Researching the Sustainability of Reform

MONTVIEW

A History Lesson Still Unfolding

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ACKNOWLEDGMENTS

Foremost, we would like to thank the site leaders in each of the study's sites for their support, hard work, and frankness throughout the data collection process. We are grateful to the teachers, principals, district administrators, and many others who spoke with us. We also would like to acknowledge the input and support of the RSR advisory members, and we would like to thank EDC staff members Judi Sandler and Karen Worth for their thoughtful attention and support throughout this work. Additionally, we would like to thank EDC staff members Keith Suranna, Daphne Northrop, and Silvia Tracanna for their assistance in revising these reports and the tireless efforts of Kerry Ouellet in the editing and layout process.

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This material is based upon work supported by the National Science Foundation (NSF) under Grant No. REC-9805078.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation (NSF).

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PROJECT OVERVIEW

The *Researching the Sustainability of Reform (RSR)* project focused on the question of how to maintain the gains of an initial educational change process and support continuing reform over time. Within the broader study of sustainability, the research paid particular attention to systemwide approaches to science education reform as well as to the role that external funds can play in initiating reforms that are sustained. The research was conducted by staff of the Center for Science Education at Education Development Center, Inc. (EDC), in Newton, Mass., in collaboration with staff at the Caltech Pre-College Science Initiative (CAPSI) in Pasadena, Calif. This research was supported by a grant from the National Science Foundation and was directed by Dr. Jeanne Rose Century at EDC and Dr. Jerome Pine at CAPSI.

The goal of this study was to identify and document factors in school systems that contribute to sustained educational change in science education. The purpose was to provide districts now engaged in improving their science education programs and districts that are considering doing so in the future with information to help them more strategically and effectively build an infrastructure for long-term improvement.

Specifically, this study focused on nine communities with K–6 science education programs begun from nearly 10 to 30 years ago. These communities differed in their sources of funding as well as the longevity of their programs. This study investigated how, and the extent to which, these communities have sustained their science education programs and the factors that have contributed to this sustainability.

Through on-site interviews and observations, surveys, case studies, and document analysis, the study investigated the districts' efforts in the following areas:

- Current status of the science program compared with initial goals
- System context and external conditions that have an impact on lasting change
- Strategies for achieving program goals and building district capacity to improve
- The influence of practitioner and system capacity on sustainability
- External funds as a catalyst for widespread, lasting reform

The findings of the research include nine descriptive site summaries and a cross-site report. The site summaries were designed primarily to provide the reader with a description of the origins, implementation, and evolution of each of the nine science programs. They also offer a brief analytic section that is designed to provide the reader with a bridge to the cross-site report. The cross-site report draws from all nine sites to identify common themes and recurring issues relevant to sustainability. It is primarily analytic while offering concrete supporting examples drawn from the nine sites. The cross-site report also includes a discussion of implications of the findings for funders, reformers, and practitioners.

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SUMMARY OF RESEARCH METHODOLOGY

Research Questions

The study was guided by the global research question: What factors contribute to or inhibit the sustainability of a districtwide hands-on science program? Within this broad question, the research focused on several sub-questions: (1) What is the current status of the science education program within the system and how does that compare with the initial goals and implementation of the program? (2) What conditions and contexts surrounding a science education reform effort impact the sustainability of the reform? (3) What decisions have practitioners made and what strategies have they used to bring about enduring change and build capacity for continuous growth? (4) How has the capacity of the practitioners in the system and the capacity of the system itself affected the sustainability of the reform? and (5) What is the role of external funds as a catalyst and/or support for lasting, widespread reform?

Research Design & Analysis

To answer these questions, the study utilized a multi-site case study methodology that made full use of primary and secondary data sources and accounted for the uniqueness of each community while allowing for cross-site generalizations. The primary data was gathered using qualitative approaches including semi-structured interviews, focus group interviews, observations, and document analysis. This data was supplemented with quantitative data collected through a survey administered to all principals and a random sample of 100 teachers at each site.

Some members of the research team had previous experience working with some sites. To alleviate bias, researchers gathered data in sites with which they had no prior interactions. Throughout the process of analyzing data, researchers were careful to address the potential of bias as a result of their experience with hands-on curriculum and any interactions with sites previous to this study.

Site Selection

The study focused on nine school districts[1] that have established an elementary science program reflecting the standards developed by the National Research Council and the American Association for the Advancement of Science. The districts fall into two main groups: those that began their science education reform efforts in the 1960s and early 1970s, and those that began their efforts from the mid-1980s into the 1990s. Four of the nine communities are in the former group. Of those four, two have had enduring science education programs and the other two had programs that were strong for a number of years, waned over time, and are currently in a process of renewal. These communities were of particular importance to the study as they shed light on the long-term development of science education programs and on how the "trajectories" of reform efforts vary over many years.

The remaining five communities fall into three sub-groups: Two had funds from the National Science Foundation that had been expended before the research began; one received funds from the National Science Foundation that were expended immediately prior to the beginning of the research; and two initiated their science reform efforts without significant external funding. Together, these districts represent a range of size and geographical location as well as years of participation in reform.

1 All district and individual names are pseudonyms.

Site Visits

Teams of two researchers made several site visits to each of the nine sites over two and one half years of data collection. Each site was visited at least three times with each visit lasting two to four days. In the initial phase of the research, researchers conducted "pre-visits" and phone interviews that enabled them to obtain an overview of the history of the site, discuss data collection procedures, and identify important issues and additional data sources/key individuals to interview. These pre-visits allowed researchers to construct a timeline of the science program, identify critical events in the life of the program, and identify major players both inside and outside the district. This initial contact also included discussions of logistical issues (e.g., timing for site visits), potential schools and classrooms to visit, and tentative scheduling of individuals to interview on-site.

Following the pre-visit, site visits typically consisted of interviews with key district personnel including the superintendent, assistant superintendent, assessment specialist, director of professional development, director of curriculum and instruction, budget manager, science coordinator, Title I and Federal Grants administrators, mathematics and language arts subject matter coordinators, technology program director, and special education director. In addition, researchers conducted teacher focus groups as well as interviews with key stakeholders, such as school board members, union representatives, and community members. Researchers also conducted a minimum of 20 observations of science instruction in at least 10 schools and conducted interviews with the teachers observed and their principals. Researchers also observed professional development sessions and reviewed documents on-site.

Interview and Observation Protocols[2]

Interview protocols were designed to gain information about the goals/vision of the district science program, actual classroom practice, professional development, support for teaching science, sustainability of the district science program, and other key critical issues that had an impact on the science program or the district. Interview protocols were adapted to the individual/group being interviewed. The interviews also explored the factors an individual thought contributed to sustainability of the science program, what factors supported or jeopardized the program, and what they envisioned for the future of the district's science program. Individuals were also given the opportunity to discuss any other issues that they thought were relevant that the interview had not explored.

Researchers conducted observations of science classes to gain a clearer understanding of the current status of the district science program. The objective of an observation was to obtain a "snapshot" of instruction, to contribute to a larger understanding of the school district's practices and goals, and to document the use of hands-on investigation and/or inquiry methods of teaching science. Researchers normally observed an entire science class in grades K–6 that varied in length from approximately 30 minutes to an hour depending on the lesson. Researchers used a semi-structured observation protocol to document the structure of the lesson and capture the teacher's instructional strategies.

Principal and Teacher Surveys

Researchers administered two surveys: the first to all principals in each of eight district sites and the second to a random sample of 100 teachers in each of the eight district sites[3]. The purpose of the surveys was to supplement the qualitative findings of the study by providing additional data on the current status of the program.

2 For a list of interviews and observations conducted at this site, see Appendix A.

3 One district, Montview, chose to abstain from participation in the survey.

These data may not accurately reflect actual districtwide practice. (For a summary of the survey data, see Appendix B.) Survey development followed a three-step process: (1) Researchers conducted a review of other similar instruments; (2) surveys were piloted and interviews were conducted with pilot participants; and (3) a survey expert reviewed the surveys and provided feedback so final revisions could be made.

The surveys provided corroboration of qualitative data and helped guide future qualitative data gathering. They were designed to answer the following questions: (1) What are the respondents' understandings of the current science program? (2) What importance do respondents place upon the science program and what priority does it get within the other areas? (3) What are the respondents doing to implement/support the science program? (4) What factors are important in sustaining an effective science program? The surveys included items about teacher/principal background and experience, school instructional practice, curriculum and materials, professional development, principal practice, teacher classroom practice, influences on science, support for science, and sustainability of science.

For more detailed information about the methodology of this project, please refer to the cross-site report.

OVERVIEW OF PROJECT SITES

	GLENWOOD*	LAKEVILLE	HUDSON††	MONTVIEW‡	BAYVIEW	GARDEN CITY	SYCAMORE	BENTON	BOLTON
SIZE									
Sq. Miles	47†	76	200	800	55	800	25	15	320
# elem. students	27,000	12,000	43,151	47,087	5,849	28,000	6,400	4,300	27,000
# elem. schools	77	23	50	92	23	52	30	15	60
# elem. classroom teachers	1,300	778	1,630	1,978	600	1,300	300	200	1,144
RESOURCES									
Per pupil expenditure	5,668	4,996	5,122	4,443	5,973	5,046	6,500	13,296	6,508
Teacher starting salary	$31,172	$35,573	$27,686	$25,832	$27,467	$27,718	$29,892	$34,116	$32,600
NSF funds?	yes	yes	yes	no	no	no	no	yes	yes
DEMOGRAPHICS									
% students eligible for free and reduced price lunch	66%	70%	41%	18%	40%	32%	65%	39%	30%
% white	13	17	68	85	57	69	69	41	62
% African American	18	34	3	1	12	28	12	34	9
% Hispanic	21	45	23	11	10	0	11	14	6
% Asian/Pacific Islander	27 (Chinese)	4	2	3	18	0	8	10	9
% Native American	21	0	4	0	3	0	0	0	13
% Other	0	0	0	0	0	3	0	1	1
OTHER INFORMATION									
Year program began	1989	1986	1974	1968	1966	1989	1988	1994	1977

* District names are pseudonyms.
† Figures are for years ranging from 1998–2000. During this time demographics and expenditures shifted and were calculated in a variety of ways.
†† The Hudson site report offers the reader an additional detailed description of a classroom science lesson.
‡ The Montview site report is unique in that it emphasizes the historical development of the program and the circumstances that influenced and shaped its evolution.

MONTVIEW
EXECUTIVE SUMMARY

INTRODUCTION

The research team felt it would be worthwhile to offer the reader an opportunity to view one program site from a detailed historical perspective. Montview was selected for this historical review because its program illustrates the evolution of a science program over a time horizon of more than 30 years and because it was considered one of the "pioneers" in the field with its history of hands-on science dating back to the very origin of the school district. Instead of portraying the story of this site with a relatively even emphasis on the current and past programs, the report instead offers a detailed account of its history that can inform the reader about the influences of district and community context, educational priorities and concerns, and local politics that are not as visible in such detail in the other reports.

BACKGROUND

Montview[1] currently is the largest school district in its state. With approximately 88,000 students K–12, it has more than twice the population of the third largest district in the state. Montview also is geographically large, covering nearly 800 square miles, with 102 elementary schools, 20 middle schools, and 21 high schools (including 8 alternative schools and 8 charter schools). Montview has among the highest average teacher salary in the state at $42,843 and with it one of the best teacher: student ratios at 20.7 students per teacher.

Enrollment in Montview has grown steadily in its history from just over 10,000 in 1950 to a peak of over 80,000 in 1977. The district has built 12 new elementary schools in the past 10 years. While the overall population has grown substantially, the diversity of the district's population has increased only modestly since the 1980s. The largest ethnic group is Hispanic students who now compose 11 percent of the school population. Asian and Pacific Islander students are the next largest group, composing 3 percent of the population. African American students compose just over 1 percent of the population.

