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SILICON VALLEY CHALLENGE 2000: YEAR 5 MULTIMEDIA PROJECT REPORT

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EXECUTIVE SUMMARY

The Challenge 2000 Multimedia Project (MMP) aims to infuse the classrooms of Silicon Valley with an exemplary model of project-based learning supported by multimedia (PBL+MM). It is intended to be a core strategy of Challenge 2000 school teams to meet the challenging goal of “sparking a renaissance” in education in Silicon Valley, by transforming teacher and student roles. Through completing extended student projects that culminate in the development of multimedia presentations, the MMP hopes to enable students to acquire the skills needed for the high-tech workplace—not just technology skills, but also content knowledge, problem-solving acumen, communication skills, and the ability to work in collaborative teams and to assess their own work.

SRI International’s evaluation report for Year 5, the 1999-2000 school year, traces the ongoing progress of the MMP in meeting its goals and highlights the role of particular components of the MMP in supporting changes in teaching and improvements in student learning. Researchers and policy-makers need to know more about successful examples of technology integration, especially what makes them successful. The chapters in this report each highlight a different lens through which one might view the MMP, its implementation, and its success.

Progress toward Program Goals. In 1999-2000, there were 144 teachers in the MMP, an increase of 12.5% from 1998-99. While participation from the three remaining Challenge 2000 Round 1 teams (Blossom Valley Learning Consortium, Family of Schools, and Palo Alto) held steady or declined, there were increases in participation from teachers in the Catholic Telemedia Network team. In addition, teachers from Round 2 and 3 teams from Challenge 2000 teams participated in the MMP for the first time in 1999-2000.

The percentage of exemplary projects for continuing teams also increased between 1998-99 and 1999-2000. At the multimedia fairs in spring 2000, nearly three-quarters of all projects reached an exemplary score of at least 4 out of 5, averaged across three dimensions of the scoring rubric, compared with just half of the projects the year before. Although only 29% of projects from new teams were scored as exemplary, this

number is slightly higher than the 22% of projects judged as exemplary during the first year that projects were scored for the original four teams in the MMP. Thus, the data support the hypothesis that teachers' ability to plan and implement exemplary multimedia projects grows over time with continued involvement in MMP activities.

MMP staff were instrumental in spreading the teaching model (PBL+MM) beyond those teachers able to participate formally in the MMP. Staff gave presentations at nine different regional, national, and international conferences on project-based learning with multimedia. The MMP Web site continued to be used in Year 5 as a resource to educators from across the United States, averaging roughly 3,000 unique users by spring 2000. Student projects were entered into several competitions, including the California Student Media and Multimedia Festival, where the MMP took nearly half of all awards at the competition.

Supporting Teachers' Transition to Project-Based Learning with Multimedia. SRI's evaluation this year examines the critical components of the MMP from the perspective of how best to support teacher integration of technology into student-centered classrooms. The MMP invites teachers to join a community of learners focused on doing project-based learning with multimedia. The MMP provides teachers with formal and informal opportunities to collaborate as they learn to use project-based learning and multimedia in their classrooms. The MMP provides a multilayered structure of opportunities to work with more expert colleagues and technology learning coordinators (TLCs) skilled in integrating technology into the curriculum for sharing skills and expertise. The MMP provides recognition and rewards, including grants for the hardware and software needed for proposed projects. And finally, the MMP enables reflection and self-assessment in different settings, especially for teacher-leaders as they meet to discuss specific projects and aspects of the PBL+MM model.

Learning by Authoring and Designing. SRI analyzes the way that the MMP helps to develop students as *authors of multimedia content*. This component of the curricular model is emphasized as a critical feature of the program for supporting student learning. Data from the Year 4 observation study show that students in MMP classrooms spent much more time engaged in complex thinking while authoring and designing multimedia presentations. MMP students were more likely to spend time interpreting and

transforming information that they had found through their research. They also were more likely to be observed attending to issues of presentation coherence and audience attention than were their counterparts in comparison classrooms. Third, MMP students were more likely to be seen engaged in a critical activity that many teachers say students typically try to avoid: revision of their work.

The report also highlights SRI's activities to disseminate findings from the 5-year evaluation of the Challenge 2000 MMP and presents recommendations for Year 6. SRI's dissemination efforts focus on three major areas: (1) designing a component of the MMP Web site focused on evaluation tools and results; (2) developing professional development opportunities for teachers to learn more about assessment and evaluation of student multimedia projects; and (3) sharing results in presentations and conferences attended by educators, policy-makers, and researchers.

In September 2000, a U.S. Department of Education technology panel judged the MMP as one of the most effective initiatives of its kind. SRI's evaluation research has identified the factors most critical to the MMP's success as the incentives for participation, the professional development model, and the focus on assessment. The financial incentives for teachers' participation have made it possible for those interested in expanding their use of technology to purchase some of the equipment they need. There are many schools in which available technology is seldom used, but the professional and technical support that MMP teachers receive from TLCs and from their partner teachers ensures that MMP teachers can use technology effectively. The frequent assessment of student work prompts the standards to rise as students themselves seek to improve the content and presentation of their multimedia projects.

Recommendations for Year 6 focus on supporting the existing teacher community and on strategies for sustaining the program beyond the life of the grant. They are:

- Maintain high levels of support for TLCs.
- Develop a consulting model for PBL+MM program development.
- Focus on helping teachers identify sources of additional funding.
- Encourage student participation in other venues for publishing student work.

1. CHALLENGE 2000 MULTIMEDIA PROJECT OVERVIEW

Increasingly, schools that have made large investments in technology are discovering the need to invest in a new area: preparing teachers to integrate technology into the classroom. To date, teachers' access to professional development has been more limited than their access to technology. There are few opportunities for teachers to learn deeply about the relationship between learning and technology, and schools and districts have provided limited ongoing support for teachers struggling to find ways to use technology to support innovative teaching. The Challenge 2000 Multimedia Project (MMP), a 5-year initiative funded by the U.S. Department of Education, provides one solution to these problems by providing mentoring and support to teachers learning to integrate project-based learning supported by multimedia (PBL+MM) into their classrooms. The MMP works by providing teachers both with initial training in a reform model of teaching and learning and with ongoing support anchored in the examination of student work.

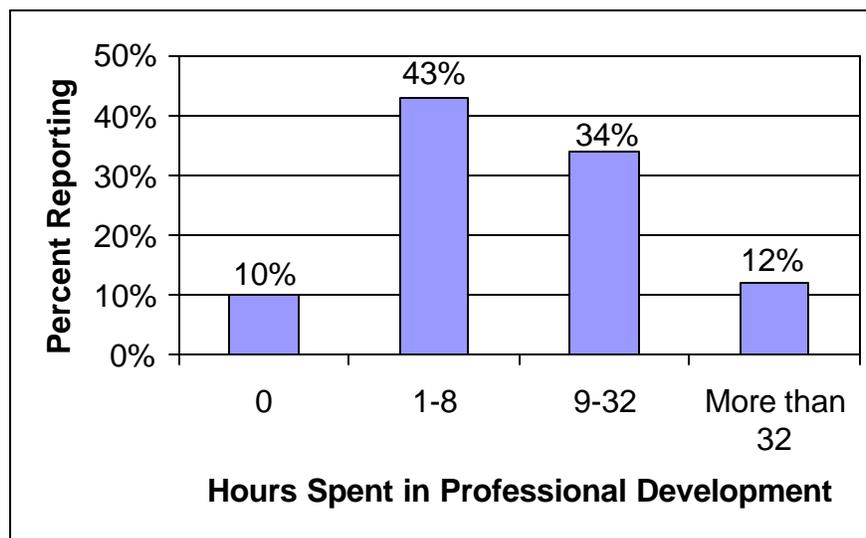
Targeting Investment in Educational Technology: The Need for Professional Development

Investments in computers and Internet connections for classrooms and schools in the past 10 years have increased students' access to new technologies that can enhance learning. In fact, nearly all schools have access to technology, according to a recent survey conducted by the American Institutes for Research with the National Center for Education Statistics (NCES). About 99% of all public school teachers said there were computers available for student use somewhere in their schools (NCES, 2000a). Similarly, 95% of all public schools were connected to the Internet by 1999, compared with 35% in 1994 (NCES, 2000b).

While access to technology is now widely available within schools, the difficulties associated with using computers that are in the school but outside of the classroom mean that access remains a barrier to integrating technology for teachers who do not have computers in their classrooms. For teachers who do have computers inside

their classrooms, the lack of release time to learn to use technology effectively presents a barrier to the use of technology (NCES, 2000a). Most teachers have received introductory training on software applications, the use of the Internet, and the use of computers. But follow-up and advanced training are generally less available to teachers than is introductory training (NCES, 2000a; Solmon, 1999). In fact, the amount of professional development teachers receive is limited: the most training the majority of teachers report they've received in the use of technology is less than 4 days over the past 3 years (Figure 1.1).

Figure 1.1. Time Spent by Public School Teachers in Professional Development Activities in the Use of Computers or the Internet during the Last 3 Years



Source: National Center for Education Statistics (2000a).

Training in advanced technologies is limited, as well. Technology coordinators from districts surveyed in 1998-99 in 27 states reported that, on average, that teachers had received 3.2 hours of professional development in conducting online projects over the previous 12 months and 3.2 hours of professional development in the use of multimedia tools (Solmon, 1999).

One reason why technology professional development is so important for teachers is that it affects their feeling of preparedness, which in turn affects the degree to which they use technology in the classroom. Teachers who spend more time in professional development activities are more likely to feel prepared to assign students work using

computers or the Internet (NCES, 2000a). Moreover, those who feel prepared to integrate technology into instruction are more likely to actually do so (NCES, 2000a). Providing introductory-level training in 1- or 2-day sessions is not enough to prepare teachers to use technology, however. As the members of the CEO Forum on Education and Technology argue,

One-time sessions are not particularly effective. As educators begin to experiment with what they learn, new questions inevitably arise. Without some mechanism for addressing questions as they emerge, educators are reticent to try new approaches. Consequently, schools should increase the value of even minimal investments of time and resources for professional development by guaranteeing adequate follow-up. (CEO Forum, 1999, p. 12)

Given the inadequacy of existing in-service training models for teachers, focusing investments on helping teachers to learn to use technology in the classroom requires careful consideration. Experience in the business sector and in education suggests that ongoing professional development is needed. Professional development that is “site-based, rigorous, sustained, and designed and directed by teachers” is likely to be most effective (CEO Forum, 1999, p. 11). In addition, professional development focused on helping teachers apply knowledge of how people learn to the design of classroom learning opportunities for students is critical, if technology is to have an impact on student achievement (Donovan, Bransford, & Pellegrino, 1999).

Integrating Knowledge of How People Learn into Professional Development

Research in cognitive science, psychology, anthropology, and education points to the importance of more actively involving students in constructing knowledge and content (Bransford, Brown, & Cocking, 1999). Learning opportunities that provide students with tools comparable to those of professional practitioners to use in solving challenging and authentic tasks are better than those that provide students with limited opportunities to reflect on the process of inquiry and research (Collins, Brown, & Newman, 1989). Similarly, engaging students in small-group collaboration, in which young people can discuss, critique, and synthesize ideas from different perspectives, helps make visible student thinking in ways that solo writing assignments may not do (Bransford, Brown, & Cocking, 1999; Collins, Brown, & Newman, 1989).

Learning how to design classroom opportunities to optimize student learning takes at least as much time as learning how to teach with technology. To engage students in authentic projects or investigations, teachers must know how to coach students who are doing projects, facilitate team learning, address unexpected questions, adjust timelines in the midst of projects, and relate students' own ideas and perspectives to curricular content (Linn, Slotta, & Baumgartner, 2000). Teachers' incorporation of these kinds of classroom practices varies greatly, and, in some cases, teachers' own philosophies of instruction may reduce the likelihood that they will engage their students in complex inquiry or extended projects (Becker & Anderson, 1999). Designing professional development to allow teachers to experiment with new pedagogies, then, requires a sensitivity to teachers' current ideas about teaching, their preparedness to act as coaches and facilitators of learning, and their skill in incorporating new and advanced technologies to support new forms of instruction.

A Model Technology Investment: The Challenge 2000 Multimedia Project

The Challenge 2000 MMP is an example of a project designed to address directly the challenges of preparing teachers to use technology to transform teaching and learning. The MMP, funded by the U.S. Department of Education's Technology Innovation Challenge Grant program, aims to infuse the classrooms of Silicon Valley with an exemplary model of PBL+MM. Through completing extended learning projects that culminate in the development of multimedia presentations, the MMP hopes to enable students to acquire the skills needed for the high-tech workplace—not just technology skills, but also content knowledge, problem-solving acumen, communication skills, and the ability to work in collaborative teams and to assess their own work.

What makes the MMP unique is its focus on providing needed supports to teachers. A number of initiatives in recent years have focused on project-based learning or teaching students to become more skilled in using multimedia technologies, but these initiatives have often used the majority of their funds to purchase equipment or pay for researcher-led design experiments that do not prepare teachers to implement complex reforms on their own. In contrast, the grant funds for the MMP have been used for the most part to support teachers in learning how to work with their students to complete

projects. Research funds allocated to the Institute for Research on Learning¹ (IRL) and to SRI, moreover, have included studies of teachers and teacher-leaders in the MMP, in order to better understand the keys to the MMP's success in infusing classrooms with the PBL+MM model.

SRI's research suggests that three important keys make the Challenge 2000 MMP a successful model for helping teachers learn to integrate technology in powerful ways into their classroom teaching. First, the MMP is embedded within a larger school reform effort based on a model of venture capital investment in schools. The reform effort provides a high level of accountability for implementing high-quality student projects in participating classrooms. Second, the MMP relies on a combination of expertise from researchers at IRL and from teacher-leaders called technology learning coordinators (TLCs) to provide ongoing support to teachers implementing projects in classrooms. The MMP's professional development model therefore offers teachers more frequent opportunities to deepen their understanding of a technology-supported model of teaching and learning anchored in student work. That teaching model, PBL+MM, is a third key to the MMP's success. PBL+MM is a research-based model, consistent with what cognitive scientists know about how people learn and the importance of learning experiences that are both engaging and challenging for students.

Key 1: Embedded within a Larger, Accountability-Driven Reform Effort

From the beginning, the MMP has been part of the Challenge 2000 initiative of Joint Venture: Silicon Valley (JVSV). JVSV was incorporated in 1993 as a nonprofit, public-private partnership between business, government, education, and the community, to address the region's needs in the areas of economic prosperity, health, and education. The aim of JVSV's educational programs is to "spark a renaissance in education in Silicon Valley." The primary goals of the Challenge 2000 initiative are to ensure that all Silicon Valley students attain world-class standards in literacy, mathematics, science, critical-thinking, and communication skills; act according to ethical principles and the public good; function effectively in multicultural and team settings; and use technology

¹ The School and Community Practices Group at IRL was the professional development partner for the MMP. In March 2000, IRL was disbanded, and the School and Community Practices Group was transferred to WestEd, an educational research, development, and service agency.

skillfully in their personal and professional lives. The leaders of the initiative decided to apply models of business investment and process improvement in accomplishing these goals, because these business models seemed to provide the kind of help that schools needed to achieve reform that would spark a true renaissance in education.

From the beginning, JVSV stressed that Challenge 2000 is not a “grant” but a “venture capital investment.” School teams receive investment funds for a specific education reform plan and are accountable for “bottom line” results in terms of student achievement, just as a start-up company is responsible for eventually returning a profit. Some teams receive a loaned executive from the business community to help them plan, organize, and execute their reform efforts. Through the process of applying for funding and negotiating annual Memoranda of Understanding (MOUs) with JVSV, the school teams develop specific education reform goals, implementation plans (“roadmaps”), and benchmarks appropriate for the communities they serve.

Just as venture capitalists get involved in the management of enterprises, Challenge 2000 staff members are active collaborators with teams, helping mentor, coach, and advise the teams as their work progresses. Their job is to increase the likelihood of a return—an increase in student achievement—on JVSV’s investment. Like other venture capitalists, JVSV is not interested in long-term investments but rather in teams that can show potential for producing results in a short time. Challenge 2000’s initial commitment to teams is for up to 3 years; and, although JVSV did not expect a complete reform of schools instantly, it did want to see evidence of progress and to know that its investment had been a catalyst for change, setting in motion a reform process that would be ongoing.

The MMP uses the Challenge 2000 teams in which JVSV has invested as vehicles for spreading the MMP across Silicon Valley classrooms. To receive financial support to buy equipment or software needed to implement PBL+MM, teachers from schools that are part of a Challenge 2000 team must formally apply to the MMP. Since the beginning of Year 4, the application process for teachers has looked similar to that of the larger Challenge 2000 reform initiative in its emphasis on collaborative reform efforts, investment in people and equipment, and focus on continuous improvement.

At the beginning of each year, groups of teachers are invited to form “partnerships” within their schools. These “partnerships” consist of a lead teacher—typically someone with experience implementing projects with students—and partner teachers. The partnership teachers submit a single mini-grant application to the MMP that details their goals for the student multimedia project, the activities students will engage in as part of the project, how students will be assessed, and the cost of equipment needed to implement the project.

A group of MMP staff, partner agencies, and teacher-leaders meet to discuss and evaluate the proposals to determine the level of funding for each proposal and to write constructive feedback on how to improve the design of student projects. At the end of the year, if the student projects have been completed, teachers are given an honorarium to recognize their success.

All participating teachers are expected to evaluate the quality of students’ multimedia products and measure changes in student knowledge and competence as a result of MMP work. Classroom assessments are complemented by more formal assessments conducted each year across the MMP in conjunction with regional multimedia fairs. Clusters of schools hold annual exhibitions of student work completed as part of the MMP, and each cluster submits six of its best projects to be scored by a group of teachers and community members using a rubric developed by a team of teachers, evaluators, and MMP staff. Scores are used as one source of data for measuring the progress of the Challenge 2000 MMP toward its stated goal of infusing the schools of Silicon Valley with an exemplary model of project-based learning supported by multimedia.

Key 2: Ongoing Support within a Teacher Learning Community

Initially, the MMP relied on teacher training sessions, held during the summer or outside of school hours, to introduce teachers to the PBL+MM model for integrating technology into the classroom. IRL provided teachers with extensive training in strategies for teaching with technology. But unlike traditional professional development offerings, which stop at offering isolated “pull-out” sessions to teachers, the Challenge 2000 MMP called for the transfer of responsibility for professional development to teacher-leaders within the MMP over the course of 5 years.

These teacher-leaders form a network of technology learning coordinators (TLCs), who are key to the MMP's success. TLCs, funded by the Challenge 2000 teams, are teachers who, over the course of the MMP, have built their own skill and practice in using PBL+MM and have begun to train and mentor other teachers in this teaching model. TLCs mentor other teachers, help develop partnerships among teachers in their schools, and provide informal support to projects in a variety of ways. Roles that technology learning coordinators typically perform include assisting teachers with the mini-grant application process, providing curricular and assessment ideas, helping troubleshoot problems with technology, and discussing student work with teachers on their team and with other TLCs.

This "push-in" approach to professional development, with support from the TLCs, is consistent with a research-based approach to developing learning communities. Learning communities are organizations of activities and people that support learning, reflection, and continuous improvement (Brown & Campione, 1994; Rogoff, 1994). Much of the research on learning communities has focused on students in schools, but in recent years, teachers and schools have investigated ideas from organizational learning (Senge, 1990) and reflective practice (Schon, 1983) for education. Furthermore, Challenge 2000, not unlike other initiatives led by reformers from the business sector, seeks to create learning communities by appropriating and transforming promising practices from the business sector that might contribute to the improvement of teaching (see Tyack & Hansot, 1992).

