stable than dynamic. In Otter Valley, the summative picture shows moderate reciprocal relationships among adjacent levels as change proceeds, but an examination of the year-by-year story reveals that the instances of interaction are widely separated in time and never engage all five levels at once. Without systemic interaction, change at Otter Valley may prove fragile.

Using the summative portraits enabled us to generate propositions about the density of interactions in a school system, reciprocity among “levels” of the system, and confluence of forces across boundaries, each of which we associated with movement toward systemic change (see Figure 19 in Chapter 8). While comparisons of schools using the summative portraits are hazardous, the summative portraits led us to our main conclusion, that systemic change depends on a pattern of ongoing interaction across organizational lines, in which both reciprocity and density play a role. As Figure 24 shows, our maps suggested that changing schools are characterized by high levels of energy exchange up and down the
The intensity of human interaction within the system allows parts of the system to adjust to changes in adjacent parts, allowing autopoeisis to occur—that is, self-organizing change within the system (Wheatley, 1994).

**Dynamic systems maps from STELLA**

Still, we were unable to use the phase portraits to answer “what if” questions about change in all the schools together. John faxed David the timeline graphics, and he experimented with the “STELLA” program to turn them into dynamical models. STELLA is systems modeling software developed by High Performance Systems in Hanover, New
Hampshire that allows teachers, students, or researchers to simulate and then manipulate the workings of complex organizations (High Performance Systems, 1995; Richmond, 1995). David first assigned each sector to its own independent area of the model, with a “storehouse” for counting the significant events mentioned in each of the research stories. Each significant event had a point in time when the event started, a line representing its duration, and an endpoint. The storehouse for that sector received input driven by a set of ordered pairs of numbers (year, event-start) representing the start moments of each event in the sector. For example, if two state policy events were involved in the story, one starting in year 2 and the other in year 5, the list of inputs might look like this: (1,0) (2,1) (3,0) (4,0) (5,1) (6,0) (7,0). STELLA modeling produced a graph showing the relative strength of different organizational levels as time progressed (see Figure 25). We then met to explore the strengths and weaknesses of the method David had used to move activities at five levels into a dynamic representation. A complete STELLA analysis of the schools in this study can be found in David Gibson’s dissertation (Gibson, 1999).

Time series graphs represent the growth of an innovation’s supporting components within the sectors over time. This view does not relate the sectors to one another but gives us a way to look at starting and ending conditions, possible linear and nonlinear relationships, and the final configurations of the sectors at the end of the study. For example, the Montpelier graph shows that school structural changes led the way for all other sectors to grow (except that the influence of state policy on the innovation lessened just after other sectors grew). In comparison, at Mount Abraham High School, student learning experiences grew faster than the school structure did. Both of these schools, deemed more systemic in the adoption of the studied innovation, contrast sharply with South Burlington High School, where state policy led first and the distance between the sectors was much greater at the end of the study. For example, professional development at South Burlington High School lagged far behind district policy development concerning student outcomes in relation to technology innovation.
Figure 25
STELLA Time-Series Graphs
for Montpelier and Mount Abraham High Schools

Montpelier High School
1: State Policy  2: District Init.  3: School Sys.  4: Faculty Dev.  5: Student Exp.

Mount Abraham Union High School
1: State Policy  2: District Init.  3: School Sys.  4: Faculty Dev.  5: Student Exp.
The STELLA maps gave us a way to “see” momentum gathering, or not gathering, toward systemic involvement. The researchers decided that the STELLA visualization did help us talk to each other about the patterns we were finding in the high schools. Innovation had a different curve in each site, and yet some of the curves looked like parts of one another. The beginning part of one school’s story, for example, looked like the ending part of another site’s story (see Figure 25 and Appendix E). We could use the STELLA maps to develop “fuzzy” theories about how change occurs in high school teaching. Consider this fuzzy theory: Top-down policy that follows a ground swell of prior capacity and activity by staff causes one kind of reaction in a school staff. Top-down policy that comes out of nowhere causes another type. The Montpelier and Mount Abraham stories seemed to be embodiments of the first part of that theory. Otter Valley’s story seems to embody the second. If there is a likeness in the underlying dynamics of Montpelier’s and Mount Abraham’s stories, then we would expect to see similar parts of curves in relatively similar circumstances.