1 Any individual, organization, or corporation named in this report has been given a pseudonym.

PROGRAM HISTORY AND DEVELOPMENT[2]

Program Groundwork: The Origins of Hands-On Science

Montview Unified School District (MUSD) formed in 1951 from 39 small independent school districts. During these early years, in an effort to bring some coherence to the district, leaders worked to establish a uniform curriculum that would "provide glue to connect and unify the various community and school differences." The interest in bringing curricular consistency to the district was an important contribution to the development of the early science initiative, because it provided a strong incentive for having a single scope and sequence and a high-quality curriculum districtwide.

From 1959 to 1964, a groundwork of leadership was laid for what would be a 35-year history of hands-on science for MUSD. In 1959, Thomas Donahue, a chemistry and physics teacher, who would ultimately champion the elementary science program, arrived. By 1963, Donahue became the district science coordinator. At the same time, the deputy superintendent developed a relationship with Educational Services Incorporated (ESI) in Newton, Mass.,[3] and its work on the *Elementary Science Study (ESS)*. *ESS* was a National Science Foundation-supported curriculum development effort that focused on the creation of highly exploratory hands-on science units for elementary students. From 1964–1968, Montview became a pilot- and field-test site for the units.

In 1968, the *ESS* field-test process had come to an end, and Donahue set out to build from that experience to develop a districtwide program for grades 3–6. The complete program, which Donahue developed in collaboration with a team of teachers, comprised *ESS, SCIS*[4], and a limited number of locally developed units that were complemented by an Elementary Science Guide with information and direction for teachers on how to use the units. This was the first document that "officially" described the district science curriculum.

Second Generation of the Program: Adjusting to District Priorities

In 1973, Donahue began an effort to conduct a complete, substantive revision of the science guide. To begin the new revision process, the science department conducted a needs assessment and obtained feedback from virtually every elementary teacher. Then, following the already prescribed

2 For a timeline of this site's history, see Appendix B.

3 Educational Services Incorporated (ESI) would later become Education Development Center, Inc. (EDC), the organization that conducted the study.

4 *SCIS, the Science Curriculum Improvement Study*, was founded at UC Berkeley in 1963 by Dr. Robert Karplus with funding from the National Science Foundation. The study developed science curricula for levels K–8.

district curriculum development process, the science department developed a prospectus of the revision work to be done. At this time, the district was focused on a newly adopted set of "Student Outcomes," and the readers pointed Donahue toward revising the prospectus in two areas. The first area focused on improvements in science content that entailed changing and/or revising topics or units covered through increasing the amount of life and human sciences units. The second area focused on integrating the science program with about three-quarters of the health and environmental education objectives and including environmental education objectives and strategies into about one-third of the units.

The prospectus was approved and a plan proposing a time line for creating, piloting, revising, and implementing units was put in place with an expectation of full implementation by 1978. As the science program was field tested and piloted in the mid-1970s, the Montview School Board took a step that established an important support: they specified the number of minutes that various subjects—including science—should be taught at the elementary level. These guidelines remained in place through the 1980s.

After the field-test and pilot program, the implementation phase of the newly revised curriculum began in January 1977. The program was composed of four strands—earth science, physical science, life science, and health—and included *SCIS* units as well as units developed by the Biological Sciences Curriculum Studies (BSCS) group.

The Primary Grade Program: The program just described was targeted to grades 3–6. For grades 1–2, a completely different program was put in place known as the Early Grades Curriculum (EGC) program. The program took an integrated approach with a mixture of language arts, science, and social studies tied together with topics or themes and, according to one teacher, "not a lot of investigative stuff."

The "Golden Years" of the Science Program

The mid-1970s through the 1980s marked the "golden years" of the program. During this time, Montview teachers and principals as well as educators across the country praised EGC and the grade 3–6 program. The program also enjoyed support from the Montview central office through a policy-level commitment to a "well-defined curriculum process." Prior to this, there was no policy that focused on the use of curricula districtwide. Science was the first, and it generated guidelines intended for use by other subject areas.

Another important aspect of the success of these "golden years" of the program, as recalled by several experienced teachers, was the strong professional development program established during 1975–76. According to a retired teacher who currently assists in providing professional development in Montview, "virtually every science teacher in every grade level had in-service on the early units that were taught during that time."

In 1980, with implementation complete, the science program leadership turned their attention to a plan for continuous monitoring and improvement of the program. Also noteworthy is the assessment component of the program. From 1982–1990, district leaders administered a science test that included a section on students' experiences with science as well as multiple choice content questions.

The Early 1980s Bring Changes to the Program

The 1980s brought changes in the district leadership and finances that would negatively affect the science program. First, according to a retired principal, the superintendent who came into office at that time brought with him a shift in district culture. Then, financial problems that had been developing in the district began to emerge more severely in the science program. While Montview continued to receive external critical acclaim, internal support began to slide. Still, its core philosophy seemed to remain secure.

The Late 1980s and the Early 1990s: The Program Declines

Donahue described Montview's program in the 1980s as "a good strong elementary science program sustained from the late 60s." Donahue had hoped to maintain what they had accomplished so far and expand it to K–12. Yet, by the end of that decade, Donahue noted that "we were scaling back."

In addition to the growth and struggles of the science program, the late 1980s also marked an era of administrative discontent districtwide. After serving as superintendent since 1981, in 1988, teacher union members, according to a local newspaper, "overwhelmingly voted for a resolution of no-confidence in [the superintendent]," and the superintendent announced he would retire early the following year. A new superintendent arrived in 1989 and brought with him many organizational changes.

Also in 1989, budget issues became more and more visible. Montview had cut 147 jobs and $5.5 million in expenditures to balance the 1989 budget. Then, to balance the 1990 budget, Montview was hoping for a mill levy to raise 14.1 million, the maximum allowable under the law.

On the political front around the same time, in spring 1989, a forum called Education 2000 was created by the Montview Chamber of Commerce, the Montview Board of Realtors, and a local foundation. After forming, more than 200 community leaders spent the year studying several educational priorities. The result was a report produced by the task force that called for "restructuring the Montview schools so that more decisions are made at each school building and teachers have a bigger say in decisions."

Within this political and financial context, Donahue was doing his best to keep science in sight. In September 1990, he authored a report that explained that although science was increasingly becoming a priority in the nation, with the reduction of the science staff by 1.5 FTE in the 1989–1990

school year, the Montview program support had decreased to "an all time low." He went on to explain that without that staff, the accomplishments outlined in the report would not be possible in the future.

By June of 1991, the school board approved "an initial reorganization of the district's administration suggested last February." The reorganization would provide for internal consultants at the primary, intermediate, middle, and high school levels with education re-directed from content areas to move along interdisciplinary lines. The consultants would aid school staff according to grade levels. At this time, Donahue decided to retire early, stating that he had philosophical differences with the superintendent and that the way things were being run "were not for me." Central office leadership was essentially disbanded. According to a former teacher, "once the in-services left, there was no way of maintaining the curriculum as it existed."

The Program Reaches Crisis

In fall 1991, the science program began to rapidly deteriorate. According to some now-retired teachers, "the program went on its own after 1991; most schools were maintaining it to some degree until it fell apart." One assistant principal explained that eventually the curriculum became fragmented. "Teachers did what they wanted, or avoided science...there were rumblings about the old program being good and wondering how to get it back." Teachers generally taught what they knew best during this time, and even when shifted to different grade levels, did not necessarily vary the curriculum. Teachers developed a chaotic view of the program. And yet, according to Alice Lahey, former director of the *Early Grades Curriculum (EGC)* program, after the program disappeared, some people held still held on to the skills.

The Late 1990s: The Program Rebounds

With the arrival of the mid-1990s, Montview aligned with the trends of the state and the nation in demonstrating an increased interest in the development of standards and student accountability. They also had some initial signs of financial recovery with the passing of a bond issue in 1993. A new science program coordinator was hired part-time to facilitate the work of writing the science standards with teachers, and, according to the mathematics coordinator, the "science people were pleased to have a leader."

From the mid-1990s on, new leadership in science began to emerge. By 1994, there was a "Science Support Team" consisting of five people who focused on elementary science. And by the mid- to late 1990s, the science program was on the rebound, due to a range of factors. There was a change in administration, the role of standards became more important in instruction, and teachers and principals expressed a desire for more centralized support for science instruction.

In the late 1990s, the Science Support Team had chosen Biological Sciences Curriculum Study's (BSCS) *T.R.A.C.S.* curriculum as Montview's districtwide curriculum and developed a plan for implementation. As of 2000, the district science department was continuing to reestablish a science program that was both internally consistent and aligned with the state standards and yet still had opportunities for kids to "muck around" and see the big ideas and how they fit together.

CURRENT AND FUTURE STATUS: ON THE BRINK OF A NEW ERA

The section below provides the reader with a brief overview of the first steps Montview has taken to re-establish its program. It briefly describes the program, and some of the circumstances and conditions that are shaping the process. The extents to which the re-established program will be sustained, and the extent to which the core beliefs and values of the original program will remain, are yet to be seen.

The Current Program

Curriculum

The adoption of the BSCS K–5 science curriculum was made after a careful review of 17 different K–8 instructional materials (including *FOSS*[5]; *Insights*[6]; and *STC*[7]). The Montview science team has been piloting and implementing the BSCS program incrementally over the past few years. As of 1999, 42 schools (of a total of 92) were involved in implementing the refined BSCS units, or about 300 teachers at the elementary level out of a total of 2,000 for the district. During the initial pilot period, the district purchased the kits, coordinated books, and provided substitute time to cover the teachers for two days of training and two half-days of follow-up.

District administrators seem to share the feeling that this is a final chance to rejuvenate the science program. According to Kevin Calhoun, the director of instructional services for mathematics and science, in the mid-1990s, "The standards were etched in silly putty. Teachers were told to teach to the standards and the students would get what they needed. Some people just latched on to particular curriculum materials 'sold' by salesmen. Now, we have progressed beyond this stage, but if we stop again, we won't be able to pick it up again. We are at a breaking point here in some ways."

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5 *FOSS (Full Option Science System)*: Developed by Lawrence Hall of Science, published by Delta Education.

6 *Insights*: Developed by Education Development Center, Inc., published by Kendall/Hunt.

7 *STC (Science and Technology for Children)*: Development by National Science Resources Center, published by Carolina Biological Supply Company.

Instruction

The research team visited 10 science classes in five schools. These classes were identified as those that were good examples of the type of teaching the science team was trying to foster districtwide. All classes were supposed to be part of the BSCS pilot and their lessons were to be drawn from the BSCS units. Despite each of these schools' involvement with the BSCS pilot, some of the lessons observed by site visitors were not based on BSCS units, but rather on some of the old Montview units, which they happened to be teaching at the time of the visit. This lends credence to the claim that many of the older teachers still use the old curriculum.

Assessment

The state already had in place standards in science, and in 1995, the district developed its own science standards. The state also has been developing its state assessment program over the past several years, first implementing literacy tests in 1997. In spring 2000, eighth grade students took part in the first state science assessment. And most recently, the Montview science department has completed writing performance expectations in science for grades K–6.

Professional Development

Two staff developers provide all the professional development in science for K–5 in this huge district. They currently are focused on the hundreds of teachers who are involved in the pilot and implementation of BSCS. Staff development generally consists of two days of training per unit with two half-days later for follow-up, although this may vary slightly by unit. Since there are three modules at each grade level, at least six days of training per teacher per year would be necessary, not including follow-up.

DECISION MAKING AND LEADERSHIP

District-Level Leadership

The current science program has strong support from the central office, in particular, from the deputy superintendent. The importance of this commitment was underscored by Kevin Calhoun, who stated, "If leadership does not buy in, then you won't have quality science."

According to Elizabeth Warren, science program specialist, the superintendent favors central support services for the district, and yet, the district "is still reluctant" to make central services positions permanent. District leaders fear the public is still unwilling to support large numbers of administrators and tends to vote in favor of distributing money to individual schools. Warren went on to express the view that "people have to be ready for change," and that "we cannot force the issue when people aren't ready."