A critical component of most learning community and learning organization models is the sharing of expertise. In businesses, mentors have often supported new workers by providing them with the knowledge they need to perform well in their jobs, introducing them to key individuals in the organization, and involving them in the company culture. Educators have also relied on such relationships, and in recent years, mentoring has been advocated as a means to assist teachers in learning new educational technologies (Clark, 1994; MacArthur et al., 1995). Mentoring models have been found successful in encouraging teachers who are more skilled in technology to share their expertise with other, less experienced teachers (Knight & Albaugh, 1997).

The TLCs who serve as mentors in the MMP share their expertise in various ways with each other and with teachers implementing projects. TLCs regularly work with teachers side by side as they implement projects and connect them to human and technical resources within their schools to help them implement projects more successfully. Also, by helping teachers learn new software programs, they help provide novice teachers with examples of successful technology integration into their classroom teaching.

Yet another component of learning communities is that they have a common set of activities about which they are organized. From years of experience in working with teachers to develop more student-centered approaches to the teaching of mathematics using videodisc technology, the Cognition and Technology Group at Vanderbilt (1997) has found that teachers need extensive opportunities to collaborate around specific projects or problems. The advantage of the partnership model developed in the fourth year of the MMP is that it allows groups of teachers to work together on a multimedia project that is shared across classrooms. Teachers can struggle together as they experiment with new methods of teaching with technology and learn from each other's successes and failures. In addition, the MMP's reliance on a single rubric for scoring projects across grade levels and subjects creates a common language for discussing the quality of student work. Groups of teachers or the TLC network itself can discuss a myriad of projects from different teams, using a common framework to guide their evaluations of how well students have mastered core academic content, worked effectively together, and produced multimedia designs that are eye-catching and coherent.

In this report, we explore in greater detail some of the important supports needed to help teachers learn how to implement projects. We outline the roles that opportunities for teachers to collaborate, share expertise, earn rewards and recognition, and engage in reflection about student work play in teacher professional development and in the continuous improvement of the MMP itself. We use data about formal and informal learning opportunities for teachers to situate the MMP's model for professional development within a larger context of helping teachers learn how to integrate technology into the curriculum effectively to promote deep student learning.

Key 3: Use of a Pedagogical Model Consistent with How People Learn

The curricular model that MMP teachers learn to implement is a project-based approach that uses multimedia as a tool to support student learning (Exhibit 1.1). Projects are expected to be integrated with students' core curriculum and have connections to students' lives and experiences. Projects are to be extended in time, engaging students often for several weeks in defining a problem, conducting research, analyzing information, and developing and revising a multimedia product. Projects are to be student-led rather than teacher-directed, and teachers are expected to find appropriate ways to give students responsibility for decision-making and project completion.

Exhibit 1.1 Features of Exemplary Project-Based Learning with Multimedia

Core curriculum. Teachers design their projects to accomplish key instructional objectives that are part of the expected curriculum in their courses.

Real-world connection. PBL+MM seeks to connect student projects with the real world in which students live. This feature may be designed into a project by means of the content chosen, the types of activities, or the types of products, or in other ways.

Extended time frame. A good project is not a one-shot lesson; it extends over a significant period of time. The actual length of a project varies with the age of the students and the nature of the project. It may be days, weeks, or months.

Student decision-making. Teachers consider carefully what decisions they make and what decisions they leave to the students. Students typically make decisions about both the form and content of their final products.

Collaboration. Students may work in pairs or in teams of as many as five or six. The goal is for each student involved to make a unique contribution to the final work.

Assessment. In PBL+MM work, teachers are expected to meet assessment challenges: evaluating the quality of students' multimedia products and measuring changes in student knowledge and competence as a result of project work.

Multimedia products as learning tools. Students do not learn simply by using multimedia produced by others; they learn by creating multimedia products themselves.

For many years, educators have noted the deep learning that can happen when students do extended projects of the kind advocated by the MMP model. Learning through projects was an important part of Progressive Education in the early part of the 20th century. The Project Method, as it was sometimes called (Kirkpatrick, 1918), was seen as a tool for engaging students in systematic, student-directed inquiry. Dewey (1910) in particular believed that various crafts, including the graphic arts, “afford great opportunity for training in self-reliant and efficient social service” (p. 168) and provide opportunities to encounter problems that require students to reflect and experiment to solve them.

As the popularity of student-centered approaches to teaching and learning has grown in recent years, projects have again become the focus of attention of educators and researchers. Today’s examples of project-based learning are similar to earlier practices in that they require students to focus over an extended period on the resolution of a real-world problem (Blumenfeld et al., 1991). Typically, through the course of completing a project, learners use multiple sources, collaborate with others, and apply cognitive tools to plan approaches, conduct analyses, and evaluate possible solutions to the problem at hand. In this way, projects provide an opportunity for students to develop deep understanding of subject matter as they acquire new information and concepts and apply this new knowledge to a production task.

Multimedia technology has been shown to be a potentially powerful aid for structuring project-based work to engage student learning. Multimedia products create artifacts for teachers and students that can become the basis for ongoing reflection and critique, helping students to develop higher standards for their work over time. For example, Allen and Pea (1992) traced the joint construction of a set of expectations for student learning by teachers and students over the course of an extended student project involving the construction of multimedia presentations. They documented the ways that teachers and students negotiated a balance between a focus on design and content. Teachers were initially concerned that students were concentrating on the quality of their multimedia design elements, and ignoring the quality of their content. When a balance between design and content was achieved, teachers began to see the two elements of constructing a presentation as interdependent. In a similar study of project-based

learning with multimedia, Erickson and Lehrer (1998) researched the evolution of “critical standards” for judging the quality of student work. Over the course of 2 years of involvement in projects, students and teachers came to develop shared representations of what constitutes a good project.

Previous years’ evaluation reports by SRI researchers have documented the success of the MMP in making a difference in the kinds of design products students produce. Our performance assessment of student learning conducted in Year 4 (see Penuel & Means, 2000) suggests that, through the MMP, students acquire design skills that are critical to many of today’s jobs in the new economy. In a task that required students to develop a brochure that conveyed information to teachers and principals on a complex social problem, students in the MMP were better able than a matched comparison group to create complex products that exhibited their skill in integrating textual and graphical elements into a coherent whole.

This report explores in greater detail the extent to which students in these same samples of classrooms participated in the design activities described as typical of multimedia-supported project-based learning by Allen and Pea (1992) and by Erickson and Lehrer (1998) in their research. Data from the Year 4 observation study are analyzed with special attention to students’ participation in seeking information, analyzing and interpreting information, structuring presentations, considering audience concerns, and revising presentations. These data are presented in Chapter 4 to give a more complete picture of the way MMP classrooms differ with respect to the cognitive demands placed on students when they engage in project-based learning with multimedia.

Organization of This Report

Unlike previous reports by SRI, this report focuses exclusively on the Challenge 2000 MMP, and not on other aspects of the Challenge 2000 reform initiative. We have chosen to focus on the MMP this year to highlight what SRI researchers believe are particularly successful components of the larger reform initiative, namely, the combination of a research-based approach to teaching and learning with a venture capital model for spreading the approach to classrooms across Silicon Valley. Researchers and policy-makers need to know more about successful examples of technology integration,

especially what makes them successful. The chapters in this report each highlight a different lens through which one might view the MMP, its implementation, and its success.

Chapter 2 traces the MMP's ongoing progress toward meeting its goal of infusing Silicon Valley classrooms with an exemplary model of project-based learning with multimedia. Data on the number of students, classrooms, and teachers are included in Chapter 2, as are rubric scores from student projects from the teams' spring 2000 multimedia fairs. Chapter 2 also presents evidence of the expansion of the reach of the MMP beyond Silicon Valley.

Chapter 3 examines the keys to the professional development model of the MMP. Opportunities for collaboration around student projects, ways expertise is shared among MMP teachers, rewards and recognitions for MMP teachers, and examples of reflection on student projects are all analyzed in Chapter 3.

The analysis of teacher learning is followed in Chapter 4 by an analysis of classroom processes. Data from the Year 4 observation study are presented that highlight student engagement in the cognitive activities of design. For each school, the processes of MMP classrooms are compared with classroom practices in a matched set of classrooms that did not participate in the MMP.

Chapter 5 describes SRI's focus in 1999-2000 on sharing results from the first 4 years of the evaluation with broader audiences of educators, researchers, and policy-makers. The development of an evaluation component of the Web site, conference presentations, and manuscripts written by SRI researchers are described in this chapter.

Chapter 6 includes conclusions from our evaluation study and recommendations for the MMP in its final year. Teachers' views on what elements of the MMP will be sustained are presented and analyzed in this chapter, as well.

2. PROGRESS TOWARD MULTIMEDIA PROJECT GOALS

The Challenge 2000 Multimedia Project (MMP) has one overriding goal: to infuse Silicon Valley classrooms with an exemplary model of project-based learning with multimedia. The MMP has expanded its reach in Year 5 by adopting two parallel strategies: expanding the number of teacher partnerships and giving teachers from Round 2 and 3 Challenge 2000 teams the opportunity to participate in the MMP. The MMP has also made progress toward its goals of improving the percentage of students' projects judged as "exemplary" by a panel of judges for the multimedia fairs sponsored by teams. Survey responses indicate that teachers in the MMP believe that project-based learning will survive in their classrooms beyond the life of the grant, as will the project-centered partnerships they've developed with other teachers in their school. At the same time, teachers believe that funding for teachers to implement projects, release time, and judging of projects at the multimedia fairs are less likely to be sustained by their schools and districts after the grant has ended.

Expansion of Multimedia Project Participation in 1999-2000

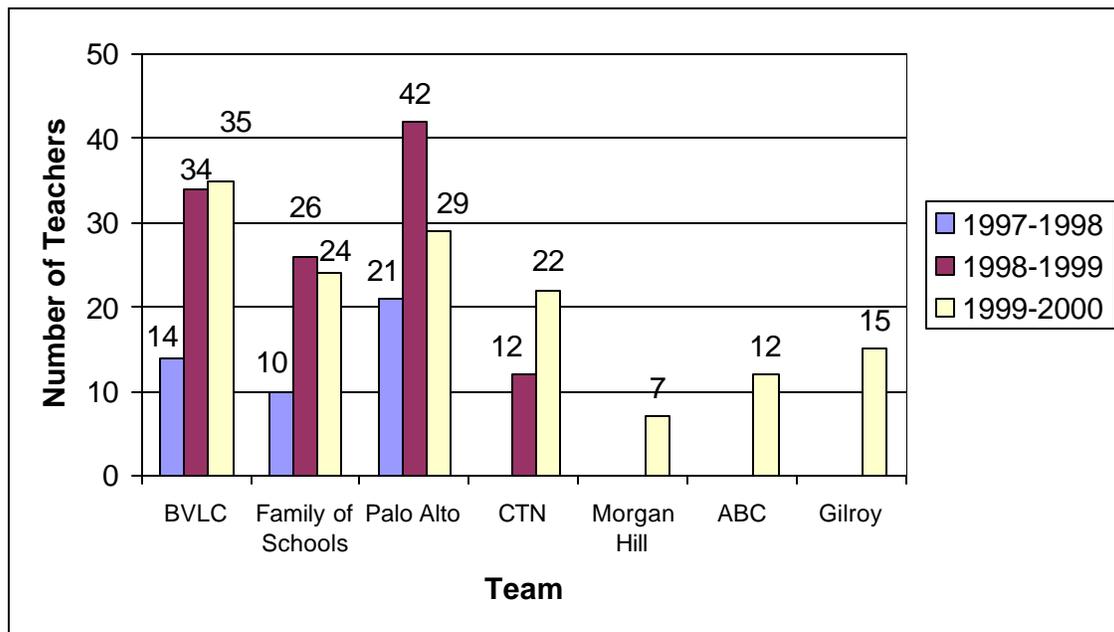
The MMP continued to build strength in Year 5 of Challenge 2000, as shown by responses to two end-of-the-year surveys. Of 144 teachers in the MMP, 132 responded to the project profile survey, each reporting on one multimedia project. The number of students who participated in the 132 projects profiled must be partially estimated because 31 respondents did not report the number of participants. The total from those who did report is 4,970 students. Estimating the overall participation on the basis of reported participation, it is likely that almost 6,500 students participated² (Table 2.1).

Table 2.1. Number of Teachers and Students in the Multimedia Project

	1998-1999	1999-2000	Change
Total number of teachers	128	144	+12.5%
Estimated number of students	5,200	6,500	+25.0%

The increase in participation was due largely to the expansion in the Catholic Telemedia Network (CTN) team and to expansion of the MMP to Round 2 and 3 Challenge 2000 teams. The CTN team grew by 10 teachers, and a total of 34 teachers were added by the inclusion of staff from the Morgan Hill, Aragon-Borel Complex (ABC), and Gilroy teams in the MMP. Participation in the MMP by the first four Challenge 2000 teams (Round 1) did not show the same rates of increase as earlier (Figure 2.1). Participation in the Palo Alto team decreased to 29 teachers, from 42 in 1999. The other two teams shown in Figure 2.1, Blossom Valley Learning Consortium (BVLC) and Family of Schools, remained stable.

Figure 2.1. Number of Teachers, by Team

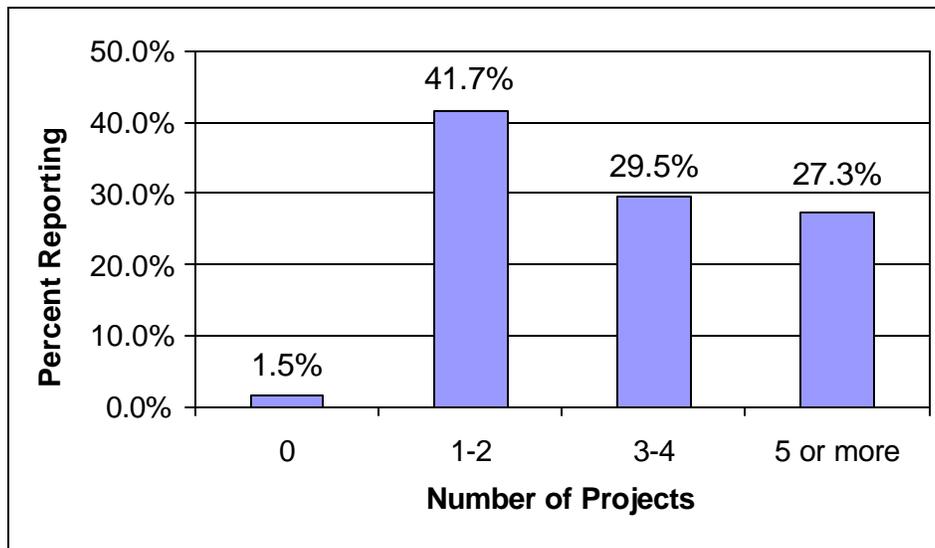


Teachers reported on only one of their multimedia projects in the project profile survey, but their responses to the second survey on teacher participation show that they conducted additional projects. The average number of projects reported by each teacher was 1.8, suggesting that teachers have become comfortable and proficient with the project-based learning with multimedia model. As Figure 2.2 shows, more than two-

² Number of students was reported by project. The same individuals may have participated in more than one project.

fifths of respondents (42%) conducted one or two long-term projects in 1999-2000. Although this level of implementation is impressive in itself, more than half of these teachers (57%) conducted three or more projects, suggesting that much of students' time in these classrooms is spent in a sustained and collaborative effort to produce products that allow students to explore academic content deeply.

Figure 2.2. Number of Projects Conducted



Teacher partnerships, a strategy for expanding participation developed in Year 4, continued to be an important part of the MMP. In partnerships, an experienced MMP teacher works with other teachers who are just joining the MMP. The partnerships implement one or more student multimedia projects across classrooms, under the leadership of the more experienced MMP teacher. The number of partnerships rose from 24 in 1998-99 to 29 in 1999-2000. In Year 5, 22% of teachers who responded to the teacher participation survey were lead teachers in a partnership, 28% were new teachers in a partnership, and 50% were not working in a teacher partnership. Most partnerships (65%) completed one project together, 14% completed two projects, 5% completed three projects, and 17% completed four or more projects.

Exemplary Projects in the Multimedia Fairs

The MMP incorporates processes for program-level accountability to measure progress toward the goal of making sure the model being spread across classrooms is in fact “exemplary.” The student interview process that is part of the multimedia fair held by each team late in the school year provides an important source of data about the quality of student projects. On the one hand, these fairs are a celebration for the school community during which the students’ multimedia projects are viewed by other students and teachers, parents, administrators, business community representatives, and members of the press. At the same time, the fairs provide an opportunity to reflect on how well students are learning in the course of completing multimedia projects and to share criteria for assessing student work. According to one technology learning coordinator (TLC), the fairs are “a point of contact for expertise among cadre members,” a way that “accountability is built into the MMP.”

As part of the multimedia fair process, each team is invited to submit six exemplary projects for judging. The judging panel at each fair is composed of teachers, TLCs, MMP staff, and community members who use a rubric to score each submission on three dimensions: multimedia, collaboration, and content.

The scoring rubric (Appendix) was developed by a group of teachers, MMP researchers, and staff. It was initially intended that the rubric would encompass all seven dimensions of the MMP model (see Page 10), but because of the complexity that would have been involved in scoring all seven dimensions, the rubric design was limited to three dimensions. Five levels of performance were specified for each dimension. The development group started with the descriptors for the highest level of performance, a score of 5 on the rubric, and then used the same descriptors to describe weaknesses at the lower levels of performance. Experience with the rubric led to the addition of the student interviews, primarily to give judges an opportunity to learn about the level and nature of student collaboration on projects, a dimension that is not generally evident in final products.

There is widespread agreement that the rubric is not the ideal measure of quality for all projects, but there also is agreement that the rubric does as good a job as can be done by a tool that must cover many needs. The rubric is used to score projects done by

students at all grade levels and to score projects presented in different formats (e.g., Web site, CD-ROM). Students seem comfortable with the rubric approach, and at several schools, students have participated in efforts to rewrite the rubric using “kid-friendly” wording so that they can use the rubric to guide their work.

The percentage of student projects judged as exemplary has steadily increased for the four teams who have been participating in the MMP for more than a year. Each year, MMP staff and TLCs have defined “exemplary” as projects that scored an average of at least 4 out of 5 across the three dimensions of the rubric. In 1998, 22% of submitted projects met the exemplary score target (Table 2.2). The percentage rose to 50% in 1999 and to 73% in 2000. The bottom of Table 2.2 shows the results for three new teams in the MMP, ABC, Gilroy, and Morgan Hill. These teams submitted 17 projects for judging, and 5 of these (29%) achieved exemplary scores. Although this rate is lower than that for the more experienced teams at the top of Table 2.2, it is higher than the rate of exemplary projects achieved by the original four teams in their first year of the MMP (22%). The fact that new teams’ projects received lower ratings also suggests that there has not been a tendency toward “score inflation” over the years.

Table 2.2. Percentage of Exemplary Projects, by Year and Team

Team	1998 Total Projects	1998 Exemplary Projects	1999 Total Projects	1999 Exemplary Projects	2000 Total Projects	2000 Exemplary Projects
BVLC	7	2	6	2	6	4
Family of Schools	6	1	6	2	6	4
Palo Alto	4	1	6	5	5	5
Overfelt Family	6	1	N/A	N/A	N/A	N/A
CTN	N/A	N/A	6	3	6	4
<i>Percentage of exemplary projects</i>		22%		50%		73%
ABC	N/A	N/A	N/A	N/A	6	1
Gilroy	N/A	N/A	N/A	N/A	5	3
Morgan Hill	N/A	N/A	N/A	N/A	6	1
<i>Percentage of exemplary projects</i>						29%

Comments from Multimedia Fair Judges

Comments written by judges as part of the project evaluations give insight into why so many projects achieved exemplary scores. Judges noted strong aspects of projects, as well as considerations for improvement in future projects. Judges' comments tend to reflect the seven dimensions of the MMP model (see Page 10), a model they review in conjunction with the scoring rubric before evaluating projects. Judges' comments are not intended to be comprehensive, but they do give the teachers and students who present a project an indication of reasons behind their project's score.