However, the point here is that the major dynamical movements are unlikely to be radically altered unless the whole story somehow shifts in completely new ways. This would not be unheard of in qualitative research. For example, Wolcott (1994) says, “There is no such thing as immaculate perception, and there is no immaculate description either” (p. 15).

**Visual analysis of qualitative data**

We finished our analysis both mystified and entranced by the prospects for converting narrative information into different visual forms. Timelines let us see five levels of organization working toward one purpose. Bubble maps let us see phases of intense interaction. Flow maps let us see human energy moving across lines. STELLA models let us see how energy ebbs and flows during reform at different levels of organization. “Fireside”
phase portraits let us see who was interacting during the change process—and what levels of organization remained disengaged. Summative phase portraits let us collapse several years into one moment, making us think about organic change in a complex system.

No single representation of energy exchange in our schools would serve all purposes equally. Different purposes called for different constructions of the same information. We finished the project fairly content with our conclusions, but sure that we had not explored all the options for the visual representation of qualitative data. If the purpose of educational research is to let educators understand their own situations and imagine solutions to the challenges they face, visual representation may have a rich future. To change our schools, we need to “see” where we are now as a place on the road to where we want to be. Using different maps allows us to see different aspects of a complex and evolving educational scene, creating different kinds of choices for all of those whose collective energy appears essential to high school reform.
Appendix A
Simultaneous Timelines

The illustrations in this appendix are timeline maps separating events from a “story” into simultaneous timelines at five levels. They each derive from a detailed description of an instructional innovation within one of the five schools that was receiving recognition as an example of change in the direction of standards-based teaching. Through an interview process, a coherent story emerged connecting all the individuals and events described by different respondents. From the stories, we abstracted specific events that had played some part in the genesis of the innovation or in the development of related events and assigned them to one of the five levels of organization.

The heavy horizontal timelines on our maps represent both long-term and short-term events, with longer lines indicating momentum—that is, continuous pressure exerted by ongoing activity. Vertical arrows show how one event was said to influence another in the stories we assembled. A vertical arrow pointing upwards and crossing an organizational line indicates a “bottom-up” influence (pressure at a lower level that forces a higher level to adapt); a vertical arrow crossing downward across an organizational boundary indicates “top-down” influence. At the policy level, the timeline of events that generated the Vermont Framework of Standards and Learning Opportunities is represented the same way on each map, augmented by other policy-level events mentioned in the narratives (Vermont Department of Education, 1996).
### Simultaneous Timelines: Standards-Based Unit Design at Otter Valley High School

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<td>Green Mountain Challenge</td>
<td>Common Core of Learning</td>
<td>Math &amp; Writing Portfolio</td>
<td>Vermont School Report implemented</td>
<td>DOE creates $500 &quot;reward&quot;</td>
<td>EEO Act 60</td>
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<tr>
<td>New American school site (Marge Sable)</td>
<td>Superintendent urges local curriculum plan: “Great matrix in the sky”</td>
<td>Beliefs about learning: ANE proficiences</td>
<td>John puts 100 acres in A&amp;B book</td>
<td>Nancy designs standards-based unit planning format</td>
<td>Goals 2000 unit design grant</td>
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<tr>
<td>Bill, John &amp; Nancy develop book on school change</td>
<td>Partnership established with UVM</td>
<td>Interns join the Otter Valley faculty</td>
<td>Ellie (mentor) &amp; Bill (intern) form team</td>
<td>Unit design teams form</td>
<td>Problem-based SDI’s</td>
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<td>District Development Initiatives:</td>
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<td>Systems Adaptation: UVM Partnership</td>
<td>Schedules, Curriculum Development</td>
<td>School Development Institutes</td>
<td>Schedules, Curriculum Development</td>
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<td>Faculty Development: Courses, Teams, Individuals</td>
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<td>Student Experience: Project Design, Course Design, Student Learning</td>
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**State Policy Initiatives:**
- Planning
- Adoption