The School Board: Calhoun noted that the school board is a powerful force, and "what the board supports happens." Further, despite the decentralized nature of the district, they do not restrict their involvement to district administration.

Science Program Leadership

The current science staff consists of five people, and is led by the K–12 science coordinator, who works with science program specialist Warren. Other elementary science staff members include a consultant (not a district employee), who previously taught in another district, and an elementary school support teacher (SST). Both the SST and the consultant are involved with professional development for teachers who are piloting or implementing the BSCS curriculum. Another SST on the science team, works with Warren on middle school science and has been developing curriculum embedded assessments.

School-Level Decisions

Since the district still has site-based management, the central office cannot require schools to use BSCS; it can only make adoption recommendations to principals. The ultimate decision as to whether BSCS is implemented is made by principals and site-based management councils.

RESOURCES AND SUPPORT

Funding

The budget for the science department for the years 1998–99 and 1999–2000 remained stable, and the staff increased by one more person for 2000–2001. According to one of the science program staff, Montview's elementary science had almost completely been paid for by Eisenhower funds. A very small percentage (5 percent) of money has come from the district, and these funds cover some staff development costs. In addition, some new money ($350,000) has recently come from two small foundation grants for elementary and middle-level materials.

The only major external funds brought into the science program in its history has been in the form of a $700,000 National Science Foundation grant focused on middle school life science.. This supported Elizabeth Warren during the mid 1990s. In 1997, she submitted a proposal for a "planning grant" to develop a plan for a professional development program, but it was not funded.

Community and Partnerships

No formal business partnerships have been established with the district. However, there are other facilities and resources in the community that teachers can take advantage of. In addition to using district outdoor lab

schools, teachers have participated in professional development from the nearby informal education institutions where scientists conduct classes. According to one member of the science staff, teachers often arrange field trips to nearby museums, the zoo, and botanic gardens.

Accountability

State- and district-level emphasis on student performance in literacy and mathematics dominates discussions of accountability in Montview. According to one of the science professional development staff, principals are held accountable for student performance only in the tested areas of literacy and mathematics. Moreover, they get extra performance pay based on meeting school goals for standardized tests (which emphasize literacy and math). The literacy coordinator confirmed that the state assessment program, with its emphasis on literacy, is driving resources and classroom practice away from science.

In this context, science is moving toward finding its place in the assessment fury. In 1999, the science department completed writing performance expectations in science and has developed a framework that includes content benchmarks at each grade level. There are two grades of proposed testing for K–6 (grade 2 and grade 5) and at the middle level (6–9) there is proposed testing for grades 6 and 7. A test in physical science is proposed for grade 8. One science staff member explained, "We are trying to get a consistent program that is aligned with standards."

Equal Access to Science

The district strategic plan raises equity as an issue of concern and interest in Montview. And yet, Montview faces a continuing issue regarding access to the science program in that there is no accountability for program delivery and, in fact, the decentralized system technically does not even require that schools teach the program. Thus, students' access to science education is at the discretion of school administrators who, as described above, are clearly focused on and distracted by the strong district and state emphasis on literacy and mathematics.

SUMMARY

The Montview program has served as a model and support for hands-on elementary science programs for many years. Throughout its celebrated history, it has undergone several stages of revision, with Donahue and other program leaders constantly seeking information about how to better support and improve instructional materials and professional development. And yet, after enjoying renown and respect from both district educators and educators across the country, it still was quite vulnerable to pressures

from district and community priorities. While Donahue and others had given great attention to ensuring that all components of the program were in place, ultimately, it was the factors that pertained to the whole program—perception, philosophy, and critical mass—that sustained the core values and beliefs through the program's "dark period" into a phase of re-establishment. As the program enters a new era, one might question the extent to which it actually is an extension of the original program: did the dark period of the early 1990s actually mark the end of the program, or was it simply an extended "pressure" to which the program had to adapt? The program now has a completely new set of instructional materials, different professional development strategies, and new leaders. Yet, the core beliefs and values set in motion nearly 35 years ago still dominate and hold sway in the decision-making process of the science leaders. They remain the foundation, and only the coming years will determine whether that foundation will stand steady or break under the pressure of district priorities and changing context.

MONTVIEW

A History Lesson Still Unfolding

INTRODUCTION

The driving question of this study—what factors support and inhibit the sustainability of a hands-on, districtwide science program—is in essence, the question that individuals engaged in education improvement efforts want answered. That is, more simply put: how can we make change last? This study was a rare opportunity to explore this question not only in theory, but also by collecting and interpreting data collected in the field. In a sense, this was a historical research project in which researchers identified places that had enduring programs and sought to understand what had been sustained, what paths the programs had followed to get to where they were, and why their histories had unfolded as they did. Researchers looked back 10, 20, and 30 years by reviewing district documents and newspaper articles, and by gathering original accounts from individuals who experienced the origins and initial establishment of the programs firsthand, many years ago.

Sustainability: The ability of a program to maintain its core beliefs and values and use them to guide program adaptations to changes and pressures over time.

The findings of this study—described in detail in the study cross-site report—identify three groups of factors that affect sustainability: those that pertain to conditions surrounding the district and its program, those that pertain to individual elements of the science program, and those that pertain to the program as a whole. To some extent, the factors that pertain to elements of the science program—leadership, implementation, materials, money, professional development and accountability—confirmed much of what already is known. Additionally, the factors that pertain to conditions surrounding the district—culture, decision making and power structures, and science for all—though not typically addressed in discussions of sustaining reform, were not completely unexpected. However, the third group—those that pertain to the whole science program—critical mass, philosophy, perception, adaptation, and quality—were unexpected and, in fact, only became evident after looking at the programs from a long-term time horizon. The perspective of years enabled researchers to see how these factors, whose importance only became visible when the programs were viewed over many years, lie at the core of sustainability.

Thus, the research team felt it would be worthwhile to offer the reader an opportunity to view one program site from this valuable historical perspective. Montview[1] was selected for this historical review because its program illustrates the evolution of a science program over a time horizon of more than 30 years, and because it was considered one of the "pioneers" in the field with its history of hands-on science dating back to the

1 Any individual, organization, or corporation named in this report has been given a pseudonym.

very origin of the school district. Instead of portraying the story of this site with a relatively even emphasis on the current and past programs, the report instead offers a detailed account of its history that can inform the reader about the influences of district and community context, educational priorities and concerns, and local politics that are not as visible in such detail in the other reports.

SIZE	
Sq. miles	800
# elem. students	47,087
# elem. schools	92
# elem. classroom teachers	1,978
RESOURCES	
Per pupil expenditure	$4,443
Teacher starting salary	$25,832
NSF funds?	no
DEMOGRAPHICS	
% students eligible for free/reduced price lunch	18%
% white	85
% African American	1
% Hispanic	11
% Asian/Pacific Islander	3
% Native American	0
% Other	0
YEAR CURRENT PROGRAM BEGAN	**1974**

Figures are for years ranging from 1998–2000. During this time demographics and expenditures shifted and were calculated in a variety of ways.

BACKGROUND

Montview currently is the largest school district in its state. With approximately 88,000 students K–12, it has more than twice the population of the third largest district in the state. Montview also is geographically large, covering nearly 800 square miles, with 92 elementary schools, 20 middle schools, and 21 high schools (including 8 alternative schools and 8 charter schools). Just west of a large metropolitan area, Montview has become, according to the school board Web site, "a thriving suburban community with businesses, industry, and residences." Within the school district, there are six major community divisions. Across these, the school district is divided into 18 geographic articulation areas with feeder schools identified for each. Montview has among the highest average teacher salaries in the state at $42,843 and with it one of the best teacher:student ratios at 20.7 students per teacher.

Enrollment in Montview has grown steadily in its history from just over 10,000 in 1950 to a peak of over 80,000 in 1977. The enrollment began to decline slightly through the 1980s until it picked up again in the early 1990s. The district has built 12 new elementary schools in the past 10 years. While the overall population has grown substantially, the diversity of the district's population has increased only modestly since the 1980s. The largest ethnic group is Hispanic students who now compose 11 percent of the school population. Asian and Pacific Islander students are the next largest group, composing 3 percent of the population. African American students compose just over 1 percent of the population.

While ethnic diversity is limited, there are wide differences in economic status. Individual schools range from having 0–70 percent on free or reduced lunch, with an average across the district of 18 percent in 1998. Mobility rates also are highly variable, ranging from 2–23 percent (depending on the school) with an average of 8 percent in 1997–98. The older schools situated along the border of the nearby urban area, in addition to having more diverse populations also have higher percentages of students on free or reduced lunch programs. The geographic clustering of schools with the poorest students and highest mobility is evident from looking at the articulation areas.

Montview's state is near the bottom in ranking in the country for school funding and, in recent years, school system budgets have been cut statewide.

The Montview district as a whole has had serious financial problems, and the uncertainty of funding loomed over the science department until the recent passing of the mill levy override in 1999. Before the mill levy override, which raised taxes and allocated more money for schools, there had not been an increase in 16 years.

PROGRAM HISTORY AND DEVELOPMENT[2]

Program Groundwork: The Origins of Hands-On Science

Montview Unified School District (MUSD) formed in 1951 from 39 small independent school districts. During these early years, in an effort to bring some coherence to the district, leaders worked to establish a uniform curriculum that would "provide glue to connect and unify the various community and school differences." The interest in bringing curricular consistency to the district was an important contribution to the development of the early science initiative, because it provided a strong incentive for having a single scope and sequence and a high-quality curriculum districtwide.

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From 1959 to 1964, a groundwork of leadership was laid for what would be a 35-history of hands-on science for MUSD. In 1959, Thomas Donahue, a chemistry and physics teacher, who would ultimately champion the elementary science program, arrived. At that time, the district had a district science coordinator as well as an additional coordinator who focused on K–6. By 1963, Donahue had become the district science coordinator and a former science coordinator, returned (after leaving to attend graduate school) as the deputy superintendent for curriculum. While in graduate school, the deputy superintendent, whom Donahue described as "a very strong and creative instructional person," became acquainted with Educational Services Incorporated (ESI) in Newton, Mass.,[3] and their work on the *Elementary Science Study (ESS)*. *ESS* was a National Science Foundation-supported curriculum development effort that focused on the creation of highly exploratory hands-on science units for elementary students. *ESS* was under development from 1964–1968, and through the deputy superintendent's relationship, Montview became a pilot- and field- test site for the units. Both the superintendent and the deputy superintendent lent strong support for this process and, as a result, according to Donahue, "set the stage and drove the culture" that enabled him to carry out his work of nurturing a hands-on science program to its districtwide potential.

In spring of 1964, a Montview newsletter documented this early involvement with *ESS* that marked not only the beginning of working with

2 For a timeline of this site's history, see Appendix B.

3 Educational Services Incorporated (ESI) would later become Education Development Center, Inc. (EDC), the organization that conducted the study.

hands-on science materials but also the foundation of the pedagogical approaches and beliefs underlying use of those materials. In the publication, Donahue explained that "the *Elementary Science Study* is primarily designed not merely to bring to elementary school children the soundest account of science, but even more, to bring to the schoolroom the spirit of science, the chance for discovery, [and] the rewards of investigation." He went on to say that "the teacher in *ESS* is no longer the authority and the giver of all knowledge, but becomes a fellow experimenter, inspiring and guiding the student in an attempt to find his own answers."

Later district publications continued to illustrate the underlying philosophy of Montview's hands-on program. In 1965, for example, the district newsletter explained that the piloting program was an "effort to improve the science curriculum in the elementary school by encouraging children to examine, analyze, and understand the world around them and to stimulate their desire to continue to do so." It continued:

> It is not an attempt to make all children scientists, but to promote their scientific literacy and general intellectual curiosity...the value of this program lies in the opportunity for the intellectual development of the student. He has a chance to experiment on his own and come to his own conclusions rather than being authoritatively presented with information. He can be creative in his experiments and has the opportunity of analyzing and interpreting the data through his own observations and conclusions.