A review of comments written about 38 projects submitted for scoring in the 1999-2000 multimedia fairs shows that judges tended to offer more comments on the strengths of a project (232) than considerations for improvement (91). Judges' comments on stronger aspects of projects most frequently addressed presentation aspects of the project (67 of 232). Examples of these comments are given in Table 2.3. These comments are shown in three categories: use of media affordances (taking advantage of what the multimedia tools can do), quality of media used, and coherence of the overall multimedia presentation.

Table 2.3. Positive Comments on Multimedia Aspects of Student Projects

Use of Media Affordances	Quality of Media	Coherence of Presentation
Simulation illustrated wonderfully how the plague spread.	Effective use of sound. Good navigation throughout.	Consistency of readability and layout allowed the project to flow between topics.
Students understood the advantages and limitations of the software applications and made decisions to use a particular software application based on the software's features.	Attractive, engaging piece of work visually; soundtrack added to presentation. Video was great, as were the actual examples filmed by the students – in the gym and the building of the roller coaster.	Could almost be on an educational television station to be used to teach students about notable characters in ancient history.

Other strengths noted by judges were relatively evenly distributed among four of the dimensions of the MMP model: core curriculum (42); student decision-making (41); collaboration (30); and real-world connection (28). Examples of comments on these four dimensions are given in Table 2.4.

Table 2.4. Positive Comments on Other Aspects of Student Projects

Element of Model	Comment
Challenging, multidisciplinary curriculum	Students were able to articulate the parallel between the search for scientific cures and the extent of incorrect medical knowledge of yesterday compared to today.
Collaboration	Good collaboration. Much evidence that students problem-solved and contributed to the project. They were an effective team. They learned from each other.
Student decision-making	The students were able to choose facts about the history of their town that were of interest to them.
Real-world connection	Personal interview was a very effective real-world connection and use of primary source material.

Comments about how projects could be improved followed a similar pattern. Almost half of the considerations offered (43) were suggestions for improving aspects of the multimedia presentation of the project, as shown by sample comments in Table 2.5.

Table 2.5. Judges' Suggestions for Improving Projects

Use of Media Affordances	Quality of Media	Coherence of Presentation
<p>Add more multimedia elements such as sound, animation, and video.</p> <p>Make more use of the editing capabilities of digital video. Example: slow motion, more use of overlays (a marker or line following the path of the ball).</p> <p>Take advantage of the interactive aspects of PowerPoint such as inserting hyperlinks to web sites that supplement the points you are trying to make.</p>	<p>Consider readability of the text. For example, more contrast between background and text would be helpful.</p> <p>Teacher could train experts in video techniques. Camera angle into the light could be improved, for example.</p>	<p>Use graphics, charts, and photos to increase the viewer's understanding of the material. For example, captions with the pictures, charts next to the written synopsis of the data.</p>

Other frequently suggested improvements reflected two of the other dimensions of the MMP model: core curriculum and student decision-making. Increases in opportunities for student decision-making were recommended (16), as well as improvements in the content of the project (14). Suggestions of ways to improve content included making use of more sources of information, making use of more primary sources, and adding a comprehensive list of references and citations.

Looking closely at judges' comments about the use of multimedia also shows that they are not enamored by the "bells and whistles" of multimedia technology but are concerned that students have an understanding of the capabilities and limitations of the technologies they are using. Increasingly, groups such as the National Research Council (1999) and the International Society for Technology in Education (1998) have argued for the importance of teaching students these kinds of understandings as a means toward developing students' fluency with educational technology.

Emerging Issues Surrounding the Quality of Student Projects

Two additional issues have emerged in discussions among TLCs related to ongoing improvement of the quality of student projects. First, there is increasing concern that many projects require extensive home use of computers for students to complete their research and presentation development successfully. In some cases, projects have been almost entirely dependent on students' having home access to computers to complete projects in time for the multimedia fairs, because access to school labs or classroom computers was limited. If project-based learning with multimedia is to benefit all students, there must be opportunities at school or in other settings for students to use multimedia technologies before and after school.

A second concern of TLCs relates to students' skill in conducting research for their projects. Some TLCs are concerned that their students do not critically examine content they incorporate into their multimedia presentations, especially when the content comes from the Internet. These teachers have attempted to incorporate strategies to help students evaluate Web sites for possible bias, comprehensiveness, and accuracy. At the same time, they and others (Lehrer, 2000) recognize the need to have more resources available to help students navigate the process of conducting research on the Internet. The focus on content and evidence maintained by teachers such as Gayle Britt (Britt,

2000; Cole, 2000) points toward how such skills might be developed in the context of project-based learning with multimedia (PBL+MM).

Beyond Silicon Valley: Expanding the Reach of the Multimedia Project

The MMP has expanded its reach beyond Silicon Valley by helping other teachers learn about the PBL+MM model, by making resources on PBL+MM available through the MMP Web site, and by showcasing student projects across the state.

Teaching Colleagues about Project-Based Learning with Multimedia

During 1999-2000, the MMP director, TLCs, teachers, and other MMP partners presented at nine conferences aimed at teachers, school administrators, and policy-makers. Of these conferences, five were either national or international in scope, and four were regional conferences. Table 2.6 lists the conferences and the presentations delivered by MMP presenters. More complete descriptions of many of these presentations can be found at <http://pblmm.k12.ca.us/linda/conferences.htm>.

Table 2.6. Conference Presentations by MMP Educators

Conference	Presentation Title(s)
Computer-Using Educators, October 29-31, 1999, Sacramento, CA.	<ul style="list-style-type: none"> • HyperStudio for the Mac • HyperStudio Workshop for the PC • Voices and Images of California Modern Art • Web Page Design Workshop
National School Boards Association's Technology + Learning Conference, Dallas, TX, November 10-13, 1999.	<ul style="list-style-type: none"> • Learning Outcomes in the Digital High School
California School Boards Association (CSBA) Annual Education Conference, December 9-11, 1999, San Francisco, CA.	<ul style="list-style-type: none"> • Realizing the Potential of Technology
Computer-Supported Collaborative Learning (CSCL99), December 12-15, 1999, Stanford, CA.	<ul style="list-style-type: none"> • Technology-Supported Innovation in Real World Classrooms • Imagination, Production, and Collaboration in Project-Based Learning Using Multimedia • Educator-Researcher Conversation on Technology-Enabled Teacher Professional Development

Table 2.6. Conference Presentations by MMP Educators (continued)

Teachers Helping Teachers, February 5, 2000, San Jose, CA.	<ul style="list-style-type: none"> • Adversity City: Multimedia Project on Ethnic Cleansing • Choosing the Best Applications for Projects • Become a Digital DaVinci: Digital Camera Projects • Poetry Templates: How to Dress Them Up • California Geography and Project-Based Learning • PBL+MM = Increased Learning • On Becoming a Great Technology Trainer
Autodesk “Kids Who Know and Do” Conference, March 30-April 1, 2000, San Francisco, CA.	<ul style="list-style-type: none"> • Good Assessment = Good PBL • Adventures in Global Collaborative PBL • Value Added: PBL+MM in an English Class
American Educational Research Association Annual Meeting, April 17-23, 2000, New Orleans, LA.	<p>Teacher Presentations:</p> <ul style="list-style-type: none"> • “Is My Project Good?”: Improving Students’ Assessments of Quality in Multimedia Design • The Video Debrief: A Tool for Collaborative Reflection in Project-based Classrooms
School Tech Expo, April 30-May 1, 2000, New York, NY.	<ul style="list-style-type: none"> • Integrating Project-Based Learning Supported by Multimedia into Your Classroom • Half-Day Assessment Workshop • Case Study on Documenting Success • Panel on Assessment Tips
Computer-Using Educators, May 11-13, 2000, Palm Springs, CA.	<ul style="list-style-type: none"> • HyperStudio for the Mac • HyperStudio Workshop for the PC • Voices and Images of California Modern Art • Web Page Design Workshop

The Project-Based Learning with Multimedia Web Site

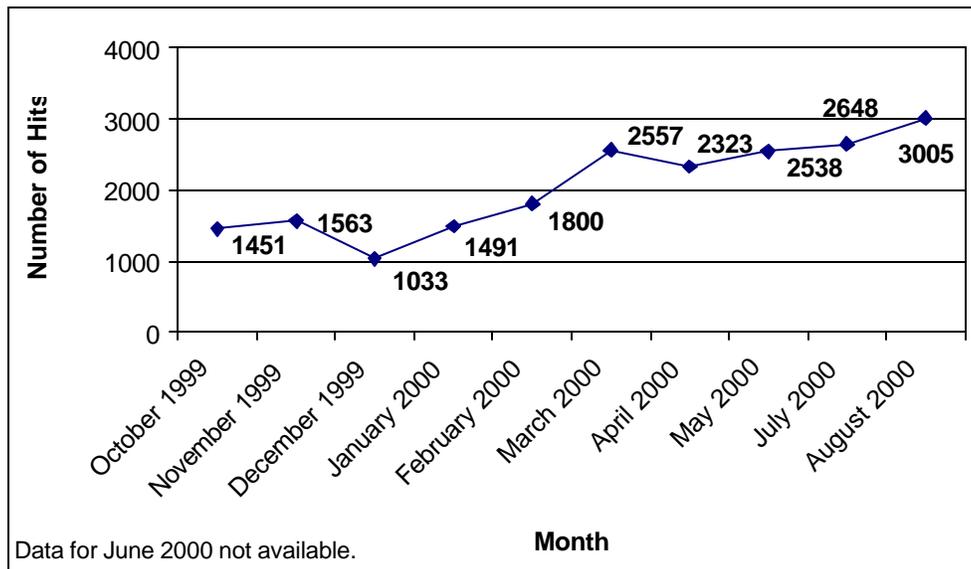
The MMP Web site (<http://pblmm.k12.ca.us>) is an important resource for teachers seeking to implement student-centered projects using multimedia, and it is a significant tool for expanding the impact of the MMP beyond the Silicon Valley teachers who are part of the MMP. The Web site can reach educators, policy-makers, and researchers who cannot attend face-to-face conference presentations but who want to learn more about the pedagogical model and its impacts on teaching and learning.

In Year 4, Jason Marsh of MarshWorks developed a Web ring to link the MMP with other sites that have resources on project-based learning with multimedia. The other sites that were part of the Web ring in 1998-1999 were: the Autodesk Foundation, the Buck Institute for Education, the WEB Project, and The Project Approach at the

University of Alberta. This year, the MMP added three new sites to the Web ring: The BaySCAN Multimedia Network, an organization focused on providing school-to-career programs to Bay Area youth in the area of multimedia design; the Digital Clubhouse Network, a network of community technology centers in Silicon Valley; and the Curriculum Using Technology Institute, a resource center for problem-based curricular ideas.

Use of the Web site has increased steadily over the past year. In spring 1999, the number of unique hits for March and April was roughly 1,000 each month. During that same period, the Web site won a “Blue Web’n” award for its content from the Pacific Bell Knowledge Network. By the same time in 2000, the monthly use had increased to more than 2,300 users, and it continues to rise. Figure 2.3 shows the number of unique hits, a rough proxy for individual users of the site, during Year 5.

Figure 2.3. Unique Hits on Multimedia Project Web Site, by Month



Recognition for the Quality of Student Projects

The performance of MMP students and teachers at a statewide media festival is an indicator of how student projects compare with other students’ multimedia presentations from across the state. The California Student Media and Multimedia Festival was started 34 years ago and is the nation’s oldest student media festival. The festival’s mission is to

encourage and reward successful classroom work that is project based and demonstrates meaningful student work in media and multimedia. This mission is based on four key principles:

- Students are capable of extremely high level work, beginning at very early grades.
- Media and multimedia are excellent tools for students.
- Media and multimedia should be integrated into regular subject-area curricula.
- Rewarding good work and good school programs encourages more of both.

(Source: <http://www.mediafestival.org>)

Each year, thousands of students and hundreds of schools enter the festival to present their work and vie for \$1,000 awards. The festival is supported by a number of organizations and has awarded over \$85,000 in the past 4 years.

Participation of MMP teachers in the statewide festival increased greatly in Year 5 of Challenge 2000 (Table 2.7). Nineteen teachers entered one or more projects in the 2000 festival, compared with only four teachers in the 1999 festival. Two factors may have contributed to this increase. First, MMP staff were active members of the festival coordinating committee. These staff members took advantage of opportunities to promote participation in the statewide festival during TLC meetings, MMP teacher workshops, and other informal settings. They also provided information and support for teachers to feel comfortable entering a large-scale competition. For instance, they emphasized the opportunity the festival presents for students to experience a statewide event.

Table 2.7. Number of MMP Teachers and Awards at the California Student Media and Multimedia Festival

Year	Number of Teams	Number of Teachers	Number of Awards	Percent of All Awards Won by MMP Students
1999	2	4	5	17
2000	4	19	18	49

A second factor in the increased participation may have been the MMP-wide meeting held in December 1999, described in Chapter 3 (see Page 30). Attended by teachers, principals, and TLCs, the keynote address was given by Hall Davidson, director of the California Student Media and Multimedia Festival. The address included presentation of many samples of exemplary student work from previous festivals. Responses to the MMP-wide meeting evaluation suggest that this face-to-face meeting with Davidson gave impetus to increased participation of MMP teachers in the statewide festival. Specifically, 84% of evaluation respondents were overwhelmingly positive about Davidson’s presentation. They cited the opportunity to see so many examples of student work—and Davidson himself—as motivating and inspiring. One teacher noted “that there are really no limits to what or how you can do a project.”

Even more impressive than the increased participation in the festival is the number of awards captured by the MMP entries. As shown in Table 2.7, MMP entries took home almost half (49%) of the statewide festival awards. The elementary school entries were particularly successful, winning two-thirds of awards for elementary school level projects. It is also significant that the award winners ranged across 8 subject areas, 13 schools, 8 school districts, and all grade levels. In all, 449 students, 19 teachers, and 18 projects shared in 18 of 37 festival awards (Table 2.8).

Table 2.8. Multimedia Project Receipt of California Student Media and Multimedia Festival Awards, by Grade Level

School Level	Number of Subjects	Number of Students	Number of Teachers	Number of Schools	Number of Districts	Number of Awards	Percent of Awards
Elementary	6	256	10	6	4	8	67
Middle	5	128	7	5	4	7	54
High	2	65	2	2	2	3	25
Total	8*	449	19	13	8*	18	49

*Some subjects and districts appear in more than one school level.

Individual student projects have also been recognized in other competitions. National Semiconductor presents awards to multimedia projects at the annual Internet Institutes, a set of technology training workshops offered by the Santa Clara County Board of Education in conjunction with many sponsors. One of the award winners was

the Iditarod Project, done by MMP 11th-grade desktop publishing students engaged in cooperative study of the Alaskan dogsled race with a kindergarten class (<http://etc.sccoe.org/i99/kndrtn.html>). The other award winner was the Geometry Project, done by 7th-grade students. This project explores the history of geometry and its applications in the professional occupations. The Geometry Project was also a winner at the statewide festival, winning the overall middle school prize. (<http://www.stleos.pvt.k12.ca.us/StLeosSite/classes/Seventh/PROJECT/geoindex.html>)

Another MMP effort, the Art of Japan, received a gold award from ThinkQuest's annual Internet Challenge competition for students 12 to 19 years of age. ThinkQuest is an international program that encourages students to use the Internet to develop their own educational resources. ThinkQuest contest winners are recognized for working collaboratively while developing leadership and critical-thinking skills. The Art of Japan project, done by three high school students, attempts to bridge the gap between appreciation of Western and Eastern art by providing a wealth of educational resources on the art and architecture of Japan. (<http://library.thinkquest.org/27458/index.html>)

3. SUPPORTS FOR TEACHERS' TRANSITION TO PROJECT-BASED LEARNING WITH MULTIMEDIA

The Cognition and Technology Group at Vanderbilt (1997) has identified a number of features that characterize learning communities that are focused on helping teachers learn to use technology to drive reform. First, teachers must have opportunities to collaborate around specific projects or problems. Second, collaboration should draw on expertise distributed among members of the group. Third, they need extrinsic motivation (recognition and rewards) for their efforts and technical support along the way. And fourth, they need opportunities for ongoing reflection and self-assessment. Connections to a wider audience—of parents, administrators, and other members of the community—can motivate reform and help drive projects to timely completion.

The Multimedia Project (MMP) invites teachers to join just such a learning community. It provides teachers with formal and informal opportunities to collaborate as they learn to use project-based learning and multimedia (PBL+MM) in their classrooms. It provides a multi-layered structure of partners, technology learning coordinators (TLCs), and teams for sharing skills and expertise. It provides recognition and rewards, including grants for the hardware and software needed for proposed projects. And it enables reflection and self-assessment at all stages of the project.

These features of a learning community, combined with student excitement about multimedia technology and eagerness to engage in project-based learning, are important factors in the success of the MMP. This chapter analyzes the opportunities teachers have to learn to implement student-centered projects by collaborating with peers, gaining from distributed and freely shared expertise, earning recognition and rewards for their involvement, and reflecting together on the quality of student work. Our purpose in this chapter is to situate the MMP's professional development model for teachers in the broader context of strategies that other programs have found successful in preparing teachers to integrate new technologies into the curriculum in ways that foster deep student learning.

Opportunities for Project-Centered Communication and Collaboration

Teacher collaboration in the MMP in both formal and informal settings is centered on student multimedia project plans and implementation, anchoring teachers' conversations with one another and creating clear directions for progress. Scheduled events include professional development sessions and coaching provided by the Institute for Research on Learning³ (IRL), MMP-wide meetings, workshops hosted by the TLCs of each Challenge 2000 team, and a summer institute offering training for novice, intermediate, and experienced multimedia teachers. The TLCs and teacher partnerships provide a more informal, but equally important, forum for collaboration that allows for ongoing communication about projects in scheduled meetings and impromptu conversations.

Formal Training Sessions and Coaching

At the beginning of the MMP, a core group or *cadre* of teachers worked closely with IRL, Challenge 2000, and each other in a participatory design process to develop support materials to help other teachers bring multimedia technology projects into their classrooms. The federal grant budget included funds to pay for teacher release time to attend "workdays," MMP-wide meetings, summer institutes, and other professional development activities with IRL. The funds also paid for more traditional, formal training led by other organizations in the use of technology tools (e.g., specific pieces of multimedia software), project-based learning, and the use of student-centered approaches supported by technology (e.g., Autodesk Foundation training in project-based learning techniques, the Apple Classrooms of Tomorrow technology integration approach).

As the MMP matured, that initial cadre of teachers began offering formal and informal sessions to help teachers learn how to implement student-centered multimedia projects in their classrooms. IRL partnered with selected members of the initial cadre of teachers to develop strategies and support materials for the more complex issues facing teachers implementing the MMP model, such as assessment. Their work resulted in

³ The School and Community Practices Group at IRL was the professional development partner for the MMP. In March 2000, IRL was disbanded, and the School and Community Practices Group was transferred to WestEd, an educational research, development, and service agency.

teacher-research studies (see Chapter 5) and in presentations to other teacher-leaders in the MMP on how to integrate assessment more fully into student multimedia projects.

Multimedia Project-wide Meetings

In the first 3 years of the MMP, MMP-wide workdays were held in which teachers participated in a variety of professional development activities aimed at helping them implement the key components of the PBL+MM model. In Year 4, the MMP's Coordinating Committee agreed to change the format of MMP-wide meetings to reflect the facts that many teachers had already learned the basics of implementation and that the number of teachers in the MMP had grown so much.

Each meeting was structured as a 3-hour session. The first hour was a social hour and allowed MMP teachers to network and share ideas. A short meal followed, at which point teachers were seated at tables corresponding to different interest categories that the organizers had established. Next, a speaker or group of speakers made presentations to the whole group. Finally, the sponsoring team held a raffle of software and other items for classroom use in conducting projects.