**District Development Initiatives:**
- Priorities
- Funding
- Leadership

**Systems Adaptation:**
- Partnership established with UVM
- Interns join the Otter Valley faculty
- Unit design teams form
- Problem-based SDI’s

**Faculty Development:**
- Courses
- Teams
- Individuals

**Student Experience:**
- Project Design
- Course Design
- Student Learning

**Student Perspective:**
- Project Design
- Course Design
- Student Learning

**Simultaneous Timelines:**
- Standards-Based Unit Design at Otter Valley High School

- **1992:** Green Mountain Challenge
- **1993:** Common Core of Learning
- **1994:** Math & Writing Portfolio
- **1995:** Vermont School Report implemented
- **1996:** DOE creates $500 "reward"
- **1997:** EEO Act 60

- **1992:** Superintendent urges local curriculum plan: “Great matrix in the sky”
- **1993:** Beliefs about learning: ANE proficiences
- **1994:** John puts 100 acres in A&B book
- **1995:** Nancy designs standards-based unit planning format
- **1996:** Goals 2000 unit design grant

- **1992:** New American school site (Marge Sable)
- **1993:** Bill, John & Nancy develop book on school change
- **1994:** Partnership established with UVM
- **1995:** Interns join the Otter Valley faculty
- **1996:** Unit design teams form
- **1997:** Problem-based SDI’s

- **1992:** DOE creates $500 "reward"
- **1993:** Partnership established with UVM
- **1994:** Interns join the Otter Valley faculty
- **1995:** Unit design teams form
- **1996:** Problem-based SDI’s
- **1997:** New teams form

- **1992:** Interns design units
- **1993:** Six teams publish units
- **1994:** Interactions with colleagues
- **1995:** Interactions with colleagues
- **1996:** Interactions with colleagues
- **1997:** Interactions with colleagues

- **1992:** Course assignment: 215, 216
- **1993:** Course assignment: 215, 216
- **1994:** Course assignment: 215, 216
- **1995:** Course assignment: 215, 216
- **1996:** Course assignment: 215, 216
- **1997:** Course assignment: 215, 216
**System-wide Focus Forums**

- Partnership established with UVM

**Partnership develops problem-based SDI**

- P. Henry forms faculty clusters
- PDS steering group forms
- Block scheduling committees

**2 x 2 block scheduling introduced**

**New governance structure: faculty senate and faculty council**

**School-based teacher preparation, with adjunct faculty: undergraduate**

**Faculty development workshops/courses: thinking skills, 4MAT**

**Kevin’s MEd on multiple intelligences**

**SDI teams form**

**Post bacs contribute 4MAT, thinking skills, multiple intell., & standards-based units**

**Faculty forms school-wide climate committee**

**American Studies course forms**

**Sophomore global studies course**

**Units designed in 4MAT structure**

**Performance-based assessment with multiple intell.**

---

**State Policy Initiatives:**
- Planning
- Adoption

**District Development Initiatives:**
- Priorities
- Funding
- Leadership

**Systems Adaptation:**
- UVM Partnership
- Schedules, Curriculum, Development
- Faculty Development:
  - Courses
  - Teams
  - Individuals

**Student Experience:**
- Project Design
- Course Design
- Student Learning

**Student Perspective**

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**Simultaneous Timelines: Adapting to Differences at Essex Junction High School**

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<td>Board adopts Framework of Standards &amp; Lng Opps</td>
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<tr>
<td>Partnership established with UVM</td>
<td>School Development Institutes</td>
<td>Partnership develops problem-based SDI</td>
<td>P. Henry forms faculty clusters</td>
<td>Armando encourages team formation</td>
<td>2 x 2 block scheduling introduced</td>
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<tr>
<td>New governance structure: faculty senate and faculty council</td>
<td>School-based teacher preparation, with adjunct faculty: undergraduate</td>
<td>Faculty development workshops/courses: thinking skills, 4MAT</td>
<td>Freshman faculty form freshman coop team</td>
<td>Kevin’s MEd on multiple intelligences</td>
<td>Post bacs contribute 4MAT, thinking skills, multiple intell., &amp; standards-based units</td>
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<tr>
<td>Faculty forms school-wide climate committee</td>
<td>Faculty forms school-wide climate committee</td>
<td>UVM undergrads and Essex Honor Society create “brain cell” tutorial service</td>
<td>American Studies course forms</td>
<td>Kevin &amp; Carol</td>
<td>Kevin &amp; Sue</td>
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<tr>
<td>Sophomore global studies course</td>
<td>Units designed in 4MAT structure</td>
<td>Performance-based assessment with multiple intell.</td>
<td>Mike designs interdisciplinary course: great ideas</td>
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**Simultaneous Timelines: Integrating Technology at South Burlington High School**