The local press reported on the program using similar language, explaining that Montview students were learning about "the process of scientific inquiry" through piloting *ESS*, a course "designed to stimulate an interest in science through the discovery method." (The Montview Reporter, 1966).

In 1968, the *ESS* field-test process had come to an end, so Donahue set out to build from that experience to develop a districtwide program for grades 3–6. The complete program, which Donahue developed in collaboration with a team of teachers, comprised *ESS*, *SCIS*[4], and a limited number of locally developed units that were complemented by an Elementary Science Guide with information and direction for teachers on how to use the units. This guide was the first document that "officially" described the district science curriculum.

The program was piloted in six schools during the 1968–69 school year, and by the following year (1969–70), they were ready for full-scale implementation. During the next three semesters, Donahue introduced the program through in-services in each elementary school area. Even from this early

4 *SCIS, the Science Curriculum Improvement Study*, was founded at UC Berkeley in 1963 by Dr. Robert Karplus with funding from the National Science Foundation. The study developed science curricula for levels K–8.

introduction, Donahue was careful to create mechanisms for feedback and input from the schools. As a first step, he identified a science leader in every school to gather feedback on the process, and then later, he established an Elementary Science Advisory Committee composed of principals and teachers appointed by the area superintendents.

The leadership of the science program and the central administration at this time was strong and well respected. Donahue and his colleagues (as well as leaders in other subject areas at the time) were recognized as being devoted to their subjects, informed about research, and able to apply that knowledge. Donahue also extended the visibility of the program by conducting a "clay boats" activity with the school board, thus engaging them and helping them understand the goals of the science program. As a result, the early years of the program were well supported.

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According to Alice Lahey, former director of the *Early Grades Curriculum (EGC)* program (a grades 1–2 interdisciplinary curriculum that included science and is described below), Donahue's efforts to enlist the district leadership were key—the administration's expectation that science would be taught was clearly communicated. But the top-down messages didn't function in isolation—they also were supported with a district culture that facilitated the acceptance of those messages. According to Lahey, a strong understanding of and respect for one another were vital contributors to the development of the program. She explained, "Everyone in the administration building had started out as Montview teachers...everyone knew kids...we all lived in Montview and raised our kids in the schools; we had an overall respect for each other.

Second Generation of the Program: Adjusting to District Priorities

In 1973, Donahue began an effort to conduct a complete, substantive revision of the science guide. They already had done a small-scale revision in 1971, but that effort had focused only on minor corrections and changes in equipment prices and vendors. To begin the new revision process, the science department conducted a needs assessment and obtained feedback from virtually every elementary teacher. Then, following the already prescribed district curriculum development process, the science department developed a prospectus of the revision work to be done.

Accommodating Back-to-Basics: Donahue and his colleagues shared the prospectus with elementary principals, area superintendents, Montview's elementary curriculum committee, and the assistant superintendent for instructional planning and development. At this time, the district was focused on a newly adopted set of "Student Outcomes," and the readers pointed Donahue toward revising the prospectus in two areas. The first area focused on improvements in science content that entailed changing and/or revising topics or units covered through increasing the amount of life and human sciences units. The second area focused on integrating the science

program with about three-quarters of the health and environmental education objectives and including environmental education objectives and strategies into about one-third of the units. Donahue worked with the environmental education coordinator and the health education coordinator and submitted a revised prospectus to the board.

The prospectus' emphasis on integration reflected a pressure to address what Donahue later referred to as a "push to go back-to-basics"—reading, writing, and arithmetic. In addition to the substantive revisions to the science program, Donahue also intended to create a guide that outlined reading, language arts, and mathematics objectives that could be met or reinforced by one of the science strategies. The prospectus states:

> Students need an opportunity to apply the skills developed in language arts, reading and mathematics within the context of a discipline…. The strong emphasis on reading, mathematics, and language arts in the last several years at the elementary level apparently has reduced the time and effort given to science in many schools. The guide revision would specifically point out where the basic skills can be applied and reinforced with science activities.

Despite these adaptations, however, the program still maintained its basic program goals. The prospectus offered a rationale (drawing from National Science Teacher Association (NSTA) materials of the time) that stated, "The major goal of science education is to develop scientifically literate and personally concerned individuals with a high competence for rational thought and action." It went on to explain the importance of elementary science as being able "to provide concrete, firsthand experiences for students so that they may begin the process of becoming scientifically literate citizens."

The prospectus was approved and a plan proposing a time line for creating, piloting, revising, and implementing units was put in place with an expectation of full implementation by 1978. As part of this plan, the district would conduct in-service training for administrators and train leaders, provide an initial supply of all new equipment, and assist schools in developing their plans. The schools had the responsibility to develop a storage system and site in-service plan, and to identify outdoor resource sites. They also needed to budget funds to replace supplies and live materials. The prospectus also proposed a monitoring system that included criterion-referenced testing administered to random samples of students, staff questionnaires, and student questionnaires. According to now-retired teachers who participated at the time, teachers involved in this curriculum writing and revision process bonded tremendously which, albeit not by design, contributed to the strong foundation that would support the science program over the years.

As the science program was field-tested and piloted in the mid-1970s, the Montview School Board took a step that established an important support: they specified the number of minutes that various subjects—including sci-

ence—should be taught at the elementary level. These guidelines remained in place through the 1980s. And yet, even with these concrete, explicit expectations for the amount of science to be taught and the widespread support and interest in the science program, there is evidence that the science program still faced stiff competition. A 1976 report describing the program stated, "The lack of sufficient time to teach science plagued us in almost every school. With a few exceptions, most schools do not allocate the percentage of the school day for science instruction called for by Board Procedure." So, even at a time when the program was well supported and on a "front-burner," the actual implementation of the program was not necessarily at the hoped-for or presumed level of use.

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After the field-test and pilot program, the implementation phase of the newly revised curriculum began in January 1977. The program was composed of four strands—earth science, physical science, life science, and health—and included *SCIS* units as well as units developed by the Biological Sciences Curriculum Studies (BSCS) group. According to a former sixth grade teacher, it was a "teacher-friendly program" that involved teachers not only in teaching it, but in writing it as well.

The program had an accompanying implementation plan with several important components. First, it explained that each school needed to identify clear materials management systems that included an equipment list, storage system, inventory procedure, and reorder system. The plan also called for clear delineation of responsibilities for the area superintendents, the principals, and the division of instruction. Furthermore, it offered suggestions for "in-service" that included a half-day for principals, one-hour staff meetings, teacher-focused activities during the semester, and a one-hour staff meeting at the end of the semester. Then, all teachers implementing units would participate in one three-day workshop with multidisciplinary activities, including science, environmental science, and health. The extent to which all of these steps took place in all schools is unknown.

The Primary Grade Program: The program just described was targeted to grades 3–6. For grades 1–2, a completely different program was put in place known as the *Early Grades Curriculum (EGC)* program. Alice Lahey, an elementary science resource specialist in 1974 (who, by 1980, was coordinator of early childhood education for Montview) worked with Donahue and teachers to develop this program after a search for an existing quality program for early grades was unsuccessful. They looked at a review of research conducted at that time as well as results from a district "task force" that documented a discrepancy between stated program guides and actual classroom practice, and decided to create *EGC* units that integrated social studies, science, health, and environmental education. According to two teachers at the time, *EGC* didn't have a lot of science content. It was a mixture of language arts and social studies with "not a lot of investigative stuff," though the content varied somewhat from unit to unit.

The "Golden Years" of the Science Program

The mid-1970s through the 1980s marked the "golden years" of the program. During this time, Montview teachers and principals as well as educators across the country praised *EGC* and the grades 3–6 program. One teacher at the time described the program goal as "having science as a verb and having it be hands-on; doing away with textbooks." Another former teacher explained, "Our goals were to make science accessible for all students and to help them understand its relevance and applicability...to have a program based on inquiry and student involvement that was hands-on." Still another teacher explained that "the strengths of the science program were that it was based on research and standards and built in the inquiry cycle."

The program also trained principals in how to support teachers in their work of teaching science. A retired principal explained that "the old program had strong in-services in science and we had many opportunities for leadership." She also noted that, "We understood where they [the science department] were coming from," and explained that the science department effectively conveyed the vision of the program to principals. A principal's handbook was developed that provided even more support.

The program also enjoyed support from the Montview central office through a policy-level commitment to a "well-defined curriculum process." Prior to this, there was no policy that focused on the use of curricula districtwide. Science was the first such policy, and it generated guidelines intended for use by other subject areas.

With the curriculum well established, Montview science program leaders took the steps necessary to ensure that teachers had the materials they needed. A de-centralized approach to materials was conceptualized as an explicit effort to protect the program from centralized cuts. Principals budgeted money from their instructional supply budget for science, which they used to purchase materials from a district warehouse. Donahue noted, "We carefully developed a list of materials and refurbished those materials every year." He even helped design materials storage systems for schools. This decentralized approach to materials also may have contributed to the strength of the program, because it required commitment and attention from principals and teachers; there would be no material-related excuses for not implementing the program.

Another important aspect of the success of these "golden years" of the program, as recalled by several experienced teachers, was the strong professional development program established during 1975–76. According to a retired teacher who currently assists in providing professional development in Montview, "Virtually every science teacher in every grade level had in-service on the early units that were taught during that time." Donahue described himself and his colleagues as being "green" at professional development, but when faced with the task of conceptualizing and submitting a budget, they made their best effort at considering what they would need and

submitted their plan. Donahue considers this a key event in the district history because they created a budget which, at the time, appeared to have an exorbitant bottom line between $100,000 and $200,000. Further, Donahue recalls, their resources appeared as only a single item within the district budget, so "we had a great deal of flexibility in how to use that money."

Immediately after the initial planning for professional development, there was a fortuitous opportunity to do collaborative work with university researchers who were able to provide feedback on implementation of the elementary science program. This work took place from 1976–78. Donahue noted that this was critical for Montview, because the researchers' work enabled them to gain critical feedback on their program and make necessary changes. He felt "we really became a team" with the researchers as the collaboration continued for three years.

In 1979, an external researcher conducted an evaluation[5] of the implementation of the science program, which revealed some discrepancies between perceptions of the program and actual implementation. The report summarized that the revised elementary science program was "alive, well, and thriving in Montview's schools. However there is still room for improvement in delivering a program to students that is meaningful, interesting and worthwhile." It went on to indicate that:

> ...even though the approach and content of the curriculum is well accepted and often appreciated by principals and teachers...science is not a high-priority instruction area and cannot compete with the district emphasis on teaching reading, language arts, and math. Science instruction is often viewed as "a little something extra," a "frill," but never a basic skill on which life-long learning will be based.

Still, the report concludes optimistically, stating that "the intended program is getting a good start toward becoming fully implemented in these schools. With few exceptions, principals and teachers are making a conscientious effort to deliver the program as intended to the Montview students."

Along with the professional development opportunities provided by the science department, the central office also provided support for the schools through a process known as "concern-and-support." The purpose of this process was not only to offer additional assistance to schools, but also to monitor how the program was proceeding in science. The concern-and-support program manager worked in the Montview science department from the late 1970s until 1991. The process was such that several members of the

5 The external study took place in a random sample of 11 out of 44 schools. Of the 12 components identified (including "time is devoted to science; science is taught according to the guide; teacher-pupil interaction facilitates program") on average, all schools were "getting a good start" (a '2' on a scale of 0–5 ranging from 'outside intended program to best practices working'). When broken down more specifically, the figures show that 44 percent of the schools were "outside the intended program," meaning they were not implementing the recommended amount of time for science.