The first MMP-wide meeting of the 1999-2000 school year was hosted by TLCs from the Family of Schools and ABC teams. It was held at the Hiller Aviation Museum in San Carlos. The evening began with some social time; then a buffet dinner was served and the evening's speaker, Hall Davidson, gave his presentation.

Hall Davidson has extensive experience in implementing technology in the classroom, as a teacher and trainer of teachers using technology and as a consultant and advisor. In one of his multiple education and technology roles, he serves as director of the California Student Media and Multimedia Festival. His presentation of examples of student work gathered from the Festival motivated and entertained the group.

The second MMP-wide meeting was sponsored in June at the end of the school year by the Palo Alto team. As in Year 4, the MMP-wide meeting featured student projects from each of the teams of the MMP. The dinner featured recognition for teachers and TLCs in the MMP and gave some of the groups of students who had presented their projects for multimedia fair judging or for the California Student Media and Multimedia Festival an opportunity to display their projects and talk about their work

together. The projects ranged from elementary school to high school levels and included a project by special education students conducted by a teacher from the BVLC team.

Team Workshops

MMP teachers also have the opportunity to attend workshops at the Challenge 2000 team level, usually organized by TLCs. One of these is described in Exhibit 3.1.

Exhibit 3.1. Multimedia Project Teacher Workshop

BVLC Team Teacher Workshop

Focus: Continual Improvement toward Creating Exemplary Projects with Students

Linda Ullah began the workshop by explaining the choice of focus. She said that the early years of the MMP were spent developing the BVLC team. Now it was time to focus on integrating multimedia into instruction and on the quality of student work. The workshop would provide formative assessment: teachers could assess “where am I with multimedia,” and from wherever that point was, they would “move it up a notch.”

Scoring Student Multimedia Projects

One of the workshop activities was a scoring exercise using the MMP rubric. Working in small groups, two projects were reviewed. Each group had to agree on one set of scores for the project. Then each group reported their scores and talked about the differences of opinion the group had experienced. One of the projects scored was a math project with only two media, text and graphs. Although there was agreement that a project is not automatically enhanced by the addition of another medium or special effect, suggestions were made about how to use additional media in a meaningful way in a math project.

Review of Student Multimedia Project Plans

Another activity was a review of plans for multimedia projects. Teachers worked in pairs or groups of three using a planning checklist. The checklist was designed by the TLCs to prompt teachers to evaluate their projects in relation to the seven dimensions of the MMP model. Through this process, teachers noted dimensions on which their projects were weak, such as student decision-making, and also confirmed the strengths of their project plans. Most teachers assessed their projects as needing improvement on only one or two dimensions. They consulted their partners for suggestions and seemed eager to make the improvements.

What is noteworthy about workshops such as these is that they are focused on student work and give participating teachers an opportunity to think critically about the projects they are developing. The discussions about project quality are anchored in a common assessment rubric that is used across projects, and project design is guided by

the MMP model and its components. Teachers have a chance through this and other workshops like it to work together to come to shared understandings about how to implement high-quality multimedia projects.

Summer Internet Institute

As in previous years, the MMP has supported teacher participation in summer institutes to learn how to use multimedia technology effectively in the context of project-based learning. The Internet Institute, held in July 2000 and sponsored by the Santa Clara County Office of Education, was one such opportunity. More than 350 teachers attended, of which a handful were teachers seeking to become part of the MMP. Two of the TLCs in the MMP helped design the Institute's offerings focused on PBL+MM.

TLC Support

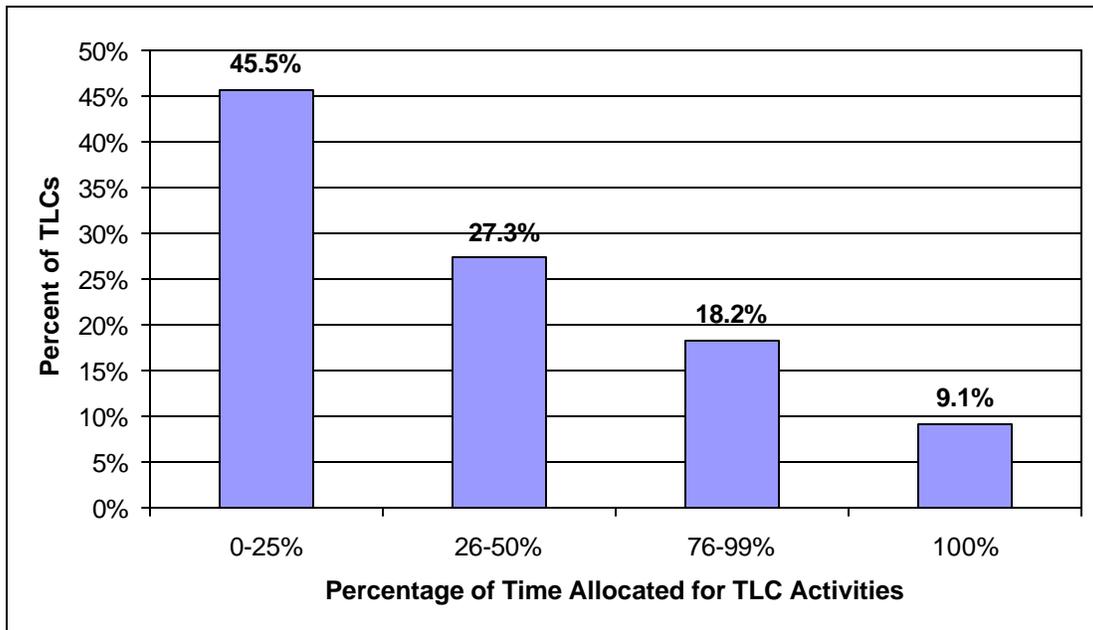
The MMP's strategy for addressing teachers' ongoing need for curricular and technical support was the creation and funding of TLC positions. The concept behind these positions is to have teachers who have been working with IRL and who are skilled both in pedagogy and in instructional uses of technology, available for on-site assistance to their fellow teachers. The TLCs play a critical role within the MMP, helping to coordinate teams' efforts and organize teamwide activities that bring teachers together to discuss ideas and share student work. Scheduled activities led by TLCs include teacher workshops, such as the one described above; the annual multimedia fairs; and training in the use of specific software tools, such as KidPix or HyperStudio.

As in previous years, in Year 5 each team was awarded funds to support the TLC salaries. Each new team received at least \$50,000 for this purpose. The continuing teams received approximately \$100,000 funding for the TLC salaries. In addition, each TLC had a \$400 personal allowance, and TLCs in each team shared an additional \$1,000 as a resource for miscellaneous expenditures.

In some cases, TLCs split their time between regular classroom teaching and assisting other teachers with implementing projects. Roughly one-quarter of TLCs have their position funded by their school or district, in some cases supporting their work with other teachers on the MMP. Most TLCs have from a quarter to half their time designated

to spend in their role as TLC (Figure 3.1). They serve an average of 4.2 schools each, though the number of schools varies by team and district.

Figure 3.1. Percentage of Time Officially Designated for TLC Role



The decision to structure the MMP with paid support staff, the TLCs, brings an invaluable resource to teachers: staff who can spend time working one-on-one with teachers in the classroom helping them to integrate technology into instruction. TLCs can also attend meetings with each other (as they do monthly) during school hours. They can use some of their time to build connections to real external audiences for student projects, something that teachers who spend all their time in the classroom have few opportunities to do. For example, in one student project conducted by teachers from the Family of Schools team, a TLC developed a relationship between her school and a local museum. Through that connection, the TLC was able to arrange student visits to the museum, and teachers who were implementing the project in her school could have their students' work displayed in a local museum, not just at the team's multimedia fair.

The TLCs themselves believe their role is critical to helping teachers implement projects successfully. They cite their role as mentors to other teachers as key. They are colleagues who are "coming to teachers giving them what they need to implement

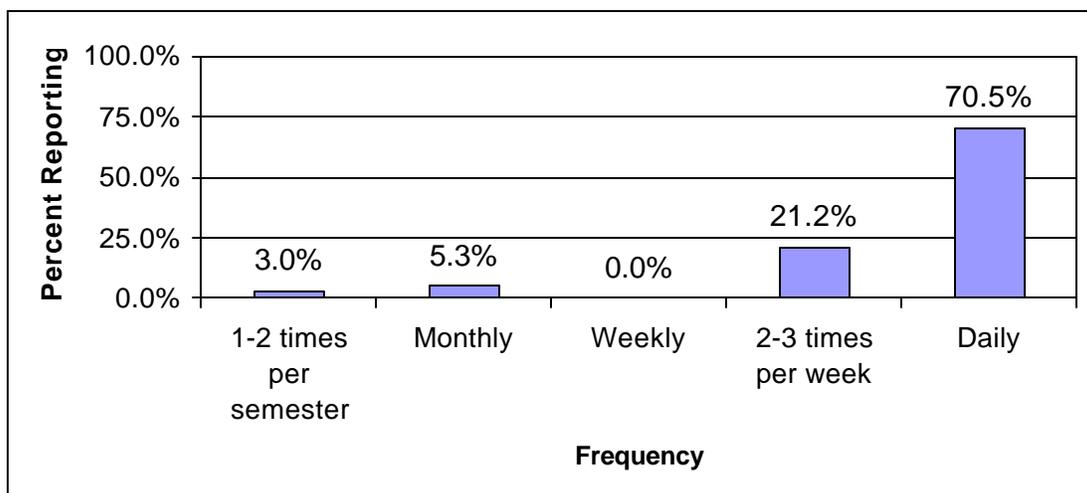
projects,” according to one TLC. Another TLC said that being able to go into a colleague’s classroom during class time was another critical aspect of their helping role. A third noted that program-level accountability was an important factor. She said that “having direct responsibility for a select group of teachers implementing projects” motivated her to work to ensure that all the teachers implemented high-quality projects.

Partnerships

Collaboration among teachers within the same school has been supported formally since Year 4 of the MMP, when “partnerships” were established as a strategy for expanding the involvement of teachers within schools. These partnerships enlist teachers who are veterans in the MMP to be mentors to new teachers. The partnership teachers apply as a group to conduct projects and have each other to rely on for advice and support as they do their projects with students. In Year 4, 24 veteran teachers served as “lead” teachers in these new partnerships. In 1999-2000, there were 29 lead teachers with 37 new partners. Almost all (97%) plan to continue their partnerships in 2000-01.

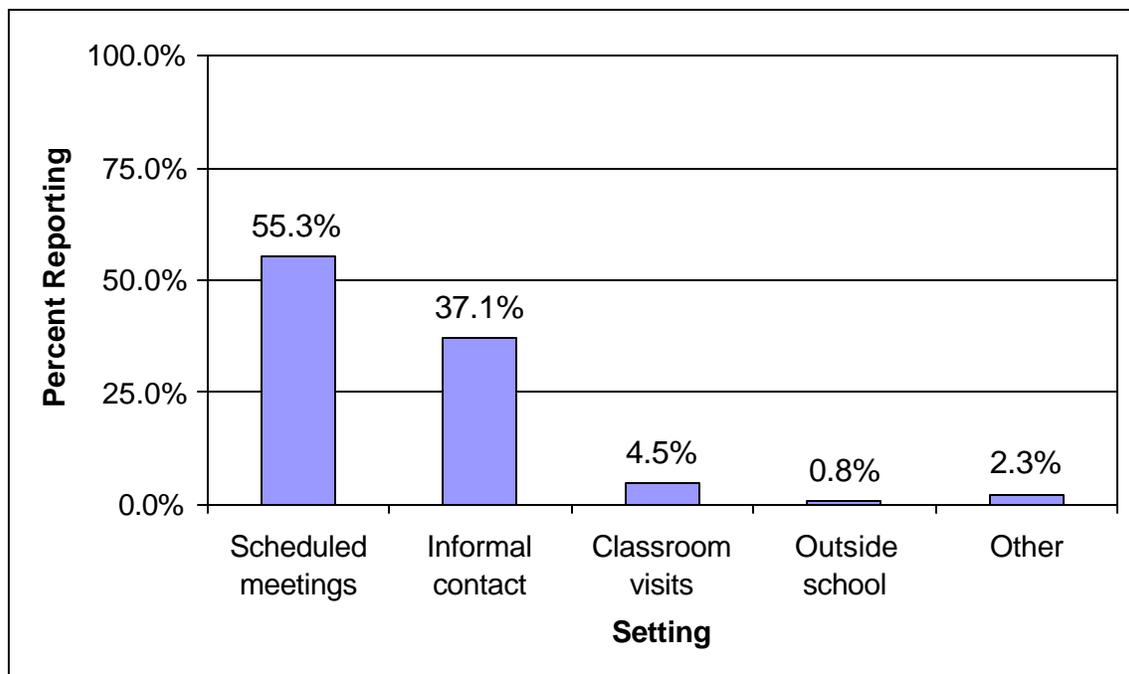
Teachers report that they feel less isolated in partnerships and that their lead teachers are instrumental in helping them complete projects. Frequent communication between partners may be a factor in the impact of partnerships (Figure 3.2). More than 90% of survey respondents reported communicating with partners at least two times each week (71% daily, 21% two to three times per week).

Figure 3.2. Frequency of Communication between Partner Teachers



More than half of respondents (55%) said that they most frequently communicated with partners in scheduled meetings (Figure 3.3). More than one-third reported that informal contact was their most frequent setting for communicating with partners (37%). It is somewhat surprising that scheduled meetings were the most frequent setting for communication between partners. In Year 4, survey respondents reported that the most frequent setting for communication was informal contact. One might expect teachers to rely more on impromptu meetings because teachers' out-of-class time during the school day is often minimal, making the scheduling of meetings more difficult. It may be that first-year experiences with the challenges of using project-based learning and multimedia technology have convinced many teachers that setting aside planning time pays off in saved time in the classroom.

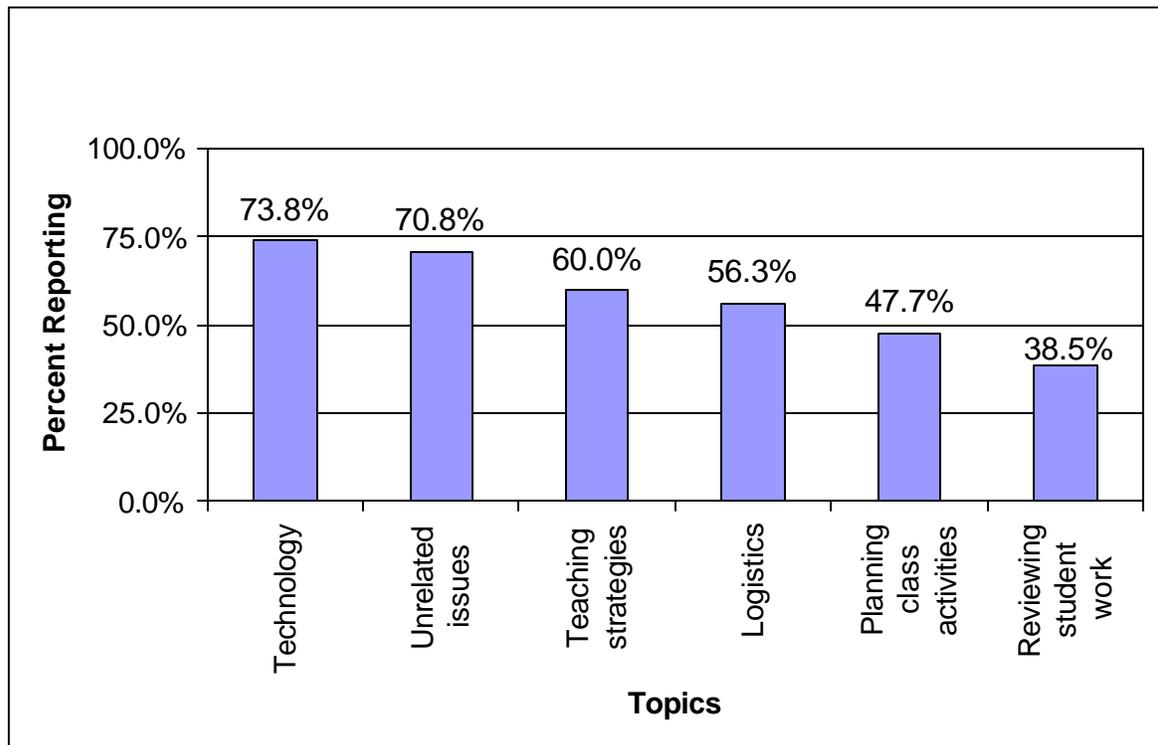
Figure 3.3. Setting for Communication with Partner Teachers



As shown in Figure 3.4, partner teachers discuss technology and unrelated issues almost equally when they meet (74% and 71%, respectively). The need to discuss technology may be dependent on the length of time the partners have used technology. Alternatively, technology might remain a major topic of discussion if new items continue to be used. Discussion of unrelated topics illustrates the nature of communities of

learners; much communication is focused on shared work, such as multimedia projects, but the shared work takes place within a broader context of shared concerns of members of a community of practice. Partner teachers frequently share teaching strategies (60%), discuss project logistics (56%), and plan class activities (48%). Review of student work on the project occurs less frequently (39%) in these settings.

Figure 3.4. Most Frequent Topics of Communication between Partner Teachers



Sharing of Expertise

The sharing of expertise means that each teacher in the MMP does not have to be an expert in using technology and in project-based learning. Instead, teachers can rely on (and learn from) partners within their schools—and TLCs within their team—to assist them with technology and curriculum concerns. In return, they contribute their own strengths to the learning experience of their partners and TLCs.

Learning within Partnerships

The teacher participation survey asked who was involved in developing the idea for projects completed by the partnerships. Responses suggest that project ideas most often combine contributions from all members of a partnership. More than half of respondents (60%) reported that the partnership as a group developed the idea, 26% said that the lead teacher was responsible, and 14% reported that new teachers developed the project idea.

Partnerships also played an important role in curricular resources used to implement projects (Figure 3.5). Seventy-six percent of respondents reported that they used materials gathered and integrated by one or more of the teachers in the partnership. The other major curricular resources used were state and district standards and benchmarks (85% and 70%, respectively), possibly attributable to the current emphasis on accountability as measured by curricular standards.