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**Notes:**
- **EEO Act 60**: CVEC Consortium forms
- **Mac Lab opens**: Henderson funding community education
- **Intern joins Tim**: Tim opens imaging lab
- **Intern joins Tim**: AV sets tech goals
- **Tim's Road Ahead grant**: "Change of Course"
- **Alias wavefront funding**: Henderson Foundation course
- **Students produce video, Road Ahead**: Students to MA & NJ
- **Nat Geo video**: Students receive award New Orleans
Simultaneous Timelines: Developing Personalized Learning Plans at Montpelier High School

1992 - 1997

State Policy Initiatives:
- Planning
- Adoption

District Development Initiatives:
- Priorities
- Funding
- Leadership

School-based Initiatives:
- Schedules, Curriculum, Development

Faculty Development:
- Courses
- Teams
- Individuals

Student Experience:
- Project Design
- Course Design
- Student Learning

Student Perspective

1992
- Green Mountain Challenge

1993
- Common Core of Learning
- Math & Writing Portfolio
- School Board adopts strategic plan
- District Leadership Cadre formed on standards

1994
- School-to-work initiatives and other efforts to meet student needs
- PLP for 9th-grade students: first year of implementation

1995
- Community-wide strategic planning includes IEPs for All
- UVM interns join all school teams
- UVM interns conduct research projects
- PLP Support System designed

1996
- Vermont School Report implemented
- UVM interns join all school teams
- UVM interns conduct research projects

1997
- EEO Act 60
Simultaneous Timelines: Integrating Math and Science to Reach Standards at Mount Abraham Union High School

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<td><strong>NCTM Standards introduced</strong></td>
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<td><strong>NSTA promotes integrated science</strong></td>
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<td><strong>ANE develops School Report Night</strong></td>
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<td><strong>ANE develops RAC goals</strong></td>
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<td><strong>ANE joins New Standards project</strong></td>
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<td><strong>ANE joins Addison/Rutland Consortium to sponsor courses &amp; SDIs</strong></td>
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<td><strong>John V. joins VISMT Assessment Group for new science standards</strong></td>
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<td><strong>Mount Abe departments become cross-disciplinary</strong></td>
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<td><strong>Problem-based SDIs begin</strong></td>
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<td><strong>Admin studies block schedule</strong></td>
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<td><strong>Departments map math and science topics to support integration</strong></td>
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<td><strong>Admin studies block schedule</strong></td>
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<td><strong>Mout Abe begins 2x2 block schedule</strong></td>
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<td><strong>Graduate students join PDS</strong></td>
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<td><strong>SDIs begin</strong></td>
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<td><strong>Two math/science teaching teams form</strong></td>
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<td><strong>Yearly retreats for math and science faculties</strong></td>
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<td><strong>D. Marschak's short courses: Mult. Intell., 4MAT</strong></td>
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* indicates national trend or influence
To interpret the timelines shown in Appendix A, we explored how certain events led to other events. As a result of this process of discussion and refinement, the numerous arrows and lines were reduced to clusters of connected activity. The maps evolved to reflect growing coherence in the narratives. With increasing coherence, the maps also began to show distinct phases in the process of development, which were visible in clusters of vertical arrows, moving either up or down across organizational lines. We used the phases in these maps, illustrated in this appendix, to organize the chapters of this book, explaining how change evolved within each of the schools.
**Phases of Change: Adapting to Differences at Essex Junction High School**