HER WORK INVOLVED DISCOVERING WHAT WAS GOING WELL FOR TEACHERS IN SCIENCE, AND WHAT THEIR FRUSTRATIONS WERE, THUS ALLOWING THE SCIENCE DEPARTMENT TO CONSTANTLY IMPROVE ON THE EXISTING PROGRAM.

science team and lead teachers would go and observe other teachers' science classes and give them feedback or support in an area. According to the program manager, much of her work involved discovering what was going well for teachers in science; and what their frustrations were, thus allowing the science department to constantly improve on the existing program. The ability to make changes in the science program as it was unfolding contributed to its strength. According to a former teacher, "It [concern-and-support] was a very comprehensive program, and there was support for it," meaning that she and others felt that the central office was behind the program.

Given the strong appreciation of the concern-and-support program, it is surprising that each school received a concern-and-support visit only once every two years. Still, teachers indicated that this was a very strong, important support for them and their schools. The very name of this program reflects what appears to have been a culture of warmth and respect in the district at the time. This respect flourished, in part, because all of the resource teachers and science coordinators were themselves teachers prior to those jobs; the teachers felt they were understood and valued. Teachers across the district felt and appreciated the support of the science program.

In 1980, with implementation complete, the science program leadership turned their attention to a plan for continuous monitoring and improvement of the program. They created a document titled *Development of an Elementary Science Instructional Improvement Plan*. This plan consisted of the following steps: (1) Establish Commitment (e.g., look at school plans); (2) Communicate (e.g., principals' workshop); (3) Practice (allow time for practice); (4) Monitor the Program (with interviews and classroom observations); and (5) Reinforce and Improve. The extent to which this plan was implemented is not known.

Also noteworthy is the assessment component of the program. From 1982–1990, district leaders administered a science test. An introduction to the test explains that the purpose was to:

> ...measure the achievement of sixth grade students on the objectives of the district science program for grades three through six...to help your school improve science instruction by analyzing the achievement of your students on the items of the test.

The test included a section on students' experiences with science, (e.g., In school have you ever...built things with straws and pins? gone outdoors to do science? put an animal skeleton together?) as well as multiple choice content questions. The extent to which the results were used is not known.

The Early 1980s Brings Changes to the Program

The 1980s brought changes in the district leadership and finances that would negatively affect the science program. First, according to a retired principal, the superintendent who came into office at that time brought with

him a shift in district culture. He wanted people "with PhDs—out of county people," whereas leadership until then had come primarily from within. Then, financial problems that had been developing in the district began to become evident in the then nationally recognized science program. One of the most dramatic examples comes from newspaper articles in one of the local papers. First, the paper ran a feature that described a number of honors that the Montview program had received, including the NSTA Programs of Excellence Award. Then, 10 days later, another headline read, "Cash crunch cripples Montview science classes." This article discussed the need that Montview schools had to cut their budgets by $7 million the previous year and explained that "science students, as a result, are getting far fewer chances to perform important procedures for themselves and they are using books that officials concede are outdated and worn."

While Montview continued to receive external critical acclaim, internal support began to slide. But, the science department persevered and, in spite of difficulties at home, Montview maintained its reputation across the country. In 1984, Montview staff attended a meeting at the National Academy of Sciences for the top science programs in the country and, at home, program leaders continued to organize in-service programs and appreciation celebrations for those who were helping to organize and lead their program. In spring 1987, a special issue of a nationally distributed teaching magazine published a piece on the Montview program, referring to it as "one of the best known in the United States."

Still, even as the program adjusted to the changing conditions in the district, its core philosophy seemed to remain secure. Materials from the professional development sessions at that time include discussions of the "inquiry cycle" as described in a *SCIS* teacher's guide (1967), suggesting that philosophically, Montview was very close to where it had started 20 years earlier. More evidence can be found later, in 1988, when there was a science workshop for elementary principals who had not yet had an opportunity to participate in other professional development offerings. The workshop was designed to acquaint principals with key features of the elementary science program and with strategies to monitor and support it. The agenda included the difference between inquiry and direct teaching, classroom management techniques, an overview of the priority in-services, budget support, and a look at the "elementary science key features." The principal's handbook was distributed and used at this workshop as well.

The Late 1980s and the Early 1990s: The Program Declines

Donahue described Montview's program in the 1980s as "a good strong elementary science program, which has been sustained from the late 60s." Indeed, there is further evidence that even as elements of the program were adapted, its goals remained much the same as they were when articulated during the revision conducted in 1973. A district document states:

Even as elements of the program were adapted, its goals remained much the same.

> The major outcome of science education in the Montview schools is the development of scientifically literate citizens (e.g., understands enough of the fundamental concepts of the physical and biological nature of the world so that he/she may act responsibly; possesses science skills and processes that give rise to facts and concepts, possesses attitudes or values generally associated with science such as curiosity and respect for data).

Donahue had hoped to maintain what they had accomplished so far and expand it to K–12. Yet, by the end of that decade, Donahue noted that "we were scaling back."

An externally written case study of the science program, developed from 1988 to 1990, captures the status of the program at the time, saying:

> It could be described succinctly as a collection of units from the *Elementary Science Study (ESS)* and *Science Curriculum Improvement Study (SCIS)* programs, modified to make a district program....All of the manipulative materials required for the program are carefully identified and an extensive teachers' guide for each grade level has been prepared, which goes beyond the original units in terms of information for the teacher and suggestions as to how to conduct the study....The program is clearly intended to be one that is activity-based learning in science..... The actual program ...is described in the following section.

This last statement suggests that there was a discrepancy between the intended program and the actual program that was in operation, and indeed, the authors went on to discuss challenges of "institutionalization" of "activity-based" science learning at the teacher, school, and district level. Evidently, the Montview program was facing obstacles that continue to challenge educators today, including a teacher commitment that was only "moderate," and limited practice of the pedagogy the program promoted. The report explains that the practices of many teachers were "closely congruent with that form of education employed in areas like writing, reading, and mathematics, where the approach is more textbook bound and tied closely to paper and pencil skills."

According to the report, in one school, teachers had a "lukewarm attitude about science," and yet they still acknowledged its importance and place in the curriculum and "dutifully taught the required concepts." A majority of teachers followed the teachers' guide 75–90 percent of the time, "adding worksheets, films, speakers, and magazines." Still, while teachers valued the curriculum for being hands-on and discovery-oriented, some considered it weak for lack of substantive content, lack of closure activities, and avoidance of written texts. Some more-experienced teachers disliked the lack of new units.

The authors went on to suggest that at the schoolwide level, commitment was a bit higher than in the classroom because of the role of the principals.

But, it was not clear to the authors whether the commitment was to this type of science learning or "to whatever science program the district has and promotes." Moving on to the district, the authors remarked that institutionalization is "very high" and that "it is seen in district goal statements, policy decisions...administrative decisions made by central administrators at all levels, and the skilled actions of the science department staff. District institutionalization clearly is present and the program is used throughout the district."

So, even in light of a strong district commitment, the authors of the report still expressed doubt about the extent to which that commitment reached classrooms. They stated that "this situation does not remove, of course, the questions raised earlier about the extent to which the district's ideal is reflected in teaching practices across the district and the means by which it could be further realized." Toward the end of the report, the authors comment on the uncertainty of whether the district is "poised for a further advance in its institutionalization of a quality science program or for a slide back."

In addition to the growth and struggles of the science program, the late 1980s also marked an era of administrative discontent districtwide. In 1988, teacher union members, as reported in the *Gazette*, "overwhelmingly voted for a resolution of no-confidence in [the superintendent], who had served in that capacity since 1981," and the superintendent announced he would retire early the following year. A new superintendent arrived in 1989 and brought with him many organizational changes.

Also in 1989, budget issues became more and more visible. Montview had cut 147 jobs and $5.5 million in expenditures to balance the 1989 budget. Then, to balance the 1990 budget, Montview was hoping for a mill levy to raise $14.1 million, the maximum allowable under the law. They also were proposing a $179.9 million bond issue, mostly to finance repair projects on schools. Both tax measures were defeated, forcing even greater cuts (the budget increase lost by just 64 votes). One teacher, the *Gazette* reported, said that this would make the previous year's cuts look like "child's play." As a result, according to another local paper, the *Telegraph*, the district cut 111 jobs, the maintenance budget was cut $1.4 million, and another $600,000 was cut from instruction development, including elimination of an assistant superintendent for instruction.

On the political front around the same time, a forum called Education 2000 was created by the Montview Chamber of Commerce, the Montview Board of Realtors, and a local foundation. After forming, according to the *Gazette*, more than 200 community leaders spent the year studying several educational priorities. The result was a report produced by the forum that called for "restructuring the Montview schools so that more decisions are made at each school building and teachers have a bigger say in decisions." The plan:

> …suggests that individual schools make hiring selections and budget decisions. Schools would also be given flexibility to choose how to test students, train staff, arrange the school day, group students, and select textbooks and other materials.

One week after the release of this report, the superintendent proposed a reform plan that would include "greater autonomy for schools," as well as redesign of the curriculum and more decision-making power for parents and teachers. Incorporation of this plan was, evidently, his effort to gain support for a $22.7 million tax increase on the ballot that fall. The plan also included an oversight committee composed of community residents that would monitor and report publicly on how the tax increase money was spent. However, in spite of these efforts, in November 1990 the tax measure was again defeated (the third in three years).

Within this financial context, Donahue was doing his best to keep science in sight. In September 1990, he authored a report that explained that although science was increasingly becoming a priority in the nation, with the reduction of the science staff by 1.5 FTE in the 1989–1990 school year, the Montview program support had decreased to "an all time low." He went on to explain that without that staff, the accomplishments outlined in the report would not be possible in the future.

Donahue recommended that a study group consisting of teachers, administrators and parents be convened to consider ways to (1) integrate science content processes and ways of learning into other parts of the elementary curriculum; (2) increase technological literacy; and (3) question the detailed "prescriptive" curriculum format. Near the end of the report, Donahue requested that the district provide ongoing program support and maintenance, stating, "for many years, the science resource specialist and the elementary science cadre provided extensive in-depth help to five to seven schools per year. With the lack of resource specialists, no replacement support mechanism is available to teachers and principals." The report also recommended a full revision of the grades 3–6 curriculum.

In February 1991, the *Telegraph* reported that the school board had offered several proposals that would open more decisions to parents and school staff. It noted that the proposals followed "many recommendations made by several community groups over the past two years, particularly by the business-sponsored Education 2000 coalition." That year, Montview also faced a multi-million dollar reduction in money coming from the state due to decreased state revenues.

By June, the *Telegraph* reported that the school board approved "an initial reorganization of the district's administration suggested last February." The reorganization would provide for internal consultants at the primary, intermediate, middle, and high school levels with the focus of education being redirected from content areas to move along interdisciplinary lines. The consultants would aid school staff according to grade levels. The *Telegraph*

stated, "The moves will necessitate the reassignment of the district's academic subject coordinators. The work formerly handled by those coordinators will be left to teacher committees." By August, the board approved a reform package "that will eventually give parents and teachers more decision-making power."

At this time, Donahue decided to retire early, stating that he had philosophical differences with the superintendent and that the way things were being run "were not for me." The public supported cuts in the central office, preferring instead for money to go directly to the schools, with less spent on administrators. According to one former principal, there was constant "yammering" from the public about too much money spent on administrators and not enough in the classroom. Central office leadership was essentially disbanded. According to a former teacher, "Once the in-services left, there was no way of maintaining the curriculum as it existed."

The Program Reaches Crisis

In fall 1991, the science program began to deteriorate quickly. According to some now-retired teachers, "The program went on its own after 1991. Most schools were maintaining it to some degree until it fell apart." According to Kevin Calhoun, the current director of instructional services in Montview, "Montview had a glorious past. We had credibility on a national level." In contrast, he refers to the early 1990s as the "dark period" of the district. During that time, everything transferred to the schools with the hope that "they'd figure it all out." As a result, there was a good deal of bitterness and anger in the district about the actual and perceived loss of central support. Many teachers who had taught the original Montview program took early retirement when they got the chance.