Figure 3.5. Curricular Resources Used by Partnerships

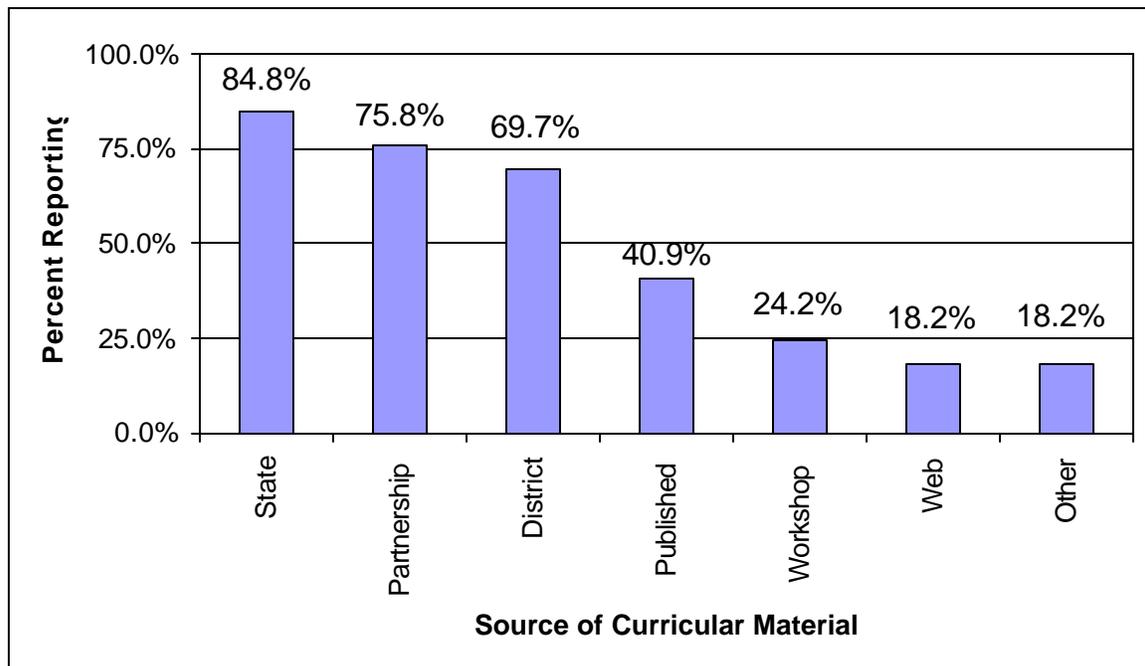
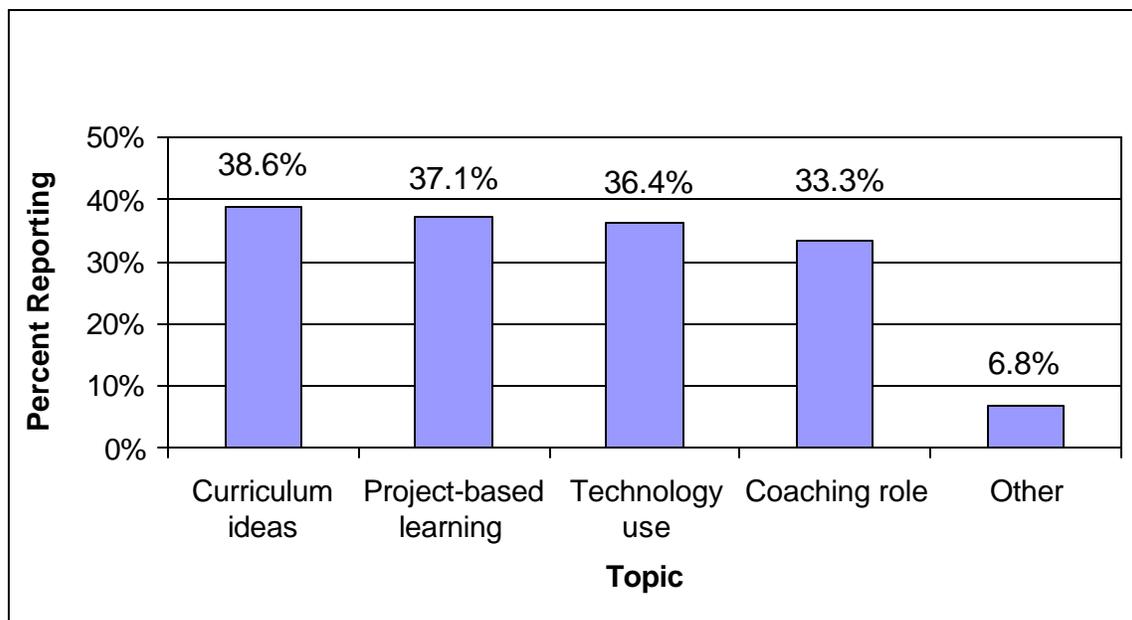


Figure 3.6 presents what teachers reported having learned from their partners. Respondents identified each of four important aspects of the MMP roughly equally: curriculum ideas (39%), project-based learning (37%), technology use (36%), and

coaching role (33%). These results suggest that partner teachers are able to share and build a deep understanding of the concepts and goals behind PBL+MM. That is, partner teachers do share surface-level skills, such as knowledge of hardware and software, with their partners, but they also assist one another with the more difficult transition to student-centered approaches in the classroom. They share ideas for topics of interest to students, sources of curricular materials, strategies for taking a facilitative rather than directive role, and ways to implement project-based learning.

Figure 3.6. Topics Learned from Partner Teachers



Many respondents wrote descriptions of the most significant lessons that they had learned from their partners. For some, the impact of collaboration was most significant.

My partners helped me to try different approaches when the first attempt to solve a problem didn't work.

This project only reinforced my strong belief that we are much more effective educators when we team and tap each other's strengths.

Using each other's strengths to create a project allows each of us to concentrate on what we do best without having to know how to do everything ourselves.

Others gained new perspectives on what they and their students can accomplish as a result of developing and sharing their skills and potential.

I am exposed to the incredible possibilities that the use of multimedia provides. When I see what other teachers are able and willing to handle, I think about the ways that I can bring more into my classroom.

Don't stress out if you don't know the software or hardware—one of the students will.

How to facilitate working in a productive way with multi-age students.

Moving on to other areas with most of the class and letting a group of students work on their own in the classroom at the same time.

My partner is an expert at “coaching” and letting her students develop their own expectations/creating rubrics.

Many respondents' most significant learning was about taking a project-based approach. They described what their partner teachers had taught them about the benefits and the process of PBL+MM.

I learned that it's never too early to get started and that doing the project is more important than having the most technologically advanced project (i.e. lots of multimedia “bells and whistles”).

Basically, to plan several extra days in the computer labs at set intervals. It will allow students to complete their projects to their satisfaction and give them time enough to “explore” the technology.

The most important thing I learned from my partnership was how to coordinate all aspects of a long-term multimedia project. It was very involved and took a lot of planning but was very valuable in the end. I feel more confident taking on long-term projects that involve multimedia, which is a HUGE plus for myself and ultimately my students.

These comments illustrate the effectiveness of partnerships in helping manage the implementation of PBL+MM. Collaboration between teachers can provide resources for learning new teaching skills and for ongoing support during the implementation of new practices.

Recognition and Rewards

The MMP provides and supports opportunities for teachers to receive recognition and rewards for implementing projects. Teachers who agree to implement projects and

report on their success to the MMP receive an honorarium of \$500 for their efforts. In addition, teachers can apply for mini-grants to purchase equipment, software, or professional development training to implement their projects. These grants have been instrumental in the acquisition of multimedia hardware and software for MMP classrooms. Table 3.1 shows the amounts from Year 5 that were allocated to different teams as part of the MMP.

The MMP awarded a total of 60 mini-grants to teachers during 1999-2000. Table 3.1 shows the total amount awarded by team, which is related to the number of individual teachers and partnerships that applied, since individual awards were for \$2,000. Generally, teachers use mini-grant funds to buy digital cameras, storage devices, and other peripherals, as well as some software and hardware.

Table 3.1. Mini-Grants to Teachers in 1999-2000

Team	Number of Partnerships	Total Grant
BVLC	12	\$24,000
Family of Schools	8	\$16,000
Palo Alto	11	\$22,000
ABC	7*	\$14,000
Gilroy	5 5*	\$20,000
Morgan Hill	4*	\$8,000

***Individual teachers, not partnerships.**

Opportunities for Reflection

One of the reasons that TLCs have become such an important resource to one another is that they engage in discussions that provide them with frequent opportunities to reflect on the curricular model and on specific student projects. As one TLC said, “This is our staff development. There’s a lot of power in this room. It’s very motivating, this group of people that meets together.” The monthly meetings of TLCs address issues related to planning for MMP events (e.g., MMP-wide meetings, the multimedia fairs), but they also involve discussions focused on teaching and learning with technology.

In one such meeting, the TLCs discussed what it means for a student multimedia project to have a “real-world connection.” The group divided into pairs and discussed the

term's meanings for TLCs as individuals helping particular teachers from their team develop student-centered projects with real-world connections. Next, the pairs presented two or three key ideas to the whole group, and then the whole group discussed the ideas presented. Some TLCs presented concrete examples of projects to illustrate their point: a TLC from CTN discussed a project in which students researched causes for rainforest destruction and proposed a plan for saving the forests. Another project that was mentioned involved students in designing clothes that could be manufactured and worn, and a third project focused on studying immigration by conducting interviews with parents and others in students' local communities.

After several examples had been presented, the TLCs began to abstract a set of guidelines for determining whether a project had strong real-world connections. They distinguished between projects that engaged students in real-world work processes—such as teaming to do research, a skill students might need in the real world of work—from those projects that required students to produce products that would affect the world outside the classroom. The TLCs were in agreement that engaging students in real-world processes is an essential part of project-based learning with multimedia, but they were unsure about whether it was necessary for student products to be useful to others outside the group. Some TLCs felt that final presentations to people outside the classroom are essential. They doubted that projects without these kinds of presentations could ever meet the criterion that students would immediately recognize the real-world connection themselves. Others, however, felt that engaging students in real-world processes is the most important way to teach skills, because focusing on process allows teachers to work with students at their own developmental level, rather than forcing students to meet “adult” expectations of quality.

At other monthly meetings, TLCs talked about specific student projects, including projects currently under way. The goal of such discussions is frequently to point out ways that such projects exemplify different dimensions of the PBL+MM model, and to identify particular strengths of the project. But the discussions can also center on ways to improve the described projects, such as strengthening assessment components, integrating additional subject matter, or giving students more decision-making responsibility in projects. The results of such discussions are often more complex and

engaging student projects. One project the TLCs discussed in a monthly meeting, *Belmont Then and Now*, is described in the next chapter in greater detail. The significant responsibilities given to students in the project were evident in the final product, and adding some of those responsibilities and roles was among the suggestions made by TLCs at the meeting.

Implications of the MMP Professional Development Model for Other Technology Initiatives

What makes the Challenge 2000 MMP unusual is not the use of multimedia, but the network of supports for teachers implementing the PBL+MM model that the federal grant has funded. Instead of assuming that a one-time course in how to use multimedia software would prepare and motivate teachers to implement high-quality classroom activities, the MMP has supplied an ongoing structure of social, organizational, and financial supports. The most significant program features identified by experienced teachers in the MMP all focus on the supports the MMP provides for collaboration with colleagues, sharing of expertise, recognition for successful completion of projects, and reflection on student work.

The central importance of developing a network of teacher supports for integrating technology into a model for innovative teaching and learning is one of the chief lessons of the MMP. As schools, districts, and government agencies allocate more funding for technology, the benefit of informal networks of instructional and technical support should not be overlooked. Innovative districts like New York's District 2 and research-based educational reforms (Cognition and Technology Group at Vanderbilt, 1997) have highlighted the importance of integrating ongoing informal professional development into daily practice.

Making available a teacher-leader to help novice teachers during class time as they try out new technologies and models of instruction allows novices to see someone handle the challenges of implementation. Making sure these teacher-leaders themselves have support is similarly critical. The time invested in these teacher-leaders should not leave them isolated from one another or demand that they spend all of their time in the classroom. They need opportunities to learn and grow in their own expertise, by sharing

with each other. To harness the “power” of the TLCs, they need to remain, as one of these teacher-leaders put it, “a group of people that meets together.”

4. LEARNING BY AUTHORIZING AND DESIGNING

Student Authorship and Design in the *Belmont Then and Now* Project

Since its founding, the town of Belmont, California, has undergone many transformations in its landscape and identity. It has gone from being a small, residential community known for its parks and sanitariums, to a postwar shipping and horticultural center, and today to a suburban community with sprawling high-tech companies just outside its borders. The *Belmont Then and Now* project, completed in 2000 by three third-grade classes from Central Elementary, helps put Belmont's changes over the past 150 years in perspective.

Central Elementary students spent a year working with a local museum curator, their classroom teachers, and a technology learning coordinator (TLC) dedicated to assisting teachers in implementing technology-supported projects to conduct research on the history of Belmont. Students collected old photographs of the town and its people from the Belmont Historical Society, took original digital photos of people and places today, videotaped interviews with longtime Belmont residents, and developed a timeline of important events in Belmont's history with narrative accounts in students' own words.

What helped bring structure and closure to the research was the development of a student multimedia presentation, to be housed at the Belmont Historical Society and showcased at a local multimedia fair. Using HyperStudio, a multimedia authoring tool developed especially for classroom use, students at Central Elementary designed electronic stacks of linked cards with scanned photos, video clips, and text. They created animations from historical photos to represent the movement of trains and horses and added their own voice-overs to parts of the presentation. Their teachers helped them with the overall architecture for the site, but students were responsible for content and coherence. They were required to make sure that links within their part of the site all worked and that the linked cards formed a coherent historical presentation that would be useful to community residents who visited the museum. The multimedia authoring tools helped students organize and synthesize their research and develop an eye-catching

presentation that made visible what they had learned from this in-depth study of their community's history.

From both participants' and outsiders' points of view, the project was a success. Students learned a lot, not only about their own community, but also about using multimedia tools to develop a presentation for an audience outside the classroom. The project was also recognized for the quality of its content and multimedia in the 34th Annual California Student Media and Multimedia Festival in spring 2000, where *Belmont Then and Now* was the winner in the history and social science category for elementary schools.

The students and teachers who participated in *Belmont Then and Now* benefited from many of the program components put in place by the Multimedia Project (MMP). The teachers got specific feedback on their project proposal from the network of TLCs on how to improve the project's design. On the basis of their project proposal, teachers in the project were awarded a mini-grant to purchase scanners, a digital camera, multimedia software, and extra memory and storage media (two items districts and schools often do not include as line items in their technology budgets). As the project progressed, Jeanine Woodell used her position as TLC on-site at Central Elementary to help the teachers with overall coordination of the project. For example, she made telephone calls to the historical museum's curator during school hours. Woodell also helped facilitate student learning as students worked on their projects and coordinated transportation for students to and from the museum, something regular classroom teachers would have difficulty finding time to do.

At the heart of *Belmont Then and Now* is the project-based learning with multimedia (PBL+MM) model of the MMP. Students certainly learn how to use specific multimedia technologies when doing projects like *Belmont Then and Now*, but the emphasis in the MMP is on developing students as *authors of multimedia content*. It is in the creative process of designing multimedia products to meet given specifications that students learn not only academic content but also critical-thinking, problem-solving, and teamwork skills. In the MMP, students are not simply consumers of advanced technologies; they learn how to use and adapt the affordances of particular tools to meet the challenges posed by a complex communication task.

Authoring and Designing in Teaching and Learning

The idea of having students form their own multimedia compositions is grounded in what cognitive psychologists and educational researchers know about how people learn (see Bransford, Brown, & Cocking, 1999; Pea & Gomez, 1992). For example, having students author multimedia content gives them greater responsibility for their own learning and prepares students to be able to transform curriculum content to solve complex problems (Bransford & Stein, 1993). The result of this transfer of responsibility for learning to students is that learners are often much more motivated to learn with multimedia (Pea, 1991). In addition, teachers and students who develop multimedia presentations for outside audiences are rarely satisfied with their initial designs; they readily engage in a process of reflection and revision that deepens students' understanding of subject matter.

The practice of design has itself been thought of as a form of reflection-in-action (Schon, 1983). It engages a number of cognitive skills that are critical to students' success in mastering curriculum content, working well with others, and communicating ideas to external audiences. Carver, Lehrer, Connell, and Erickson (1992) identified a set of design skills that can be expected to emerge when students work on a series of multimedia products:

- Allocating resources and time to different segments of a project
- Searching for information
- Analyzing and interpreting information
- Developing representations of information
- Developing a structure for a presentation
- Catching and maintaining audience interest
- Evaluating the process and reflecting on one's product.

Subsequent research by these and other researchers has borne out the potential of multimedia development activities to support the development of these design skills and the emergence of self-regulation of learning among students who participate in extended projects. For example, Allen and Pea (1992) traced the joint construction of a set of expectations for student learning by teachers and students over the course of an extended student project involving the construction of multimedia presentations. They

documented the ways that teachers and students negotiated a balance between a focus on design and content. Teachers were initially concerned that students were concentrating on the quality of their multimedia design elements, and ignoring the quality of their content. When a balance between design and content was achieved, teachers began to see the two elements of constructing a presentation as interdependent. In a similar study of project-based learning with multimedia, Erickson and Lehrer (1998) researched the evolution of “critical standards” for judging the quality of student work. Over the course of 2 years of involvement in projects, students and teachers came to develop shared representations of what constitutes a good multimedia product.

In the remainder of this chapter, we document how design skills receive increasing emphasis in MMP classrooms. In Year 4 of the MMP, SRI researchers conducted structured observations in a set of middle schools that included 12 MMP classrooms and 9 comparison classrooms. Classrooms selected for the observations included a combination of experienced and novice teachers within the MMP who were funded with mini-grants for the 1998-99 school year. Principals from the MMP teachers’ schools selected comparison classroom teachers. Principals were given instructions to select a teacher in the same grade who was not part of the MMP but who taught in a subject area similar to that of the MMP teacher. Because the MMP encouraged partnerships within schools, finding a comparison teacher at the same grade level was not always possible. In two cases, classrooms from the same grade level at a comparable school in the same district were chosen. Still, the resulting classrooms were similar in size and in demographic composition (Table 4.1).

Table 4.1. Composition of Classrooms in the Observation Study

	MM Project Classrooms	Comparison Classrooms
Average attendance	27.5	28.4
Ethnic composition		
White	56%	61%
Asian/Pacific Islander	20%	17%
Hispanic/Latino	15%	16%
African American	2%	4%
Other	7%	2%

Classrooms did differ on one significant measure, namely, the number of computers that were in their classrooms. On average, MMP classrooms had six computers, whereas comparison classrooms had only two. Both samples included only 6th- and 7th- grade classrooms. We selected classrooms from these two grades because the performance task designed to measure the impact of the project on student learning administered in Year 4 was targeted to students in the middle grades.

SRI researchers visited each of these classrooms twice during the school year, once in the fall and once in the spring. Each time, they used the same structured observation protocol designed to measure how much time students spent engaged in particular activities. Data on a number of the classroom practices and how they differed across groups are reported in the Year 4 Evaluation Report (Penuel, Golan, Means, & Korbak, 2000), but this chapter addresses additional data focused on the extent to which students were engaged in the specific cognitive activities of design. Each chart below focuses on the percentage of time students spent engaged in a particular activity. Separate activities within the classroom were identified and timed by observers during each class period observed. Researchers then coded those activities to identify what students were required to do as part of the activity. Particular activities could require students to engage in more than one cognitive activity of design at a time, so the numbers across categories exceed 100%.

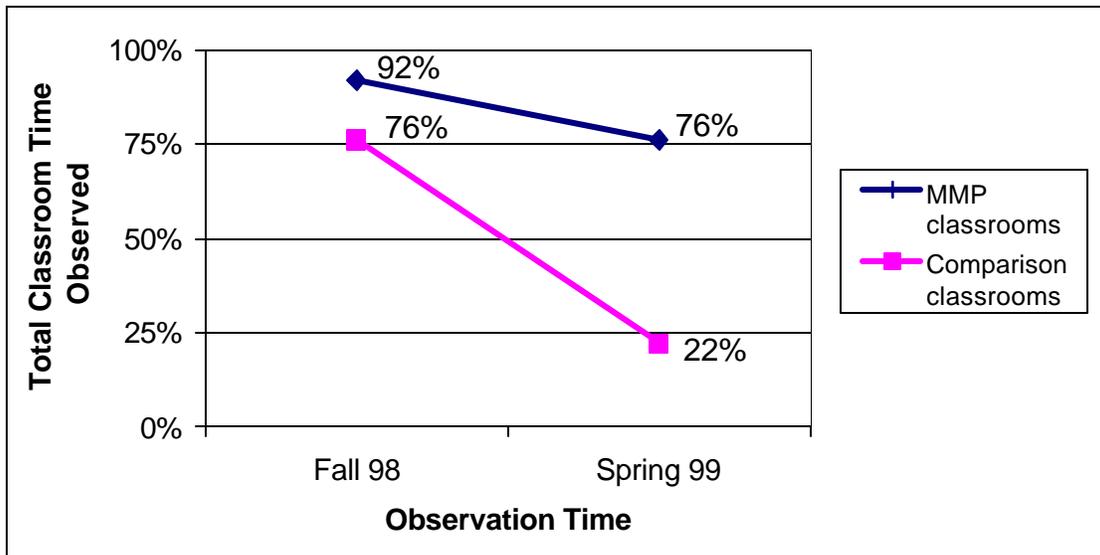
Student Engagement in the Cognitive Activities of Design

In nearly every category observed by SRI researchers, students in MMP classrooms were observed to spend more time, especially in the spring, engaged in the cognitive activities of design described by Carver et al. (1992). Springtime differences may reflect the fact that many students were actually completing the multimedia presentations they would present that spring at their local multimedia fair. The differences observed in classroom practices thus reflect the particular power of having students author and design multimedia presentations to transform the way teaching and learning take place in classrooms in the MMP.