### State Policy Initiatives:
- Planning
- Adoption

### District Development Initiatives:
- Priorities
- Funding
- Leadership

### Systems Adaptation:
- UVM Partnership
- Schedules, Curriculum Development

### Faculty Development:
- Courses
- Teams
- Individuals

### Student Experience:
- Project Design
- Course Design
- Student Learning

### Student Perspective

#### 1992 - 1997

- **1992:** Green Mountain Challenge
- **1993:** Common Core of Learning
- **1994:** Math & Writing Portfolio
- **1995:** Vermont School Report implemented
- **1996:** Board adopts Framework of Standards & Lng Opps
- **1997:** EEO Act 60

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- **1992:** Partnership established with UVM
- **1993:** School Development Institutes
- **1994:** P. Henry forms faculty clusters
- **1995:** PDS steering group forms
- **1996:** Block scheduling committees
- **1997:** 2 x 2 block scheduling introduced

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- **1992:** Post-bacs join PDS: courses on site
- **1993:** Faculty forms school-wide climate committee
- **1994:** Faculty development workshops/courses: thinking skills, 4MAT
- **1995:** Freshman faculty form freshman coop team
- **1996:** SDI teams form
- **1997:** Kevin’s MEd on multiple intelligences

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- **1992:** Mike designs interdisciplinary course: great ideas
- **1993:** UVM undergars and Essex Honor Society create "brain cell" tutorial service
- **1994:** Sophomore global studies course
- **1995:** Kevin & Carol
- **1996:** Kevin & Sue
- **1997:** Units designed in 4MAT structure

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- **1992:** Post-bacs contribute 4MAT, thinking skills, multiple intell. & standards-based units
- **1993:** Performance-based assessment with multiple intell.
## Phases of Change: Developing Personalized Learning Plans at Montpelier High School

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>Green Mountain Challenge</td>
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<tr>
<td></td>
<td>Community-wide strategic planning includes IEPs for All</td>
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<tr>
<td>1993</td>
<td>Common Core of Learning</td>
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<tr>
<td></td>
<td>Community forum</td>
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<td></td>
<td>School Board adopts strategic plan</td>
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<tr>
<td></td>
<td>Partnership with UVM: Interns on site</td>
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<tr>
<td></td>
<td>Modified long block schedule creates flexible time</td>
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<tr>
<td></td>
<td>UVM interns join all school teams</td>
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<td></td>
<td>PLP Team formed to plan program</td>
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<td></td>
<td>Manuals and guides designed</td>
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<tr>
<td>1994</td>
<td>UVM interns conduct research projects</td>
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<td></td>
<td>Faculty discussions: meaningful TA's</td>
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<tr>
<td></td>
<td>Community-based learning open to any student</td>
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<tr>
<td></td>
<td>School-to-work initiatives and other efforts to meet student needs</td>
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<tr>
<td></td>
<td>PLP for 9th-grade students</td>
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<tr>
<td></td>
<td>first year of implementation</td>
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<tr>
<td>1995</td>
<td>Vermont School Report implemented</td>
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<tr>
<td></td>
<td>UVM Conf. PLP</td>
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<td></td>
<td>Faculty awareness discussions</td>
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<tr>
<td></td>
<td>Monthly staff-led PLP in-service</td>
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<tr>
<td>1996</td>
<td>Board adopts Framework of Standards &amp; Lng Opps</td>
</tr>
<tr>
<td></td>
<td>EEO Act 60</td>
</tr>
<tr>
<td>1997</td>
<td></td>
</tr>
</tbody>
</table>
Phases of Change: Integrating Math and Science to Reach Standards at Mount Abraham Union High School


State Policy Initiatives:
- Planning Adoption

District Development Initiatives:
- Priorities
- Funding
- Leadership

Systems Adaptation:
- UVM Partnership
- Schedules, Curriculum Development

Faculty Development:
- Courses
- Teams
- Individuals

Student Experience:
- Project Design
- Course Design
- Student Learning

Student Perspective

1. Green Mountain Challenge
2. NCTM Standards introduced
3. NSTA promotes integrated science
4. ANE develops School Report Night
5. ANE joins New Standards project