One assistant principal explained that, eventually, the curriculum became fragmented. "Teachers did what they wanted, or they avoided science...there were rumblings about the old program being good and wondering about how to get it back." Teachers generally taught what they knew best during this time, and even when moved to different grade levels, did not necessarily vary the curriculum. As a result, there were redundancies in student learning in science. According to a teacher at the time, it was very frustrating. They no longer had any specialists to call; there was no support. This was aggravated further by a high turnover of teachers and no standards to provide guidance for science instruction. Teachers developed a chaotic view of the program. And yet, according to Alice Lahey, after the program disappeared, some people still held onto the skills.

The district's financial woes continued. In fall 1992, the voters rejected a proposed penny increase in the state sales tax and approved a constitutional amendment that limited taxes and spending. As a result, Montview had to make an additional $30 million (9 percent of the budget) in cuts. The first step was to close the administration office building and cut one-third of the

administrative staff (including four area superintendents, a deputy superintendent, and an assistant superintendent). Changes were widely felt by August 1993, when the superintendent at the time wrote in the *Telegraph* that Montview was "undergoing the most dramatic restructuring since the district was formed more than 40 years ago." He continued, "Rather than having full-time curriculum specialists housed at the central office, issues related to curriculum and instruction will be addressed by response teams. A team will generally be coordinated by a teacher in the curriculum areas to be studied. The use of response teams shifts primary responsibility away from the central office and provides more opportunities for dispersed leadership by those personnel who are closest to students."

The Late 1990s: The Program Rebounds

With the arrival of the mid-1990s, Montview aligned with the trends of the state and the nation in demonstrating an increased interest in the development of standards and student accountability. They also had some initial signs of financial recovery with the passing of a bond issue in 1993. In 1994, the interim superintendent stated in the *Gazette* that "a priority will be to implement standards for what students should know and be able to do in six major content areas: reading, writing, math, science, history, and geography." He did, in fact, become superintendent in 1994, bringing a new era of leadership to the district. A new part-time science program coordinator was hired to facilitate the work of writing the science standards with teachers, and, according to the mathematics coordinator, the "science people were pleased to have a leader." An assistant principal commented that things started changing with the new superintendent and her accompanying assistant superintendent (head of instructional services). She "was very visionary," remarked the assistant principal and "gradually rebuilt central services" as there was a demand from the schools for help.

By 1995, a new state school finance act allotted Montview an additional $12.3 million in funding. The *Gazette* reported, "The proposal before the Montview School Board marks the beginning of a recovery from deep cuts the district made two years ago." But the recovery never seemed complete. Only a few years later, Montview was continuing to fight budget cuts and working to pass tax increases. By spring, 1999, Montview schools were looking at cutting as much as 14.5 million but the cuts did not materialize for the 1999–2000 budget. But then, by fall 1999, the threat of cutting $9–13 million reappeared. School board members decided, once again, to put a tax increase on the ballot for that fall.

By 1998, a rebound of interest in central support services and districtwide priorities was evident. In February, Montview residents gathered for a meeting in the district main offices. The *Telegraph* reported that their top objective was "basic skills in mathematics, reading, and writing, with willingness to spend up to $6 million on reading programs and paraprofessionals." This meeting included 100 citizens and staff members from the district's strate-

gic planning and accountability committees. That year, the *Gazette* reported that the school board had approved a budget (not without dispute) that would cut 6 percent of the money distributed to schools and increase by 56 percent the amount that would go to the central office of instructional services "to improve literacy programs, train staff, and develop curricula and tests to support new state and district standards."

The interest in more centralized support and guidance that emerged hand in hand with the emphasis on standards and accountability was evident in the science program as well. From the mid-1990s on, new leadership in science began to emerge. In 1993–1994, for example, a group of teachers known as the Elementary Science Cadre initiated, organized, arranged funding for, and facilitated meetings for representatives from every elementary school in the district to obtain feedback regarding needs in science education. This cadre of lead teachers had an interest in science, and according to a former teacher, they had "camaraderie" and "a real team spirit."

The interest in more centralized support and guidance that emerged hand in hand with the emphasis on standards and accountability was evident in the science program.

By 1994, a "Science Support Team" formed consisting of five people who focused on elementary science. Still, even within the team, there was no strong focus; they spent a good amount of time talking about "what is good science" The team did an in-service in fall 1994 that helped participants better understand the science curriculum (what it was) and how it related to standards. The Science Support Team created a budget for their continuing work addressing the needs of elementary teachers, which included providing knowledge and support to elementary teachers in their awareness of Montview Science Standards; assisting teachers in identifying a science scope and sequence within their schools; maintaining support for individual teachers and schools in science instruction; and co-sponsoring workshops on supplemental science materials. They proposed training for themselves and requested money for providing support to schools and teachers as well as supplies for a total of $18,096. They also wrote an Eisenhower grant and received $20,000 to spend on in-service for the science program. This provided in-service for one teacher from each elementary school for two consecutive years.

In 1996, 17 of the principals in Montview were surveyed about the science program. In response to a question about describing the science programs offered in their schools K–4, most replied that there was no strong sense of a science program at all—and of those who felt their schools had science programs, they were using Montview units. *EGC* was still being used in many schools, but the extent depended on availability and condition of the materials. Similarly, responses on evaluations of a "science representatives/chairs meeting" indeed suggest that there was a shared frustration with the lack of direction of the program and a desire to have some guidance. Further, literacy concerns had pushed science to the back burner in some schools. All principals indicated that they wanted some kind of support for science; most said they wanted something standardized across the district and they would like a curriculum or specific program.

Despite these obstacles, the science program was on the rebound due to a range of factors. There was a change in administration; the role of standards became more important in instruction; and teachers and principals expressed a desire for more centralized support for science instruction. In 1997, one full-time position was re-instated in the curriculum department. Since then, the Science Department staff increased from the one full-time equivalent (shared by two people) to two FTEs the following year, up to a total of five in the 1998–1999 year. As the department slowly built (and continues to build) back, they worked to redefine the vision for K–6 science.

By 1997, Montview had six main content standards. They included"

1. Students understand that science is a search for patterns in nature and that these patterns suggest broad concepts.
2. Students know that science is a framework for understanding the natural worlds and understand the processes of scientific investigation.
3. Students know and understand interrelationships among science, technology and human activity.
4. Students know and understand the structure, processes, and interactions of Earth's systems.
5. Students know and understand the characteristics and structure of living things.
6. Students know and understand common properties, forms, interactions, and transformations of matter and energy.

In each content area from fall 1997 to spring 1998, a content team developed a scope and sequence aligned with the standards that described the content at each grade as well as the performance levels that were expected. Each team also researched best practices in the nation and evaluated and recommended curricula for specific standards and/or levels. Then, in spring, 1998, there were area meetings for K–6 science representatives and 7–8 science chairs focused on the long-range science plan.

Concurrent with these efforts, the Science Support Team reported that after going through a review process, they were close to recommending a K–4 science program. They had decided to consider only complete programs, not compilations of units published by different publishers. They found that the programs most heavily promoted by the major publishers did not meet their standard of having students "do" science, and these programs were weak in science concepts. At this time, they also were recommending assembling a leadership team to work on defining grades 5–8 science.

The group decided on Biological Sciences Curriculum Study's (BSCS) *T.R.A.C.S*. curriculum and developed a plan for moving to the new curriculum. This included offering "transitional" in-service training for new teachers in grades 3–6 who were not yet using the newly adopted program but who were unfamiliar with the older Montview units and needed support

to implement them. At this time, the principals' science handbook recommended that in grades 1–2, science be taught about 25 minutes a day, in grade three about 30 minutes, and in grades 4–6, about 45 minutes each day.

In 2000, the district science department was trying to reestablish a science program that was both internally consistent and aligned with the state standards. One member of the district science leadership, Elizabeth Warren, noted that they were trying to take a middle path, between using hands-on strategies and textbooks to learn science concepts. Other administrators felt that while the old curriculum emphasized process, the new curriculum contained a better balance of content knowledge and science process "for what we need now." According to the director of math and science instruction, their goal was to "create a comprehensive experience for students K–12." He explained that they spent a lot of time discussing the components of a quality program, and he felt that their choice included accurate materials (as opposed to using science texts that often contain a lot of errors) and opportunities for kids to "muck around" and see the big ideas and how they fit together.

CURRENT AND FUTURE STATUS: ON THE BRINK OF A NEW ERA

The Montview program is on the brink of a re-establishment. As the district implements its current plan, the "old Montview units" and the *EGC* curriculum are, after 30 years, being phased out. The long history has set a philosophical foundation for the new program and points Montview once again toward the goal of a districtwide program that can bring coherence to Montview's elementary science instruction.

Still, the conditions and contexts surrounding the rebirth of the program have changed enormously, and the new program must account for those changes through its implementation, leadership, and communication strategies. According to a central office administrator, Montview is a "very different world now than what this program was originally created for." Now that the central office is rebuilding itself, there is a growing change in the perception of the district and the role of centralized support. According to Kevin Calhoun, "The superintendent and others have gone out to the schools. The tone has changed, and more teachers support us. The central office is better off now." He remarked, however, that they still are in the midst of an effort to re-establish trust. Referring to the past, he commented that, "We led them to the Promised Land, and then we all disappeared." Now, "leadership must see the value of doing quality science—at the building and the district level."

The conditions and contexts surrounding the rebirth of the program have changed enormously, and the new program must account for those changes.

The section below provides the reader with a brief overview of the first steps Montview has taken to re-establish its program. It briefly describes

the program and some of the circumstances and conditions shaping the process. The extents to which the re-established program will be sustained, and the extent to which the core beliefs and values of the original program will remain, are yet to be seen.

THE CURRENT PROGRAM

Curriculum

The adoption of the BSCS (Biological Sciences Curriculum Study) K–5 science curriculum was made after a careful review of 17 different K–8 instructional materials (including *FOSS*[6], *Insights*[7], and *STC*[8]). The science department and teachers on the committee that reviewed the curricula used the following criteria to determine elements of a good program:

1. Broad learning goals and specific learning objectives are clearly defined.
2. The program explicitly attempts to address standards.
3. Lessons address processes and concepts of science simultaneously.
4. Activities are inquiry-based, not confirmatory.
5. Activities are integral to the program.
6. Lessons are coherent and sequential.
7. The program has a research-based design, such as the learning (or inquiry) cycle.
8. All technical vocabulary is defined and used (as opposed to mentioned).
9. Diagnostic, formative, and summative assessments are included.
10. The science content is accurate and will not leave students with misconceptions.
11. Elements of the program align.

The committee determined that BSCS came the closest to meeting their idea of a "good program." BSCS describes itself as inquiry-based and advocates the 5 "E's" of learning: Engage, Explore, Explain, Elaborate, and Evaluate. The curriculum includes both kits of hands-on materials and related texts, and this combination, according to several people, was one reason for its selection. The content of the curriculum is organized around six unifying themes in biology: evolution; homeostasis; energy, matter, and organization; continuity; development; and ecology. According to Warren, they are developing a few units to fill the gaps between available BSCS units and the science standards, noting, "concepts are the focus, names of units are not."

The Montview science team has been piloting and implementing the BSCS program incrementally over the past few years. Science staff explained that

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6 *FOSS (Full Option Science System)*: Developed by Lawrence Hall of Science, published by Delta Education.

7 *Insights*: Developed by Education Development Center, Inc., published by Kendall/Hunt.

8 *STC (Science and Technology for Children)*: Development by National Science Resources Center, published by Carolina Biological Supply Company.

it is very important for the units to be tried out in classrooms to see what works well and what doesn't, and then to be de-bugged and revised before full implementation. During 1997–1998, about 75 teachers were involved in piloting some of the BSCS units and providing feedback to a group of "school support teachers" (SSTs) for refinement. During 1998–1999, about 150 teachers were involved in piloting units and providing feedback, and by 1999–2000, 450 teachers were involved in the piloting process. As of 1999, 42 elementary schools (46 percent) were involved in implementing the refined BSCS units, involving about 300 (15 percent) of total teachers in the district. During the initial pilot period, the district purchased the kits, coordinated books, and provided substitute time to cover the teachers for two days of training and two half-days of follow-up, so there have been many willing participants.