Allocating Resources

One index of how much students were required to allocate resources in the context of completing projects is the percentage of time they were engaged in long-term projects. Long-term projects, by their very nature, require students and teachers to assign roles, divide tasks, and pursue and adjust timelines to accomplish their goals. An analysis of the percentage of time students spent in long-term projects showed that the MMP students were much more likely to be engaged in such activities than were their peers in the comparison classrooms (Figure 4.1).

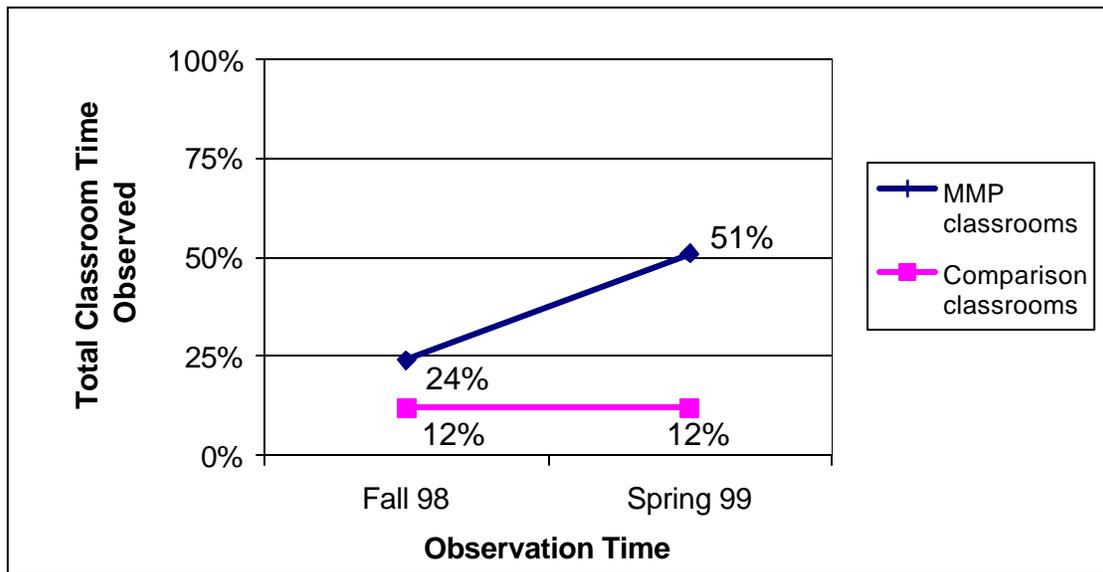
Figure 4.1. Time Spent in Long-Term Activities



Searching for Information

Observers coded activities in which students searched for information as part of their ongoing research as “searching for information.” In many cases, students were using technology, especially the Internet, to search for information, either on computers in their classrooms or in laboratories. In both the fall and the spring, students in MMP classrooms spent more time, on average, than did students in comparison classrooms searching for information related to research they were conducting in the classroom (Figure 4.2).

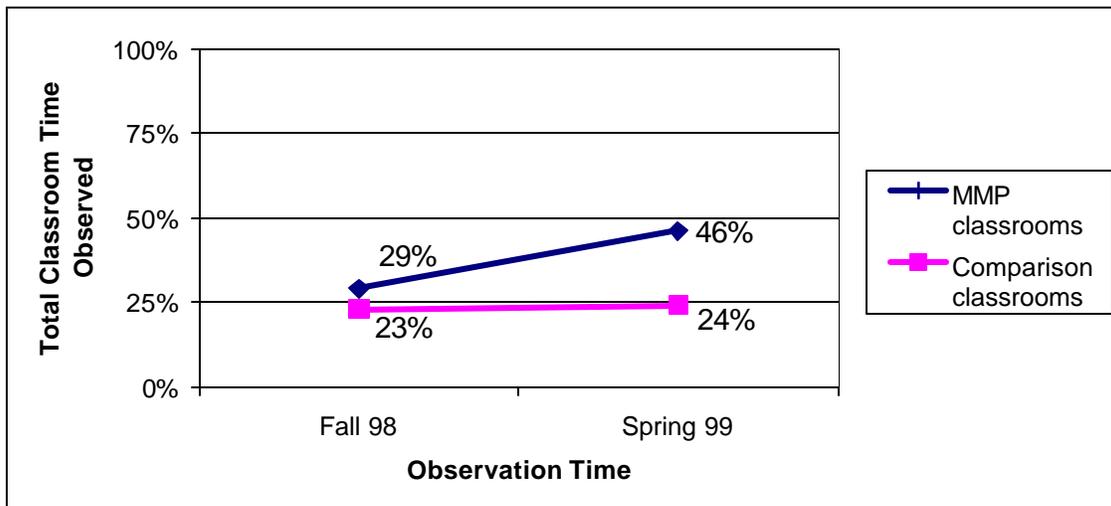
Figure 4.2. Time Spent Searching for Information



Analyzing and Interpreting Information

Teachers who assign research projects and term papers to students report that students often fail to do more than copy information from texts, encyclopedias, or Web sites without considering the relevance of the information or how they should transform it to create a coherent paper or presentation. More student-centered classrooms require students to do more than read and summarize information; they require students to analyze and interpret given information to construct new meanings. SRI researchers observed that in the fall, MMP classrooms and comparison classrooms did not differ markedly in the time students spent interpreting information, but by the spring, there were wide differences between the two sets of classrooms on this activity dimension (Figure 4.3). By spring, these activities took up nearly half the time in MMP classrooms, while these activities made up only a quarter of the time observed in comparison classrooms.

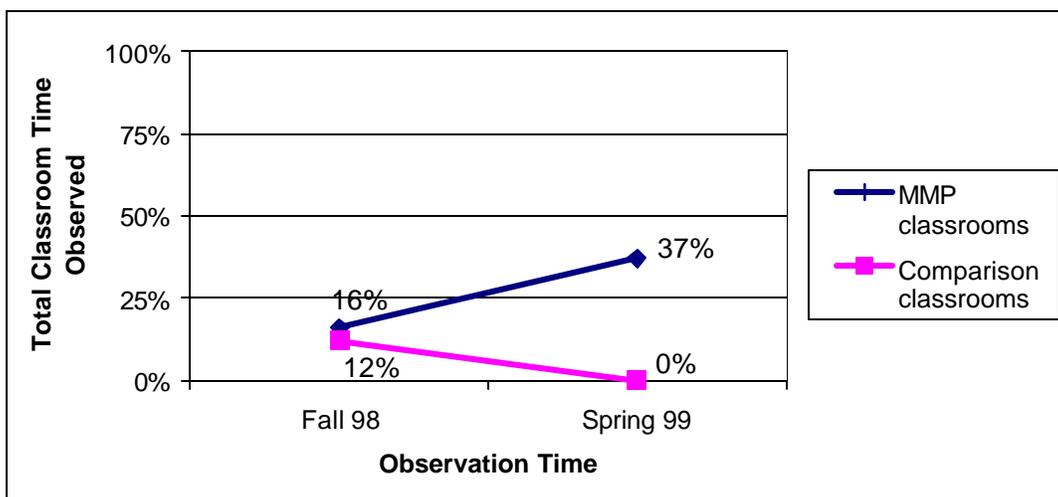
Figure 4.3. Time Spent Interpreting Information



Developing Representations of Information

One way that students transform given information is that they develop representations—whether in textual, audio, or visual format or in models and simulations of phenomena—to embody concepts they have been studying or to communicate a novel idea. Students in the MMP were more likely than students in comparison classrooms to be observed developing representations of information, especially in the spring, when they were developing multimedia products (Figure 4.4).

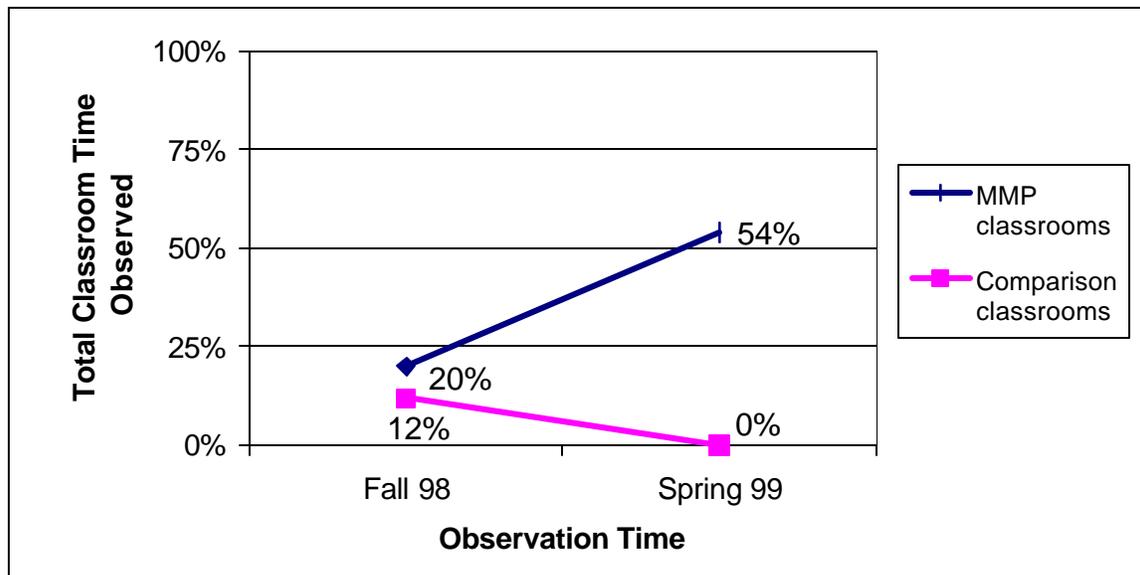
Figure 4.4. Time Spent Creating Models or Representations



Developing a Structure for a Presentation

The processes of composing a written report and composing multimedia presentations both provide opportunities for structuring presentations, but multimedia development more closely resembles film editing and animation than it does report writing, since students have more control over where, when, and how long objects are displayed on a screen (Pea, 1991). As such, students' multimedia presentations require them to take on potentially more responsibility for developing structures and organizations that make a presentation cohere. Researchers' observations confirmed that in fact MMP students were much more likely than students in comparison classrooms to be spending time developing and deciding on a structure for a presentation or report (Figure 4.5).

Figure 4.5. Time Spent Deciding on the Structure of a Presentation

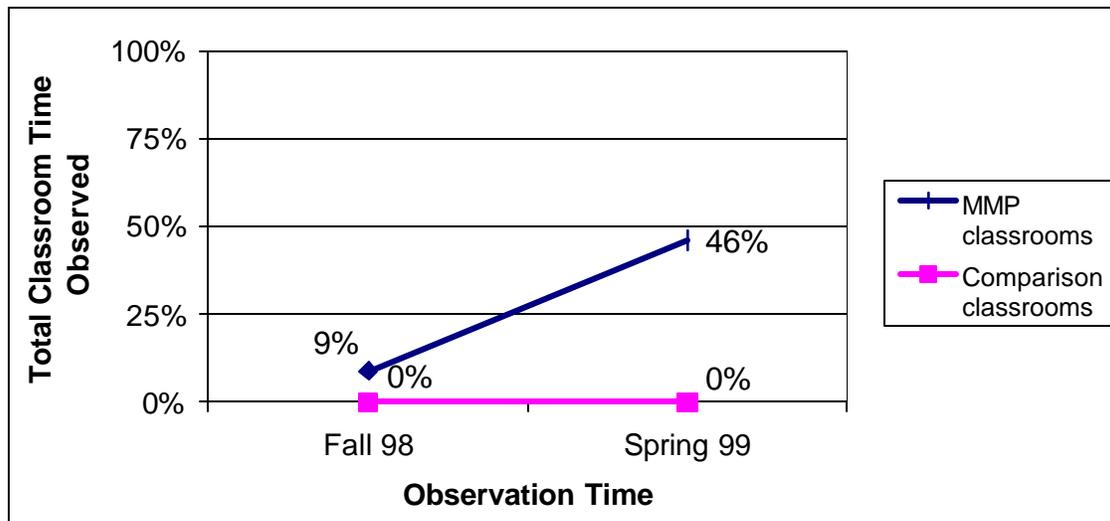


Catching and Maintaining Audience Interest

The annual multimedia fairs are an important part of the Challenge 2000 MMP for teachers and students. The fairs are important culminating events in the life of student projects, motivating their timely completion. They also provide an external audience for student work. In the MMP, student presentations are not just for teachers who assign grades according to their own criteria. Students are more often than not motivated by the

recognition that others outside the classroom will view their presentation, so they pay close attention to catching and maintaining their imagined audience’s interest in developing their multimedia products. Observers found differences between classrooms in the MMP and comparison classrooms that confirmed the special role that an imagined audience plays in the development of multimedia presentations (Figure 4.6).

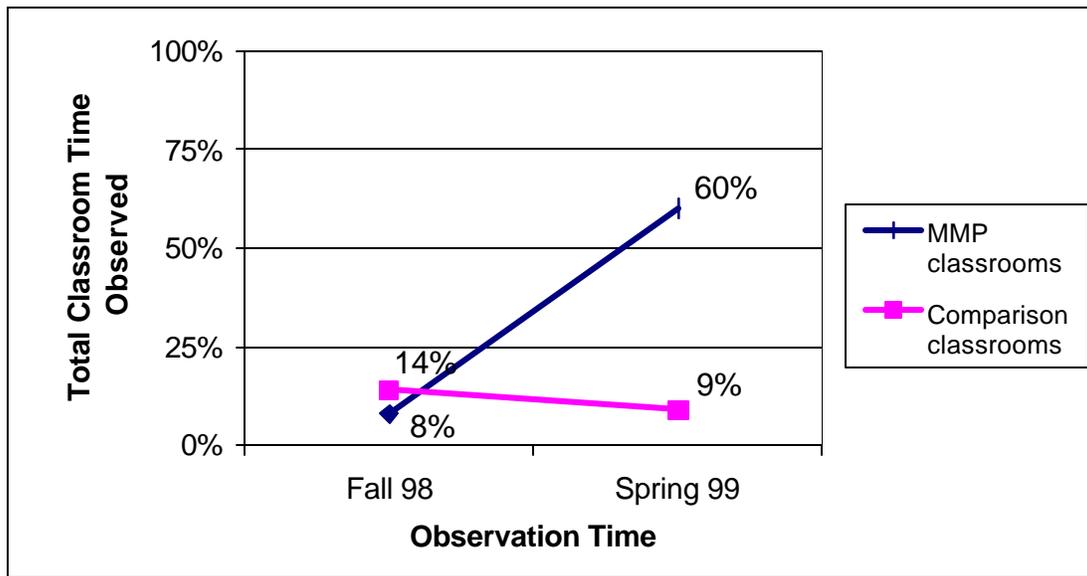
Figure 4.6. Time Spent Thinking about an Audience



Evaluating the Process and Reflecting on One’s Product

The way that students develop and iterate their multimedia presentations in the MMP underscores the insight that multimedia authoring and composition are fundamentally activities of *design*. Schon (1983) has described design as a “reflective conversation with the situation,” involving the evaluation of particular moves in light of problems and potentials and in light of an evolving and ever-changing whole. Although students’ design moves are rarely as sophisticated as those of architects or engineers, students do have some of the character of professional designers in that students are frequently observed to iterate their designs and to evaluate the whole in light of the parts they are creating. Observers saw much more reflection and revision of products in MMP classrooms, where students were engaged in the reflective conversation of design, than in comparison classrooms in the spring of Year 4, as Figure 4.7 shows.

Figure 4.7. Time Students Spent Reviewing and Revising Their Work



Discussion and Implications

The results of the observation study presented here are consistent with the results presented in the Year 4 report, which show significant differences between MMP and comparison classrooms. Students in MMP classrooms spent much more time engaged in the cognitive activities of design as described by Carver et al. (1992). They were more likely to spend time interpreting and transforming information that they had found through their research. MMP students were also more likely to be observed attending to issues of presentation coherence and audience attention than were their counterparts in comparison classrooms. And MMP students were more likely to be seen engaged in an activity that many teachers say students typically try to avoid when they write papers or develop presentations: revision of their work.

The pattern of differences between the two sets of classrooms was most striking in the spring, when students were engaged in developing presentations for the multimedia fairs. Like the other findings from the Year 4 evaluation, these results point to the significance of the fairs in motivating teachers and students to engage in project-based work. They are also consistent with what other researchers have found in project-based classrooms. Typically, much of the fall semester is spent providing students with an

overview of contents, methods, and approaches to study that students will need to engage in successful projects (see Polman, 2000). Project-based learning typically requires extensive scaffolding on the part of teachers to break down the complexities of a project into smaller problems that students can attack successfully before completing an extended project (Barron et al., 1998).

The need to provide students with extensive support and scaffolding to learn from design activities is well documented by researchers (Bransford, Brown, & Cocking, 1999). Such scaffolding can include the provision of models of expert performance to students (Collins et al., 1989) or specialized software or learning environments that are targeted to the needs of learners (Pea, 1985; Resnick, 1987). Both have the potential to improve the extent to which students do more than copy or recapitulate information from textbooks to develop a deep understanding of subject matter.

The MMP classrooms themselves may benefit from these additional kinds of scaffolds, as well. Even though observation results show students engaging more critically with information than do students in comparison classrooms, some MMP teachers complain that students are too often cutting-and-pasting text and images from Web sites rather than developing their own content for presentations. They also note that students are not always sensitive to issues of accuracy, relevance, bias, or comprehensiveness in the conduct of their research, especially on the Internet. TLCs have recently called for the development of a “research curriculum” aimed at helping teachers scaffold the inquiry process for students as a critical component of their multimedia projects. Researchers at the Institute for Research on Learning⁴ (IRL) plan to develop a set of activities for classrooms in the coming year to address this need. Although MMP classrooms need to improve in this regard, it is noteworthy that MMP activities have heightened teachers’ efforts to help their students become critical consumers of information.

Field notes from SRI researchers’ observations suggest that teachers already are engaging in many informal practices that scaffold the research and inquiry process, which may have contributed to the differences found between MMP and comparison classrooms

in the extent to which students spent time engaged in the cognitive activities of design. Teachers frequently asked students to go back and look for more information when they felt their students' research was incomplete or encouraged them to consider opposing points of view in developing presentations. In short, students' authoring and designing, without assistance from teachers, may lead to the same kinds of shortcomings teachers describe in student report writing, namely, incomplete research resulting in a narrow understanding of the material. But assisted design performance has great potential to motivate student learning and advance the design and communication skills of students engaged in project-based learning.

⁴ The School and Community Practices Group at IRL was the professional development partner for the MMP. In March 2000, IRL was disbanded, and the School and Community Practices Group was transferred to WestEd, an educational research, development, and service agency.

5. EXPANDING KNOWLEDGE OF THE PROJECT'S SUCCESS

During Year 5, the primary focus of SRI's evaluation effort was on disseminating findings of the evaluation research to audiences beyond Silicon Valley. The aim of broad dissemination is to help other researchers, policy-makers, and school staff understand the key components of the Multimedia Project (MMP) model and evidence of its effectiveness in transforming teaching and learning. All dissemination activities thus did more than present accomplishments of the project; they were designed so that novices in the field of multimedia-supported project-based learning (PBL+MM) could design and implement projects themselves in new and diverse settings.

Creating a Web Site to Share Results of the Multimedia Project

One of the key activities of the SRI evaluation this year was the development of a Web site (Exhibit 5.1) to share our evaluation results of the MMP with a larger audience (<http://pblmm.k12.ca.us/sri/SRIEvaluation.htm>). The Web site design process included two distinct stages: identifying possible audiences and streamlining information.