- Board adopts Framework of Standards & Lng Opps
- EEO Act 60

- John V. writes "New Trends" article
- John V. helps write new science standards
- John argues "math is the language of the sciences: 'Less is more'" (Sizer)
- Standards-based assessment being tested
- Department develops coordinated math-science curriculum matrix
- Mount Abe begins 2x2 block schedule
- Problem-based SDI's begin

- John V. follows model project: NSTA Coordination Project 2061
- ASPMME Program courses
- Why change Conference
- Ed & Sandy visit NH
- NH Speaker Yearly retreats for math and science faculties
- Graduate students join PDS
- Two math/science teaching teams form

- Tom Tailer develops "Physics war" to integrate math, science, and social studies
- AP Biology introduced, linking math & science
- Math and science teachers begin Mount Abe study
- Math teachers implement Integrated Math - Grades 7-12
- Science Fair each spring integrates math, science, and social studies in student research projects
- Bill Connor, Max, and Tom begin school-to-work integration

- Ed (math) starts grad challenge via standards

* indicates national trend or influence
Examining the phases of change illustrated in Appendix B, we discerned patterns of coalescence repeating on different maps, albeit at different times. Some patterns were repeated in different schools, but the more compelling interpretation was that the different maps represented the same wave pattern—at different intervals during the change process.

By creating boundaries between the clusters of activity appearing in our phase maps, we created representations of the flow of human energy over the six years between 1992 and 1997. In the flow maps, the lightly shaded area indicates the parts of the organization that were active as change evolved, providing an estimate of “density” within the organization, the degree to which all layers were engaged in change at the time. We interpolated the dark arrow near the midpoint of the shaded area to represent the direction of energy flow across organizational lines.

Top-Down Change Process

State & Federal Policy
District Initiatives
Systems Adaptation
Faculty Development
Student Experience


Building Local Capacity

State & Federal Policy
District Initiatives
Systems Adaptation
Faculty Development
Student Experience
Systems and Curriculum Adaptation

State & Federal Policy
District Initiatives
Systems Adaptation
Faculty Development
Student Experience

Growing Systemic Change

State & Federal Policy
District Initiatives
Systems Adaptation
Faculty Development
Student Experience

Systemic Evolution

State & Federal Policy
District Initiatives
Systems Adaptation
Faculty Development
Student Experience
Appendix D

Phase Portraits

The phase portraits let us “see” the interactions across boundaries in a sequence of six years, so we could begin to imagine how one year led to another. The phase portraits start with the state policy sector and arrange the five sectors counterclockwise from there. Reading the six phase portraits in order from 1992 to 1996 allows us to observe the waxing and waning of influence within a school’s history and draw inferences about the conditions leading toward systemic engagement, or simultaneous interaction among organizational levels. The portraits show, year by year, the positive influences crossing boundaries between the five sectors.
Phase Portrait: Otter Valley High School

Phase Portrait: Essex Junction High School
Phase Portrait: South Burlington High School

Phase Portrait: Montpelier High School
Phase Portrait: Mount Abraham Union High School
Appendix E

STELLA Maps

STELLA modeling produced a graph showing the relative strength of different organizational levels as time progressed. Each significant event had a point in time when the event started, a line representing its duration, and an endpoint. The storehouse for that sector received input driven by a set of ordered pairs of numbers (year, event-start) representing the start moments of each event in the sector.

These time series graphs represent the growth of an innovation's supporting components within the sectors over time. This view does not relate the sectors to one another but gives us a way to look at starting and ending conditions, possible linear and nonlinear relationships, and the final configurations of the sectors at the end of the study.
South Burlington High School

1: State Policy  2: District Init.   3: School Sys.   4: Faculty Dev.   5: Student Exp.  

Montpelier High School

1: State Policy  2: District Init.   3: School Sys.   4: Faculty Dev.   5: Student Exp.
Mount Abraham Union High School

1: State Policy  2: District Init.  3: School Sys.  4: Faculty Dev.  5: Student Exp.


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Peter McWalters  David Wolk