The science staff has restricted the pilot to schools in which they can work with all the teachers at a given grade. Non-pilot schools must compile their own materials; however, in 1998, the district supported half of the cost of buying kits and materials for the schools. According to one assistant principal, implementation costs are on average $800 per teacher for three kits, accompanying texts, and six days of initial professional development. Although principals do have some money allotted in their budgets and may distribute money for purchasing science materials, the amount varies by school.

District administrators seem to share the feeling that this is the final chance to rejuvenate the science program. According to Kevin Calhoun, in the mid-1990s, "The standards were etched in silly putty. Teachers were told to teach to the standards and the students would get what they needed. Some people just latched onto particular curriculum materials 'sold' by salesmen. Now, we have progressed beyond this stage, but if we stop again, we won't be able to pick it up again. We are at a breaking point here in some ways."

Instruction

The research team visited 10 science classes in 5 schools. These classes were identified as good examples of the type of teaching the science team was trying to foster districtwide. All classes were supposed to be part of the BSCS pilot and their lessons were to be drawn from the BSCS units. Despite each of these schools' involvement with the BSCS pilot, some of the lessons observed by site visitors were not based on BSCS units, but rather on some of the old Montview units, which they happened to be teaching at the time of the visit. This lends credence to the claim that many of the older teachers still use the old curriculum.

Assessment

The state already had in place standards in science, and in 1995, the district developed its own science standards. The state also has been developing its

state assessment program over the past several years, first implementing literacy tests in 1997. In spring 2000, eighth grade students took part in the first state science assessment. According to the state law, additional districtwide assessments can be implemented at the district's choice of grade levels. The Montview science department has recently completed writing performance expectations in science for grades K–6. According to one member of the science team, "it [writing the performance expectations] was a gargantuan effort" to complete them and distribute them to schools by the fall of 1999. The director of instructional services and the deputy superintendent indicated that standards need to be built in or embedded within the curriculum. The director of instructional services added that "even some of the good materials don't have it [embedded assessment]," and developing good assessments is a constant challenge to the science department.

Decisions by individual principals influence what standards are addressed in the classroom and how they are assessed at the classroom and school level.

Warren explained that assessment is occurring at three levels—the classroom, school, and district—and that there is the constant "going back and forth" at each place. She said the state standards are also of concern but notes that the district standards are more in line with national standards since they are more rigorous. Since the district is site-based, decisions by individual principals influence what standards are addressed in the classroom and how they are assessed at the classroom and school level.

Professional Development

Districtwide, the department of instructional services offers professional development in the content areas of English, social studies, and mathematics as well as cross-subject topics (e.g., diversity and multicultural populations, gifted and talented populations). The literacy program coordinator mentioned that her staff and the science team had worked jointly to give a few workshops linking literacy and science, but for the most part, the staff in each content area work separately and are very busy with their own subject areas.

Within the science program, two staff developers provide all the professional development in science for K–5 in this huge district. They currently are focused on the hundreds of teachers who are involved in the pilot and implementation of BSCS. In addition to increasing the number of schools each year involved in the BSCS program, staff have to contend with covering a huge geographic area to serve the teachers. One of the staff members who do professional development said that "the district emphasis is on implementing the program in as many schools as are interested without any increase in district staff to do the staff development." In the past, staff have also had to live with considerable uncertainty about future funding, which made it difficult to plan effectively. In 2000–2001, one full-time staff person was added.

Staff development generally consists of two days of training per unit with two half-days later on for follow up, although this may vary slightly by unit. Since there are three modules at each grade level, at least six days of train-

ing per teacher per year are necessary, not including follow up. Teachers interviewed were quite positive about the new program saying "having an actual program helps," and "I like the idea of a kit where I can get supplies." When asked what else might be done to improve science teaching, they made suggestions focusing on two areas: improving professional development opportunities by including ample time for teachers to talk with others about their teaching and providing opportunities for them to view what other teachers are doing either through videos of their classrooms or direct observation. In the 2000–2001 school year, the science department offered kit training workshops to teachers and was overwhelmed by the response. They did not have the space to accommodate all of the teachers who wanted to participate.

Some Montview teachers who had taught for 25–30 years in the district indicated that the district's commitment to staff development was much higher with the "old" Montview program. Teachers with many years of experience felt that the culture of Montview had changed and that prior to 1991 there was a much greater emphasis on mathematics and science. One teacher expressed that "now science is at the bottom of the totem pole." Teachers also felt that with the pressures on them for literacy and the reduced in-services, it was difficult to retain or re-establish the same level of involvement for science. They indicated that the environment was more threatening now and less conducive to having teachers be committed to learning and teaching a new program.

Decision Making and Leadership

District-Level Leadership

The current science program has strong support from the central office, in particular, the deputy superintendent. Prior to this position, she was assistant superintendent for curriculum and instruction, and before that, she taught in the district and was one of the writers of the *EGC* curriculum. Her current support for the program dates to her years as teacher, when she realized that science is an important part of the curriculum and "touches on students' natural curiosity about the world." Back then, she recalls, "Thomas Donohue was well-respected and the curriculum was highly centralized. You taught what came to you." Then, the interim period was "total chaos," when teachers could choose whether and how to teach science, and the kits were not well-maintained. "Now," she explains, "there is a greater focus on accountability, and we have tried hard to align the curriculum with standards and assessments." The importance of this commitment was underscored by Kevin Calhoun, who stated, "If leadership does not buy in, then you won't have quality science." He also noted that the assistant superintendent and others are "listening to us...."

"IF LEADERSHIP DOES NOT BUY IN, THEN YOU WON'T HAVE QUALITY SCIENCE."

Calhoun also stressed that "we need to go back to communities to get support," undoubtedly referring to the need for public support via tax increases to fund the school programs, including science. The deputy superintendent noted that "science is not what most parents get involved in. They are more focused on reading and math." And Calhoun concurred, suggesting that "we should bring the parents along" and "try to get the communities on board," regarding their understanding the importance of having a strong science program. He noted that attending community meetings and getting the attention of individual school accountability groups would facilitate the process. By gaining public support through media and the community, he felt that it would be easier to move forward with BSCS and with middle and high school science.

According to Warren, the superintendent favors central support services for the district, and yet, the district "is still reluctant" to make central services positions permanent. They fear the public is still unwilling to support large numbers of administrators and tends to vote in favor of distributing money to individual schools. Warren went on to express the view that "people have to be ready for change," and that "we cannot force the issue when people aren't ready."

The School Board: Calhoun noted that the school board is a powerful force, and "what the board supports happens." Further, despite the decentralized nature of the district, the board does not restrict their involvement to district administration. For example, they recently debated whether or not a particular math curriculum would be taught. This huge controversy resulted in a split of the school board and the decision that three schools could continue to use this program, although the district as a whole does not support its use. The conflict surrounding the independence of schools has reduced somewhat with the departure of one of the school board members, who was promoting school autonomy.

Science Program Leadership

The current science staff consists of five people, and is led by the K–12 science coordinator, who works with science program specialist Warren. The K–12 science coordinator, who was a high school physics and earth science teacher, was hired to that position in 1997. She works with administrators to coordinate the science program with other district efforts and is responsible for budget issues. She also supervises the SSTs who focus on science and works with high school teachers as well. The mathematics coordinator noted that her arrival "brought coherence to the science program."

Warren (a trained geneticist, not a teacher) had worked with Donahue during his time as science coordinator. During the early 1990s, she was the only person remaining in the central office, because she was the recipient of grant money to develop a seventh grade textbook and to work in seventh grade life science. Other elementary science staff members include a consultant (not a district employee) who previously taught in another district

and an elementary SST. This SST, who recently made the shift from classroom to central office, said she provides "the classroom reality check and discovers what works in the classroom." Both the SST and the consultant are involved with professional development for teachers who are piloting or implementing the BSCS curriculum. Another SST on the science team works with Warren on middle school science and has been developing curriculum embedded assessments.

School-Level Decisions

Since the district still has site-based management, the central office cannot require schools to use BSCS; it can only make adoption recommendations to principals. The ultimate decision as to whether BSCS is implemented is made by principals and site-based management councils. If a school selects BSCS, the district offers some support but the schools must assume the responsibility for purchasing and refurbishing the materials. Some of the schools not using BSCS are known to be using textbooks, but the district science team is so busy with facilitating the adoption of the curriculum by those who wish to use it that it hasn't yet had time to determine what is happening in other places. Many of the veteran teachers apparently still teach the old Montview curriculum; other teachers sometimes write their own science units or the schools may purchase materials other than BSCS.

Resources and Support

Funding

The mill levy override that passed in 1999 provided that the school district would receive up to $45 million a year over four years. The money, however, was to be pro-rated in the third and fourth years based on student improvement in test scores. According to the *Montview Telegraph*:

> During years three and four, the district would get an additional $1.5 million annually for every percentage point of improvement in the number of students meeting the standard on the state standardized test. The goal: 25 percent improvement over three years to receive the full $45 million.

In addition to having money tied to student improvement in test scores, each school receives a letter grade based on their scores and these grades are, in turn, to be posted on the Internet. Teachers expressed concern about this process and the threatening environment it creates.

The budget for the science department for the years 1998–1999 and 1999–2000 remained stable, and the staff increased by one more person for 2000–2001. According to one of the science program staff, Montview's elementary science has almost completely been paid for by Eisenhower funds. A very small percentage (5 percent) of money comes from the district, and

those funds cover some staff development costs. In addition, some new money ($350,000) has recently come from two small foundation grants for elementary- and middle-level materials.

The only major external funds brought into the science program in its history came from a $700,000 National Science Foundation grant focused on middle school life science. This supported Elizabeth Warren during the mid-1990s. In 1997, Warren submitted a proposal for a "planning grant" to develop a plan for a professional development program, but it was denied.

Community and Partnerships

The Montview community historically tends to vote against increased funding for schools, and overall public support is behind literacy and math. The conservative faction is stronger now in Montview than 15 years ago; and this faction supports "doing their own thing" regarding education. The public tends to lend its support to business and, according to Warren, Montview is not an "education friendly environment."

No formal business partnerships have been established with the district. However, there are other facilities and resources available to teachers. In addition to using district outdoor lab schools, teachers have participated in professional development from the nearby informal education institutions where scientists conduct classes. According to one member of the science staff, teachers often arrange field trips to nearby museums, the zoo, and the botanic gardens.

ACCOUNTABILITY

State- and district-level emphasis on student performance in literacy and mathematics dominates discussions of accountability in Montview. According to the literacy coordinator, "Literacy is the first priority statewide." Students are tested in grades 3 and 4 in reading. After third grade, if students are not reading at grade level or above, each student must have an individual literacy plan and parents are asked to commit to supporting literacy at home. Students' reading is assessed via the Iowa Test of Basic Skills (ITBS), the state assessment, classroom evidence using a districtwide rubric, and the diagnostic reading assessment. There also is a fifth grade ITBS test in reading, an ITBS test in writing for third and fifth grades, and a fourth grade writing test statewide. The director of assessment confirms that there is "an incredible emphasis on literacy now," and she works with schools to help them perform better on standardized tests.

Some teachers complained, "We're being assessed to death," and explained that the posting of their schools' letter grades on the Internet has led to such pressure that they teach only literacy all day. The mathematics coordinator confirmed, noting that "the assessment is driving the curriculum."

One principal noted that "because of district mandated literacy, our efforts around science got put on hold," alhough he did share a small glimpse of optimism regarding science when he noted, "It is a transition time within the district, and there has gradually been more of a focus on science."