Identifying Audiences

SRI's evaluation of the MMP spanned 5 years and produced dozens of reports and documents. To parse this information base, we considered the various stakeholders who participated in the MMP, types of prospective audiences, and types of documents. We wanted to make the information broadly available to as many audiences as possible but knew we needed to tailor it to help viewers navigate through it. We talked to teachers about—and discussed among the evaluation team—the types of situations that might lead people to seek out a Web site like ours. Among the situations of use generated were:

- Technology coordinators looking for good ideas for using technology in the classroom.
- Administrators and school service leaders looking for ideas to include in grant proposals and school technology plans.
- Teachers being asked to teach with multimedia.

- Parents and students who had just learned that their teacher would be using technology for learning and wanted to know more about what to expect.
- Business partners and foundations being asked to finance technology for schools.
- Researchers like ourselves, who are looking for tools to measure student learning in project-based, technology-rich environments.

Each of these audience members—technology coordinators and administrators, teachers, students and parents, business partners, and researchers—would necessarily find different aspects of evaluation information useful for their different perspectives and needs. In designing our Web site, we considered those diverse perspectives in shaping the organization of the information to be included.

Streamlining Information for the Site

We first organized the information according to its type. Our database included many diverse documents: case studies of exemplary projects, classroom observations, program descriptions and analyses, annual surveys of teachers, analyses of student outcomes, evaluation tools and methodologies, slide presentations, brochures, executive summaries of the MMP, and full evaluation reports. Then we determined which of these documents would appeal most to our different audiences. In addition, we wanted to provide visitors to our site with links to related Web sites that provided further background on using technology in the classroom and project-based learning.

Technology Coordinators & Administrators. These are stakeholders who would be most likely to need materials to make persuasive presentations on technology investment or multimedia learning. We assembled documents that would help this audience make presentations. We included slide presentations and survey findings on teachers' perceptions of the program, as well as analyses of student learning outcomes. We also referred this audience to further Web links so they could obtain more background information to make their presentations.

Teachers. This group would want to know more about how to use technology in the classroom and how to implement project-based learning, so we included our survey findings about teachers' perceptions of the program. They would also want to know about the types of support for professional development that might be helpful, so we

included descriptions of the options designed for the MMP. They might also want to get a better idea about the practice and the ultimate pay off of multimedia projects, so we included our case studies of exemplary projects, the analyses of student learning outcomes, and the classroom observations. Teachers might also need more information to guide their use of technology in the classroom, so we included links to related Web sites.

Students and Parents. This audience would want to familiarize themselves with this type of classroom activity, so we provided them with links to our analyses of student learning outcomes and our case studies of exemplary projects.

Business Partners. These visitors to the Web site would probably be looking for ways to finance, develop, or promote partnerships with educators. To meet their needs, we provided executive summaries outlining the cultural distinctions between the world of education and the world of business. We also provided them with links to our slide presentations and pamphlet to help them present the idea to prospective investors.

Researchers. This audience would seek tools for measuring student achievement while using multimedia, and they might also want to review our evaluation methodologies and results. We linked them to a set of evaluation rubrics we developed for the MMP, as well as the full evaluation reports and pages featuring the evaluative methodologies we used.

Users with Targeted Interests. We also gave viewers the option of selecting from a general menu of information: evaluation reports, slide presentations, Web links regarding education and technology, evaluation tools for project-based learning, and our presentations about the MMP at the American Educational Research Association's spring 2000 annual meeting.

Site Usage Statistics

Our Evaluation Web site went online in late April 2000. Each month, a server logged the usage of the site, showing that the site was accessed an average of 371 times per month from April to August. During that period, the five most-accessed pages (Exhibit 5.1) within the site were: Education and Technology Web Links page (130 total hits), Tools for Evaluating Project-Based Learning with Multimedia page (104 total hits), and AERA (American Educational Research Association) Presentations page (69 total

hits). Each of these evaluation pages appears in the list of quick links at the bottom evaluation home page, so it can be inferred that visitors to the site find those links of interest and convenient to use.

Exhibit 5.1. Multimedia Project Evaluation Web site



The Challenge 2000 Multimedia Project
Project-Based Learning
with
Multimedia



SRI International Evaluation of Challenge 2000 Multimedia Project

SRI International's Center for Technology in Learning evaluated the Challenge 2000 Multimedia Project from 1995 to 2000. The evaluation examined three aspects of the Multimedia Project: its dissemination across various schools and districts, its impact on teaching practice, and its effects on student achievement. This page is designed to offer the evaluation findings to specific audiences: [Technology Coordinators and Administrators](#) , [Teachers, Students and Parents](#), [Business Partners](#), and [Researchers](#) . There are also [Quick Links](#) to the full evaluation reports, slide presentations, research and evaluation tools, and related research into education and technology.

Technology Coordinators & Administrators

Download [slide presentations](#) of evaluation findings, [survey findings](#) about teachers' perceptions of the program, [analyses of student learning outcomes](#) . View other [Web links](#) to related research in education and technology.

Teachers

Find out more about project-based multimedia learning by reviewing our [survey findings](#) about teachers' perceptions of the program, [professional development](#) options, [exemplary project](#) case studies, [classroom observations](#), [analyses of student learning outcomes](#) . View other [Web links](#) to related research in education and technology.

Students and Parents

What can young people expect to achieve through multimedia learning? How does teaching look different from traditional classrooms? Review our [analyses of student learning outcomes](#) and our [exemplary project](#) case studies.

Business Partners

Looking to get involved in educational reform? Examine the [executive summaries](#) of what business leaders need to know to work well with educators. If you're ready to sell your partners on the idea, use our downloadable [slide presentations](#) of evaluation findings and our [pamphlet](#) for prospective business investors.

Researchers

Get [tools](#) for measuring student achievement while they are learning with multimedia. View the full [evaluation reports](#) of the Challenge 2000 Multimedia Project. Review the evaluative [methodologies](#) used.

Quick Links to Specific Reports and Evaluation Resources

- [Challenge 2000 Evaluation Reports](#)
- [Slide presentations of Challenge 2000 Evaluation Findings](#)
- [Education and Technology Web Links](#)
- [Tools for Evaluating Project-Based Learning with Multimedia](#)
- [AERA Presentations](#)

Many users accessed data using links within the list of audience categories in the middle of the Evaluation home page. For example, the student learning outcomes topic appears in three different audience categories: “Technology Coordinators & Administrators,” “Teachers,” and “Students and Parents.” Visitors to the site used those links to access data on student achievement 59 times from April to August. The interest in student data suggests that many visitors to the site wanted to obtain further information with which to weigh the costs and benefits of technology use in the classroom.

The Evaluation Web site was visited least often in April (95 total hits) and most often in May (536 total hits). These numbers likely reflect the Evaluation Web site’s inception in late April and the initial flurry of activity on the site after the AERA annual conference in late April and after Joint Venture announced to MMP participants that the site had gone online.

Additional statistics showed that interest in the site came from educators located all around the United States. The most hits during the 5-month period came from users in the America Online domain (229), suggesting that use is high during off-school hours. Of those servers that were geographically identifiable, the bulk of the hits came from servers located in and around the Bay Area, Georgia, and Texas. Hits came from 112 different school district servers from states all around the United States.

Professional Development for Teachers

LINC Class on Using and Assessing Multimedia Projects

The Foothill College Center for Innovation is an emerging center for teacher education in the Silicon Valley region. Throughout the area, teachers have attended workshops and classes focused on helping them learn strategies to improve educational outcomes for students. LINC is a special program that offers continuing education credits to teachers and is aimed at helping teachers learn how to integrate technology into their teaching. As part of the offerings of the LINC program in winter 2000, SRI researcher Bill Penuel and Family of Schools Technology Learning Coordinator (TLC) Jeanine Woodell co-taught a course titled “Using and Assessing Multimedia Projects.”

“Using and Assessing Multimedia Projects” was a 12-hour course aimed at providing an introduction to the design of project-based learning activities, with special

attention to the integration of ongoing assessment into the life of projects. Through the course, teachers developed a project plan to implement in their classrooms that included all components of the MMP model (e.g., extended in time, real-world connections) and that included an assessment of students' skill in synthesizing content, working together, and designing a coherent and convincing presentation to a real external audience.

The class was held at Central Elementary School in Belmont and was attended by seven teachers from across Silicon Valley's public and private schools. Three teachers came from a French-language intensive private school, three were members of the MMP's newest team from Gilroy, and another was a technology coordinator at an elementary school. Nearly all had some basic knowledge of project-based learning with multimedia, but many were hoping to learn more about assessment and to explore more deeply how to design effective projects. Of the seven teachers who attended, four were relative novices in integrating technology into the classroom.

The first 4-hour session of the course focused on defining project-based learning with multimedia and outlining goals and objectives for student projects. Teachers saw an example of a project under way at Central Elementary and watched a taped segment of a middle-school project from the George Lucas Educational Foundation's *Learn and Live* video. Consistent with the idea of building assessment into the process of project planning, the session included an opportunity for teachers to offer each other feedback on how well the projects they were designing as part of the course were likely to address the key components of the project-based learning model. During the last hour of the first session, teachers were given an opportunity to practice using multimedia technologies, including Netscape Composer, HyperStudio, and KidPix. The last hour of subsequent sessions was also used for this purpose.

The second session focused on defining assessment strategies for projects and on classroom management techniques. Tools developed by the Institute for Research on Learning⁵ (IRL) and SRI for formative assessment and program evaluation were presented and described to teachers, and teachers had an opportunity to work in pairs to define assessment strategies for their projects. Teachers discussed how to use rubrics,

peer critiques, and performance tasks in their own classrooms to learn about depth of student understanding of academic content and about students' emerging design and communication skills. The session also highlighted strategies for pairing technology "experts" with "novices" in the classroom to ensure that diverse student talents were tapped for completing projects.

The final session focused on completing project plans. Teachers worked in small groups to identify audiences for the projects, real-world connections, the extent of student direction, and forms of collaboration. Each teacher had an opportunity to present his or her plan and receive feedback from peers and from the course instructors. On the basis of on these initial plans, teachers wishing to earn credit for the course were required to e-mail completed project plans to the instructors for feedback. Of the seven who attended the first session, two submitted completed projects for full course credit.

Teachers who attended the training reported that it was helpful to them and that they enjoyed the opportunities to collaborate with their peers to develop project ideas. As one new technology learning coordinator who attended the class said, "I picked up a lot of information that I was unsure of or missing and enjoyed the class very much." Still, of the teachers who attended, only two completed all the course requirements. One of the main concerns and deterrents to completing assignments was that not enough credits were given to teachers to help them increase their position on district pay scales. An additional half-credit for each course would have removed this deterrent, according to the teachers who attended.

TAPPED-IN After School Online Session: Presentation of Evaluation Results

TAPPED IN is a multi-user virtual environment for informal teacher professional development created at SRI's Center for Technology in Learning. SRI researcher Bill Penuel led a session in TAPPED IN on November 4, 1999, to discuss evaluation results with MMP teachers and other teachers who participate regularly in After School Online sessions. Just two other participants, the project director and a TLC already familiar with many of the findings, attended the session. One teacher from outside the project visited

⁵ The School and Community Practices Group at IRL was the professional development partner for the MMP. In March 2000, IRL was disbanded, and the School and Community Practices Group was transferred to WestEd, an educational research, development, and service agency.

the virtual discussion but left after just a few minutes of “lurking.” The project director and the TLC who attended the session valued TAPPED IN as a professional development environment, but the project has not been successful in motivating a core group of teachers or TLCs to participate in this online environment. The limited participation in November was consistent in this respect with earlier experiences scheduling meetings or sessions in TAPPED IN.

Leveraging the Multimedia Project’s Success in an Urban Context

SRI researchers conducted a study of technology supports for urban high schools, funded by Joyce Foundation, in Chicago and Detroit from 1997 to 1999. As part of that study, two high schools in Detroit determined that there was a need for teacher professional development in technology-supported educational reform strategies that would help teachers make the transition to block scheduling successfully. Teachers in these schools were concerned that traditional teaching methods, especially lecturing, would be much less effective when students and teachers spend much longer periods of time together in class. SRI researchers suggested offering a day-long workshop to teachers on project-based learning with multimedia (PBL+MM), as part of their commitment to help schools in the study develop strategies for technology integration into the curriculum. Although the workshop was not paid for by MMP evaluation funds, the workshop format drew heavily on the materials and methods developed as part of SRI’s experience with the MMP.

The day-long workshop included an introduction to the MMP’s model for project-based learning, examples of successful multimedia projects from Detroit high schools that had been part of the study, and an opportunity for teachers to brainstorm both project ideas and strategies for making technology-supported project-based learning a schoolwide reform strategy. As a resource for teachers, a Web site with links to project-based learning ideas and to the Challenge 2000 MMP Web site was developed. Staff at one school that participated were so excited by the workshop that they invited SRI researchers to return in the fall to provide the workshop to all department heads, with the hope that those leaders, drawn from throughout the school, would encourage their colleagues to adopt a project-based approach to teaching as the school moved toward block scheduling.

Presentations in the Silicon Valley Region

SRI researchers made presentations in three settings where leaders from both the business community and the education community were present. In each of these settings, SRI researchers had the opportunity to present evaluation findings from the Year 4 report to influential decision-makers in education throughout the region.

21st Century Investor Breakfast

Instead of a single Annual Celebration for investors and stakeholders, Joint Venture: Silicon Valley (JVSV) held separate events during 1999-2000 that highlighted its initiatives individually. In November, business leaders from companies that had made significant investments in the Challenge 2000 education reform initiative were invited to attend a 21st Century Investor Breakfast. The breakfast included presentations from Challenge 2000 teams, JVSV staff, and SRI on progress toward systemic education reform.

Among the more than 200 people present for the meeting, held at AMD in Sunnyvale, were business representatives, superintendents of school systems, JVSV board members, and Challenge 2000 team leaders. SRI's presentation highlighted three key findings from the Year 4 evaluation of the MMP. Results of the performance assessment, analysis of SAT-9 scores, and teacher observations were all included in the presentation. Of the different presentations about the MMP evaluation SRI has conducted in the past year, these slides are the most requested by team leaders and TLCs as they deliver their own presentations to local district and school leaders and colleagues.

Educational Technology Consortium January Meeting

On January 11, 2000, SRI researcher Bill Penuel co-lead a presentation with Family of Schools TLC Gayle Britt at the Santa Clara County Office of Education. The presentation was delivered to the Educational Technology Consortium, a group of school districts across the region focused on building leadership and capacity of schools for integrating technology into instruction. In attendance were more than 40 education leaders from schools, district offices, commercial education providers, and research organizations from across the Silicon Valley region. The half-hour presentation focused on the collaboration between Penuel and Britt in the development of the performance

assessment to measure students' design and communication skills that was used to measure student learning in the MMP.

California School Leadership Academy

In June 2000, SRI researchers Viki Young and Christine Korbak addressed a group of superintendents from across the state of California at the California School Leadership Academy (CSLA). The CSLA is an initiative jointly led by WestEd and the California Department of Education that develops and provides professional development for administrators and teacher-leaders from across the state. The mission of the organization is to help practicing administrators and teachers in leadership positions strengthen their skills in providing instructional leadership and in improving student achievement. The presentation by SRI was made to 50 attendees at the Executive Leadership Center of the CSLA, a seminar series designed through a partnership of the Association of California School Administrators and the California Department of Education.

The SRI presentation and discussion focused broadly on strategies for integrating technology into the classroom and used the Challenge 2000 MMP as an example of successful integration. Results from the observation study, which showed differences between MMP and comparison classrooms in classroom processes, were highlighted in the presentation. Questions and comments from the superintendents during the presentation indicated that many of them had only recently begun addressing issues of integrating technology in the classroom. For instance, schools in their districts may now have computers in classrooms, but the superintendents wanted to know how they could lead teachers in effective use of the technology. Consequently, they were keenly interested in the MMP data indicating that technology could improve student learning and demonstrating which uses of technology best support improved student outcomes. Evaluation comments from session participants said the cases, including the example of the Challenge 2000 MMP, were informative and that superintendents would like more classroom examples—grounded in theory with data to support implications—in future presentations of this kind.

Presentations at National and International Conferences

SRI researchers have made several presentations to researchers and teachers at national and international conferences focused on education and technology in education. Each of these presentations has been a collaborative effort involving project participants, reflecting the partnership approach to evaluation that SRI has adopted throughout the life of the Challenge 2000 MMP.

Computer-Supported Collaborative Learning (CSCL)

CSCL '99 was the third international conference devoted to the exploration of the role of technology in collaborative learning in classrooms, community settings, and the workplace. Organized by Stanford University, SRI International, IRL, and UNext, the conference has become an important biennial gathering of leading technology designers, educators, researchers, and students from across the globe in different disciplines, including psychology, education, cognitive science, anthropology, computer science, and linguistics.

SRI collaborated with a researcher from IRL and a 5th-grade teacher in the project to develop a case study of processes critical to the successful implementation of PBL+MM. The presentation highlighted how collaborative processes were scaffolded by the teacher and emphasized the role of assessment of group learning in motivating student engagement.

Autodesk Foundation's "Kids Who Know and Do" Conference

In spring 2000, SRI researchers presented alongside the project director, experienced MMP teachers, and TLCs at Autodesk Foundation's 8th Annual Conference on Project-Based Learning. The conference attracted more than 1,500 educators to San Francisco on March 31 and April 1.

The presentation, led by Linda Ullah, TLC for Blossom Valley Learning Consortium (BVLC), was titled "Good Assessment = Good PBL" and featured presentations focused on how assessment was integrated into project-based learning experiences of several MMP students. The presentation included explanations of the project scoring rubric and how IRL researcher Karen Cole worked in partnership with two classroom teachers to involve students in peer assessment of projects using the

rubric. SRI's part focused on presenting findings of the Year 4 evaluation report, with special attention given to the performance assessment results.

American Educational Research Association (AERA) Annual Meeting

SRI researchers organized a symposium for AERA's April 2000 meeting in New Orleans, Louisiana, focused on assessment of multimedia-supported project-based learning. In this symposium, we presented diverse approaches to addressing the problem of how to measure the quality of learning in classrooms where students design multimedia products in the context of project-based learning. We provided examples of promising practices in assessment and evaluation drawn from studies conducted as part of the MMP evaluation, both to help teachers improve student learning and to provide researchers and policy-makers with knowledge of how the effective use of multimedia technology can affect student achievement.

Our symposium drew on three perspectives: those of project director, classroom teacher, and professional researcher. The project director presented the process by which researchers and project staff jointly developed and implemented a rubric for measuring the quality of student projects exhibited at annual multimedia fairs sponsored by participating teams of schools. Two teachers described classroom assessment strategies they developed in partnership with IRL, and a researcher from IRL discussed the impact of these assessment practices on teaching and learning. Two researchers from SRI discussed the development of a performance assessment and scoring rubric used to measure the impact of MMP participation on classroom learning.

The five presentations that were part of the symposium, chaired by SRI's Barbara Means, were:

- **Developing and Implementing a Rubric for Assessing Student Multimedia Projects.** In this presentation, Michael Simkins, project director, described the development and use of a project rubric for assessing the quality of multimedia projects for program accountability. (<http://pblmm.k12.ca.us/sri/ReportsPDFFiles/Simkins.pdf>)
- **“Is My Project Good?”: Improving Students’ Assessments of Quality in Multimedia Design.** Gayle Britt, TLC and teacher at Central Middle School in San Carlos, described her experiences with developing a culture of peer

self-assessment of project quality using student-generated versions of the MMP rubric. (<http://pblmm.k12.ca.us/sri/ReportsPDFFiles/Britt.pdf>)

- **The Video Debrief: A Tool for Collaborative Reflection in Project-based Classrooms.** Otak Jump, teacher at Ohlone Elementary School in Palo Alto, described an innovative form of assessment he developed to foster better teamwork, using video feedback of student collaboration. (<http://pblmm.k12.ca.us/sri/ReportsPDFFiles/Jump.pdf>)
- **Issues in Developing Classroom Assessments as Part of a Design Experiment.** Karen Cole, researcher at IRL, discussed the life of rubrics and assessment tools as aids to teachers and students in negotiating standards of quality for multimedia projects. (<http://pblmm.k12.ca.us/sri/ReportsPDFFiles/Cole.pdf>)
- **Designing a Performance Assessment to Measure Student Communication Skills in Multimedia-Supported Project-Based Learning.** Bill Penuel and Barbara Means from the Center for Technology in Learning at SRI described the development and use of a performance task to measure design and communication skills of MMP and comparison students. (<http://pblmm.k12.ca.us/sri/ReportsPDFFiles/Penuel.pdf>)

The discussant for the session was Dr. Richard Lehrer from the University of Wisconsin, a researcher with extensive experience in studying multimedia or hypermedia projects in classrooms.

ED-MEDIA World Conference on Educational Multimedia, Hypermedia & Telecommunications

Project director Michael Simkins and SRI researcher Bill Penuel conducted a joint poster session at the ED-MEDIA conference held in Montreal, Quebec, in June 2000. The conference, sponsored annually by the Association for the Advancement of Computing in Education, attracts educators and researchers from around the world. Researchers from the fields of design, engineering, business, cognitive science, psychology, and education participated in the fourth annual ED-MEDIA conference. The poster developed for the conference focused primarily on describing the nature of the project and outlining basic findings from the evaluation study. Participants from 6

countries stopped by to ask questions about the MMP and to learn more about how it was implemented in Silicon Valley classrooms.

Research Articles Published

In Year 5, SRI researchers published two research articles as part of the effort to disseminate evaluation results from the MMP:

Penuel, W. R., Korbak, C., Cole, K. A., & Jump, O. (1999). Imagination, production, and collaboration in project-based learning using multimedia. *Proceedings of CSCL '99*.

There is evidence that technology has played a role in transforming classrooms into places where students are actively constructing knowledge and where teachers structure learning resources to facilitate discovery, problem-solving, and collaboration. In our research, we considered the roles of two processes to support a project-based approach to learning with multimedia: creating cycles of student imagination and production and supporting well-developed student collaboration. Our paper examined how technology and pedagogy work together in a 4th/5th-grade classroom taught by the fourth author to support student imagination, production, and collaboration and explored mechanisms that relate these characteristics to the building of student identities as members of a community of practice.

Penuel, W. R., Means, B., & Simkins, M. B. (2000). The multimedia challenge. *Educational Leadership*, 58 (4), 34-38.

This article discusses the life of one exemplary project, *Belmont Then and Now*, in the context of the MMP. Results from SRI's 5-year evaluation of the project are presented. Critical program components, including support from a network of teacher-leaders and a focus on ongoing assessment, are also examined.

6. CONCLUSIONS AND RECOMMENDATIONS

Data from Year 5 show, as did previous years' evaluation data, that the Challenge 2000 Multimedia Project (MMP) is a powerful way to transform teaching and learning with technology. In fact, an expert panel has judged the MMP to be among the most effective initiatives of its kind. In September 2000, the Educational Technology Panel of the Office of Educational Research and Improvement (OERI) at the U.S. Department of Education recognized the Challenge 2000 MMP as one of two exemplary programs in educational technology in the United States. The 18-member panel that decided on the award was composed of education practitioners; researchers; school reformers; evaluators; and representatives from local education agencies, institutions of higher education, businesses, foundations, and state and federal agencies.

The panel based its decision on evidence that the MMP was an effective reform strategy for using technology to transform teaching and learning. The criteria that programs had to meet were:

- Educational goals that result in complex learning supported by technology
- Promotion of organizational change
- Equity and educational excellence for all students
- Demonstration of effectiveness
- Usefulness and adaptability to other school settings.

The recognition from the U.S. Department of Education is strongly supported by SRI's evaluation data for the MMP. Data from the Year 4 report, especially the observation study and the performance study, support the claim that participating in the MMP results in complex learning. From the analysis of data collected in Year 5 and on the basis of SRI's 5-year evaluation of the MMP, three factors appear critical to the MMP's success: the incentives for participation, the professional development model, and the focus on assessment.

Incentives for Participation. Teachers new to the MMP have a number of incentives that help to overcome initial inertia with respect to implementing complex technology-supported projects with their students. Among these incentives are mini-

grants that support individual teachers' requests for equipment, software, or special training activities to help them design multimedia projects for their classes. The teachers who led the *Belmont Then and Now* project, discussed in Chapter 4 used mini-grant funds to buy scanners, a digital camera, multimedia software, and extra memory and storage media (two items districts and schools often do not include as line items in their technology budgets). Teachers who implement multimedia projects are also given a stipend for successfully completing a project with their students and displaying examples of student multimedia products at regional multimedia fairs sponsored by the grant.

To secure mini-grant funds, teachers must develop proposals that are reviewed by MMP staff and a team of experienced teacher-leaders in the MMP. The proposals must identify specific objectives for the project and methods for assessing student work, and they must outline how the project will include each of the elements of the multimedia-supported project-based learning model (see Simkins, 2000, for a detailed examination).

Teacher Professional Development. New teachers have help in developing proposals from the technology learning coordinators (TLCs). The TLCs in the MMP are teachers skilled both in pedagogy and in instructional uses of technology. They provide on-site assistance to their fellow teachers to develop project ideas, assist with implementation, and coordinate the involvement of teachers and students in regional multimedia fairs held each spring. The TLCs have become a strong teacher network over the 5 years of the MMP: they meet monthly to share progress, plan continuing professional development activities, and discuss specific projects.

The development and implementation of *Belmont Then and Now* illustrates how individual TLCs and the TLC network can support a particular project. Jeanine Woodell, TLC for one team in the MMP, had the idea for the project a few years ago. In fall 1999, Woodell took her idea to three teachers at Central Elementary, and together they developed the proposal for *Belmont Then and Now*. Proposal reviewers saw the promise of the project and decided to include a discussion of the project on the agenda of the monthly TLC network meeting. At the meeting, all the TLCs from the MMP discussed *Belmont Then and Now's* strengths and made specific suggestions for improving the project's design.

As the project progressed, Woodell used her position as TLC on-site at Central Elementary to help the teachers with overall coordination of the project. For example, she made telephone calls to the historical museum's curator during school hours. Woodell also helped facilitate students' learning as they worked on their projects, taking a hands-on approach throughout.

Teachers implementing *Belmont Then and Now* also relied on one another's support, using a form of organization adopted in the fourth year of the MMP. This "partnership" model emerged as the MMP grew to include multiple teachers within a single school. Each partnership includes a lead teacher (often with more than a year of experience in implementing multimedia projects) and one or more additional teachers. The partnership submits a mini-grant proposal to secure some of the hardware, software, and network tools they need to implement their project. Partner teachers discuss the projects within their school, and they have the opportunity to meet with teachers from partnerships in other schools at MMP-wide meetings throughout the year.

Focus on Assessment. Yet another critical component of the MMP's success is the extensive use of assessment to improve the quality of student products. It is too easy to get caught up in the activity of technology use and to neglect the quality of the content students are learning. The MMP's emphasis on assessment counteracts this tendency. All participating teachers are expected to evaluate the quality of students' multimedia products and measure changes in student knowledge and competence as a result of project work. Classroom assessments are complemented by more formal assessments conducted each year across the MMP in conjunction with the regional multimedia fairs. Clusters of schools hold annual exhibitions of student work completed as part of the MMP, and each cluster submits six of its best projects to be scored by a group of teachers and community members with a rubric developed by a team of teachers, researchers, and MMP staff. Scores are used as one source of data for measuring progress of the Challenge 2000 MMP toward its stated goal of infusing the schools of Silicon Valley with an exemplary model of project-based learning supported by multimedia (PBL+MM) (see Simkins, 2000).

Sustaining the Multimedia Project

The Federal Innovation Challenge Grant is a 5-year grant and the MMP has now reached the end of 5 years and will lose this source of funding, but there are left over funds that will be used in 2000-01 to sustain parts of the MMP. These left over funds will provide some support for team TLCs and provide smaller incentives to teachers who just began participating in the MMP in 1999-2000. Once the remaining funds have been used, the larger question remains: what aspects of the reform are likely to last beyond 2000-01?

SRI asked teachers in the MMP to address questions related to sustainability as part of the teacher participation survey administered online in spring 2000. The aspect most frequently rated as very likely to continue (84%) was the implementation of the long-term multimedia projects themselves (Table 6.1).

Table 6.1. Teachers' Ratings of Likelihood That Aspects of the Multimedia Project Will Be Sustained

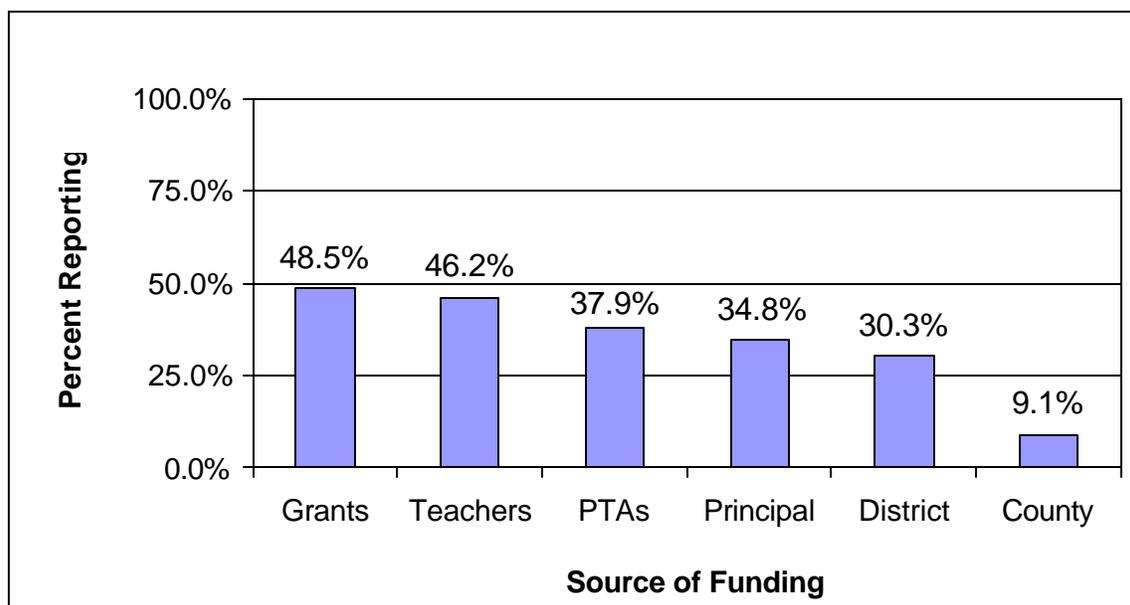
Aspect of Multimedia Project	Very Likely	Somewhat Likely	Somewhat Unlikely	Very Unlikely
Student-centered projects	84.1%	12.9%	0.0%	2.3%
Teacher partnerships	60.6%	26.5%	7.6%	3.0%
TLCs	32.6%	35.6%	22.7%	8.3%
Multimedia fairs	31.1%	46.2%	13.6%	8.3%
Technical support	28.8%	44.7%	19.7%	6.1%
Release time	22.7%	20.5%	30.3%	22.7%
Mini-grants	16.7%	23.5%	22.7%	34.1%
Project judging	15.9%	31.1%	36.4%	15.9%

Most respondents said they intended to continue using a project-based approach when the MMP has ended. Interestingly, on the surface, this aspect of the program is one that is most under the control of individual teachers to implement. At the same time, respondents frequently rated teacher partnerships as very likely to continue (61%). Like the use of project-based learning, this aspect indicates that many teachers have experienced a change in teaching practices as a result of the MMP; other teachers are seen as a valuable resource, and the planning time required to work collaboratively has become part of the routine, rather than being viewed as an extra demand for time. This

view that collaborative planning time is part of the routine is particularly important since only 23% of respondents rated release time as very likely to be sustained beyond MMP funding, suggesting that teachers expect to carve out the time needed for projects and partnerships, even if they have less support for doing so.

The aspect most frequently rated as very unlikely to continue is mini-grants (34%). Additional survey data show that when federal funding for mini-grants ends, many respondents do not expect county, district, or school funding to become available for sustaining the MMP (Figure 6.1). Only 9% of respondents reported that they expected funding from their county office of education. Roughly one-third thought that their school principal (35%) or their school district (30%) would provide funding. More likely sources of funding, according to the survey respondents, are parent/teacher organizations (38%) and individual teachers (46%). About half of respondents (49%) saw other grants as the most likely source of funding, suggesting that they will look for avenues of support that they can pursue individually.

Figure 6.1. Expected Funding Sources for Sustainable Aspects of Multimedia Project



On the whole, these expectations for funding suggest that there may be a significant decline in funds available for multimedia projects. What impact might the

lack of funding have? It may be that access to technology will not be severely affected. In the early years of the MMP, many participants were just beginning to add technology to their classrooms. Since then, funding for purchasing computers, installing them in classrooms, and connecting them to the Internet has become available from many sources. The response to whether technical support for implementing multimedia projects will continue (Table 6.1) provides further indication that schools are now able to provide technology basics. Most respondents thought that technical support for multimedia projects would continue to be provided (29% very likely and 45% somewhat likely). Consequently, the role that the MMP has played in bringing the basic technology infrastructure to classrooms is no longer as vital as it was, but teachers' access to multimedia tools like digital cameras and scanners may be lessened without mini-grants for implementing multimedia projects.

The impact of reduced funding may be more strongly felt in a breakdown of the team structure of the MMP. Specifically, respondents were divided about the likelihood that the TLC role would continue (Table 6.1). Although many thought that the TLC role would be sustained (33% very likely and 36% somewhat likely), about one-third thought it was unlikely to continue (8% very unlikely and 23% somewhat unlikely). Respondents were more optimistic about the likelihood of multimedia fairs continuing. Most respondents thought it was likely the fairs would continue (31% very likely and 46% somewhat likely).

The predictions made by the teachers in the MMP may not all be realized, but they point to some important challenges in the near future. Given SRI's analysis of what factors are most critical to the MMP's success, they also lead to a set of recommendations for the final year of the MMP.

Recommendations for the Year 6 Extension

Maintain High Levels of Support for TLCs

The central importance of TLCs in maintaining high levels of project quality and supporting within-school collaboration around student projects is well documented. Given the likelihood that some districts may not sustain this aspect of the program, available funds should be used to support this group.

Develop a Consulting Model for PBL+MM Program Development

The MMP has received requests from schools outside the Silicon Valley region to teach their teachers how to implement project-based learning with multimedia. To sustain the program locally and to expand it to other regions and states, a model of partnership with schools and districts that brings in income to sustain the MMP leadership and a cadre of teacher-leaders who act as trainers and support to teacher-leaders in other districts and schools is needed. Ideally, each school or district would be encouraged to provide the same supports for teachers—incentives for completing projects, just-in-time technical and curricular support, and opportunities for collaborative reflection and sharing of expertise—as teachers in the MMP enjoy.

Focus on Helping Teachers Identify Sources of Additional Funding

Already, the MMP listserv is used to announce opportunities for teachers to take advantage of competitions and give aways of software and hardware. Some mini-grant programs are also announced through the listserv, but future posts could focus more intensively on identifying additional sources of funding for teachers needing to buy peripherals such as digital video cameras and current off-the-shelf multimedia software.

Encourage Other Organizations to Support the Multimedia Fairs

The multimedia fairs are a central component of the MMP. The fairs help motivate completion of projects and form an important external audience for student work. Districts and county offices of education should continue support for the fairs, with the recognition that these will support teachers' continuing to implement multimedia projects with their students.

Encourage Student Participation in Other Venues for Publishing Student Work

There are a number of low-cost ways for students to publish their multimedia presentations and Web pages that provide the same kinds of recognition for their efforts as the multimedia fairs. One of these venues is the ThinkQuest competitions (<http://www.thinkquest.com>), which target middle- and high-school-aged programs. ThinkQuest is a program that encourages students to use the Internet to create information-rich, Web-based educational tools and materials. Lightspan's CyberFairs are

another venue for publishing student work on the Web (<http://www.lightspan.com>). Such venues are important, because they provide an external audience for student work and help to motivate teachers and students to complete projects.

Address the Need for Balance and Alignment with Standards and Assessments

A survey of TLCs by SRI in spring 2000 revealed that TLCs on the whole spent less time serving teachers in schools where there was a strong emphasis on teaching to standards and on improving standardized test results. The approach to teaching emphasized in project-based learning with multimedia emphasizes depth and complex thinking skills. By contrast, many of today's standards emphasize breadth of knowledge, and tests measure students' basic reading and mathematics skills. If new teachers are to adopt the MMP model of teaching, they need to see how the MMP aligns with local standards and assessments and be supported by districts that use assessments that measure complex thinking skills. Otherwise, the pattern of data showing TLCs spending less time in schools where they perceive the emphasis to be on standards and standardized testing will continue.

The MMP is a good example of a reform initiative that has helped teachers transform their teaching to integrate technology into student-driven projects and helped students to become skilled in design and communication with technology. The MMP model and its participants should be given every opportunity to continue their successful work in Silicon Valley and across the United States, to address the vital need for teachers to learn powerful ways to integrate technology into the classrooms of the new century.

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APPENDIX. Multimedia Project Scoring Rubric

LEVELS	MULTIMEDIA	COLLABORATION	CONTENT
	<i>The integration of media objects such as text, graphics, video, animation, and sound to represent and convey information. Videotapes that include sound and images fit this definition.</i>	<i>Working together to accomplish a common intellectual purpose in a manner superior to what might have been accomplished working alone.</i>	<i>The topics, ideas, concepts, knowledge, and opinions that constitute the substance of the presentation.</i>
5	Students have used multimedia in creative and effective ways that exploit the particular strengths of the chosen format. All elements make a contribution. There are few technical problems, and none of a serious nature.	Students were a very effective team. Division of responsibilities capitalized on the strengths of each team member. The final product was shaped by all members and represents something that would not have been possible to accomplish working alone.	Meets all criteria of the previous level and one or more of the following: reflects broad research and application of critical-thinking skills; shows notable insight or understanding of the topic; compels the audience's attention.
4	Presentation blends 3 or more multimedia elements in a balanced, attractive, easy-to-follow format. Elements include original student work. With minor exceptions, all elements contribute rather than detract from the presentation's overall effectiveness.	Students worked together as a team on all aspects of the project. There was an effort to assign roles based on the skills/talents of individual members. All members strove to fulfill their responsibilities.	The project has a clear goal related to a significant topic or issue. Information included has been compiled from several relevant sources. The project is useful to an audience beyond the students who created it.
3	Presentation uses 2 or more media. There are some technical problems, but the viewer is able to follow the presentation with few difficulties.	Students worked together on the project as a team with defined roles to play. Most members fulfilled their responsibilities. Disagreements were resolved or managed productively.	The project presents information in an accurate and organized manner that can be understood by the intended audience. There is a focus that is maintained throughout the piece.
2	Presentation uses 2 or more media, but technical difficulties seriously interfere with the viewer's ability to see, hear, or understand content.	Presentation is the result of a group effort, but only some members of the group contributed. There is evidence of poor communication, unresolved conflict, or failure to collaborate on important aspects of the work.	The project has a focus but may stray from it at times. There is an organizational structure, though it may not be carried through consistently. There may be factual errors or inconsistencies, but they are relatively minor.
1	Multimedia is absent from the presentation.	Presentation was created by one student working more or less alone (though may have received guidance or help from others).	Project seems haphazard, hurried, or unfinished. There are significant factual errors, misconceptions, or misunderstandings.
	Multimedia score =	Collaboration score =	Content score =