According to one of the science professional development staff, principals are held accountable for student performance only in the tested areas of literacy and mathematics. Moreover, they get extra performance pay based on meeting school goals for standardized tests (which emphasize literacy and math). She went on to explain that principals are more concerned with observing language arts and math and less concerned with science, creating a climate in which it is "easy" for teachers to feel science is less important than literacy. In all of the schools visited, the fact that reading and math were taught in the morning, with science left for the afternoon and sometimes taught as the last session of the day, was evidence of its reduced status.

The literacy coordinator confirmed that the state assessment program, with its emphasis on literacy, is driving resources and classroom practice away from science. For example, she supervises 27 teachers on special assignment (TOSA) who do professional development in literacy, compared with three TOSAs in science for the district. (The mathematics department also has more staff than the science department, which has a modest full-time staff of five). Some of the literacy staff members have worked with the science staff during teacher workshops on how to teach literacy through science. These workshops are supposed to help teachers think beyond an "either-or" mentality to see how both science and literacy can be taught. She noted that "there is a lot of interest in the district in science," but questioned the strength behind the well-wishing.

In this context, science is moving toward finding its place in the assessment fury. In 1999, the science department completed writing performance expectations in science and has developed a framework that includes content benchmarks at each grade level. There are two grades of proposed testing for K–5 (grades 2 and 5) and for grades 6–9 (grades 6 and 7). A test in physical science is proposed for grade 8. One science staff member explained, "We are trying to get a consistent program that is aligned with standards."

Science is moving toward finding its place in the assessment fury.

Equal Access to Science

The district strategic plan raises equity as an issue of concern and interest in Montview. All district documents demonstrate an investment in increasing achievement for all students and, in particular, "low-achieving" groups. In evidence of this goal, a recent professional development catalog offers more workshops in the diversity/multicultural category than any other category.

And yet, Montview faces a continuing issue regarding access to the science program in that there is no accountability for program delivery and, in fact,

the decentralized system technically does not even require that schools teach the program. Thus, students' access to science education is at the discretion of school administrators who, as described above, are clearly focused on and distracted by the strong district and state emphasis on literacy and mathematics. This is exacerbated by the fact that school administrators' salaries are tied to student achievement. Combined with public scrutiny of performance, there is little extrinsic motivation compelling school administrators to ensure science is taught.

ANALYSIS

The story of elementary science in Montview is, like any district program, complex. Many factors have contributed to and inhibited its sustainability over time. These factors fall into three general categories:

1) factors that pertain to the surrounding conditions—these describe the influences of the context in which the program operates;

2) factors that pertain to the science program components—these describe the role that concrete elements of the science programs (e.g., curriculum, professional development, leadership) have in contributing to or inhibiting sustainability; and

3) factors that pertain to the whole science program—these describe overarching contributors to and inhibitors of sustainability that affect the program in less tangible but still powerful ways.

These factors do not operate in isolation. They interact with each other and shift in importance and influence over time. Factors that were particularly striking and pertinent in Montview are discussed below. For an in-depth discussion of all of the factors, see the cross–site report of this study[9].

FACTORS THAT PERTAIN TO SCIENCE PROGRAM COMPONENTS

Instructional Materials: Increasing Endurance Through Materials Management

Until the recent program revival, the Montview program used a combination of internally and externally developed instructional materials. In grades 3–6, the district used *ESS* and *SCIS,* supplemented by limited numbers of district-developed units and complemented by a district-developed teacher's guide to help facilitate teachers' use and interpretation of the materials in the Montview context. The early grades, on theother hand, used a district-developed curriculum that focused on integration of subject areas and took the form of teacher notebooks, which included assembled activities built around topics and themes.

9 The Executive Summary for the Cross-Site Report can be found in Appendix C.

Regarding materials management, until the program lost centralized leadership in 1991, Montview's system was minimally centralized. All kits resided in the schools and, during the establishment phase of the program, each school was asked to develop a materials management system that included an equipment list, storage system, inventory procedure, and reorder system. Central office staff helped schools organize their systems and provided them with a list of consumable materials they could order from the central district warehouse.

The intention behind decentralizing materials management was two-fold. First, it was viewed as a way to protect the program from centralized budget cuts. Program leadership believed that if materials management rested with the schools, then the program would be immune—at least as far as materials were concerned—from potential budget reductions that might affect staffing and space for a centralized materials management system. Second, some believed that asking schools to take responsibility for materials management would more effectively instill in them a sense of ownership over and responsibility for the program—again, contributing to its ability to withstand threats, should they arise.

Though strategically reasonable in practice, the decentralized materials management strategy in Montview did not support the program as hoped. In other districts in the study, even under the most dire circumstances, the materials center seemed relatively unaffected—one could speculate that it was evidence (though only symbolic in some cases) that the district was attending to the science program. Once established, other districts found it difficult to disassemble the science materials center as it would suggest they no longer were giving attention to science. In Montview, the pressures to focus on other subject areas, combined with loss of centralized leadership, simply seemed to overwhelm even the most well-intentioned school administrator.

Still, in retrospect, it is possible that the enormous public pressure to decentralize in the early 1990s would still have extended to a centralized materials center, had there been one. Under those circumstances, schools would have been left completely without materials systems to support science instruction. It is possible that having the materials on-site and having teachers accustomed to accessing them on-site may have been what enabled the program to survive (albeit underground) until its revival.

Factors that Pertain to the Whole Science Program

Adaptation: Merging with District Priorities

Throughout his nearly 30 years with the program, Thomas Donahue persisted in ensuring that he had communication and feedback mechanisms for gaining information about improving the program and its stability in the

Thomas Donahue persisted in ensuring that he had communication and feedback mechanisms for gaining information about improving the program and its stability in the district.

district. As a result, the Montview program has undergone many adaptations that have reflected changing knowledge of program leaders and shifting district priorities. Still, throughout all changes, the program remained bound to its fundamental beliefs and values.

Looking only at the instructional materials, for example, the first major revision after the program's establishment took place in 1973 (a minor revision took place in 1971) and was shaped by a survey of all participating teachers and by an emerging district priority on identified student outcomes. This revision reflected expansion of the life sciences as well as an accommodation of environmental science and health goals. The prospectus for these revisions also described the development of a guide that would highlight connections between the science program and other subject areas. These revisions were driven by both Donahue's interest in improving the quality of the materials and by his need to address what he described as "back to basics" concerns in the district.

The district began implementing the newly revised curriculum in 1977. At that time, they developed a collaboration with university researchers whom Donahue described as "critical" to the program. The researchers' work, which focused on teachers' views about their changing practice, enabled the district to gain critical feedback on their program and to make necessary changes. Also during these phases of program establishment and maturation, the professional development support strategy known as "concern-and-support" contributed to monitoring the program and provided Donahue and other program staff with important information about how to adjust the materials and professional development to best meet the needs of the teachers.

Later, in 1980, Donahue created a plan that moved beyond instructional materials improvement to the whole program. This plan emphasized program commitment, communication, monitoring, and reinforcement. Though the extent of implementation of this effort is unknown, it is evidence that the program leadership recognized the importance of gathering concrete information on program status and making adjustments based on that information. Even as district support for the program began to wane and Donahue's concerns grew, he recognized the importance of adapting the program. In a 1990 report, he recommended a full revision of the curriculum. Unfortunately, the changing views toward the curriculum would pose an insurmountable barrier for any further revisions to the program.

Critical Mass: Reaching Enough to Hold On

Conventionally, when educators think about critical mass, they are referring to numbers of teachers using a particular program. From a perspective of sustainability, however, it can be more sensible to consider critical mass differently—as numbers of teachers who share a set of beliefs and values

about instruction—in this case, about science instruction. The size of Montview posed a challenge from either perspective, but program leaders seemed to be able to find a way to reach enough teachers to keep the program alive even during its darkest period.

Montview is an enormous district, reaching nearly 800 square miles with nearly 100 elementary schools. These figures alone would loom above the heads of any science program leaders, even those with fully staffed departments. Montview leadership was small in size and, in fact, there is no evidence that sufficient numbers of teachers ever were using the materials in their standard day-to-day practice. In fact, there was evidence to the contrary—that even though the district administration was committed to the program, use of the program materials in the classrooms was highly variable.

Still, the resurgence of the program after its decline in the 1990s suggests that there was some critical mass of "belief" among the educators in Montview. This belief is evident in the fact that teachers continued to teach the program on their own, even after central leadership and support for the program waned. Also, when it came time to reestablish the program, the fundamental views about how science should be taught were still present and helped shape the criteria with which the new instructional materials would be selected.

Philosophy: Sticking to the Core

Montview has had a commitment to hands-on science that extends back nearly to the origins of the district. Throughout its duration, amidst adaptations of instructional materials and the addition and reduction of professional development support, the basic underlying goals for the science program never wavered. Montview educators wanted a science program that supported students' scientific literacy, that enabled them to experience science firsthand, and that would help them have personal investments in their science learning.

This aspect of philosophy—the commitment to teaching science through hands-on instruction—was steadfast. However, another aspect of philosophy—the commitment to teaching science at all—was not as secure. While program leaders, administrators, and teachers all felt that science instruction should embody direct student experience and learning, they still yielded to pressures that placed science low on the list of instructional priorities and, in some cases, eliminated it from the instructional schedule altogether. Thus, while there was widespread commitment to teaching science using hands-on approaches, the science program became vulnerable in the presence of inconsistent philosophies about the importance of teaching science.

Perception

The Montview program was, without doubt, one of the pioneers of district hands-on science programs. It deservedly had a reputation for having an innovative, strong elementary science program and was looked to as a model for others. The national reputation also extended to an internal pride for the program and for the status it held among science educators in the country.

Though program leadership recognized areas of needed improvement, national and local perceptions of the program still seemed to bolster its continuation.

However, as evidenced in several sources that assessed the status of the program throughout its life, the perception of the program differed greatly from the program's actual status. Even as administrators and principals strongly supported the science program, actual classroom practice was not at expected levels. Even though Montview did have mechanisms for gathering information about the program, none were associated with any serious consequences. Periodic reports, as well as Montview's own surveys and student tests, all provided data that Donahue could use to shape his recommendations for program improvement. However, his suggestions were overshadowed by emphases on other district priorities, such as reading and mathematics. And yet, even though program leadership recognized areas of needed improvement, national and local perceptions of the program still seemed to bolster its continuation.

Montview offers another example of the power of perception in the ways its teachers viewed the science program. The 1970s and 1980s were considered "golden years" of the program, and those who were in Montview at the time remember it as a time when the central office supported them fully, not only with in-service sessions focused on kit use, but also with their school visits that were part of the "concern-and-support" program. Though schools received these visits only once every two years or so, they, along with communications from, and other small opportunities offered by, the science program, were perceived as full support. The view of the science program at the time seemed to grow more from trust in and respect for the program leadership and less from the actual direct experience with professional development and other supports.

SUMMARY

The Montview program has served as a model and support for hands-on elementary science programs for many years. Throughout its celebrated history, it has undergone several stages of revision, with Donahue and other program leaders constantly seeking information about how to better support and improve instructional materials and professional development. And yet, after enjoying renown and respect from district educators and educators across the country, it still has been quite vulnerable to pressures from district and community priorities. While Donahue and others had given great attention to ensuring all components of the program were in place,

ultimately, it was the factors that pertained to the whole program—perception, philosophy, and critical mass—that sustained the core values and beliefs through the program's dark period into a phase of re-establishment.

As the program enters a new era, one might question the extent to which it actually is an extension of the original program: did the dark period of the early 1990s actually mark the end of the program, or was it simply an extended "pressure" to which the program had to adapt? The program now has a completely new set of instructional materials, different professional development strategies, and new leaders. Yet, the core beliefs and values set in motion nearly 35 years ago still dominate and hold sway in the decision-making process of the science leaders. They remain the foundation, and only the coming years will determine whether that foundation will stand steady or break under the pressure of district priorities and changing context.