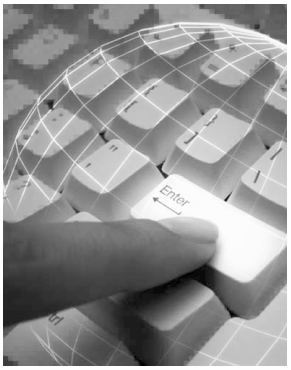

Teaming with Technology: A Case Study of a Faculty Design Team Developing Electronic Portfolios

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Abstract

To better prepare preservice candidates for teaching in the information age, the International Society for Technology in Education (ISTE) has defined National Educational Technology Standards (NETS) to guide technology integration into teacher education programs. Based on these standards, Brigham Young University (BYU) has implemented strategies for technology integration into their teacher education program by creating curriculum design teams composed of School of Education faculty, public school personnel, and instructional design and technology specialists. From our analysis of the initial activities of the faculty design teams, we have developed basic principles that have led to successful personal and institutional change. To demonstrate the realization of these six principles, we provide a detailed case study in highlighting the formation, development, and support of faculty design teams.

There are fundamental changes taking place in the way we access information (Castells, 1989, 1996, 1997), in the production and circulation of culture (Castells, 1989; Grossberg, 1992; Soja, 1990), and in our economy (Rifkin, 1995; Reich, 1995; Zuboff, 1988). Most people believe these changes are a result, in large part, of the availability of sophisticated computer technology and the expansion of global communication networks (Castells, 1996; Hawisher & Selfe, 1999; Bruce, 1997). To better prepare preservice candidates for teaching in the information age, the International Society for Technology in Education (ISTE) has defined standards to guide technology integration into teacher education programs. Based on these standards, Brigham Young University (BYU) has implemented strategies for technology integration into its teacher education program by creating curriculum design teams composed of School of Education faculty, public school personnel, and instructional design and technology specialists.

Connecting curriculum and technology is a goal of the McKay School of Education teacher preparation program at BYU. As part of a federal grant to prepare tomorrow's teachers to use technology (PT^3), the McKay School of Education is supporting graduate and undergraduate students, technology specialists, public school teachers, and university faculty in collaborative efforts to create technology-enhanced curricula. (Fullan & Stielgelbauer 1991; Means, 1994). Technology integration and systemic reform require complex changes in people, processes, and support structures (Fullan & Stielgelbauer, 1991). This paper will begin with a review of the literature on technology integration and change followed by a description of the teacher education program at BYU and the implementation of the department's PT^3 grant. A detailed case study of a curriculum design team supported by the grant will be used to discuss the basic principles of change identified in this study.

Technology Integration[1]

Defining both terms (technology and integration) is important to understanding the complexity of integrating technology into learning environments. Computer technology is merely *one* possibility in the selection of media and the delivery mode—part of the instructional design process—not *the* end but merely one of several means to the end. Integration does not just mean placement of hardware in classrooms. If computers are merely add-on activities or fancy worksheets, where is the value? (Hadley & Sheingold, 1993). Technologies must be pedagogically sound. They must go beyond information retrieval to problem solving, allowing new instructional and learning experiences not possible without them, promoting deep processing of ideas, increasing student interaction with subject matter, promoting faculty and student enthusiasm for teaching and learning, and freeing up time for quality classroom interaction—in sum, supporting and improving sound instructional goals and systemically reform educational practice. Wager (1992) argued that "the educational technology that can

[1] The thoughts in the section were first expressed by one of the authors in Earle, R. S. (2002). The integration of instructional technology into public education: Promises and challenges. *Educational Technology, 42*(1), 5–13.

make the biggest difference to schools and students is not the hardware but the process of designing effective instruction" (p. 454) that incorporates computer technology and other media appropriately. In short, integrating technology is not about technology—it's primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used.

Successful technology adoption/integration requires a concerted focus on the mission of improving education for all students. As an add-on or fad it soon withers. It must be seen as an ongoing innovative process designed to meet instructional/learning needs (Robey, 1992). Bernauer (1995) captured a significant insight when he stated that "it is not technology *per se* that has resulted in improved student outcomes, but rather how the technology was used and integrated into instructional processes" (p. 1). While noting increased student proficiency in using technology for learning rather than as technology for its own sake, he also attributed such achievements to teacher planning and expertise, recognizing that true success must be measured in terms of improvement in teaching and learning, not merely in the placement of computers in classrooms. Munoz (1993), who described herself as a technophile, emphasized the prudent, ethical use of technology and warned us to "resist the seductive force of technology to replace rather than enhance" (p. 49). She stressed that very human elements such as intuition, judgment, imagination, and creativity cannot be replaced, and that technology may fail if it's viewed as change for the sake of change. Initially, the real power of technology probably lies in the way its use causes teachers to develop different perspectives through rethinking teaching and learning (Riedl, 1995; Ritchie & Wilburg, 1994). Teaching with technology causes teachers to confront their established beliefs about instruction and their traditional roles as classroom teachers.

Personal and Institutional Change

To prepare K–12 teachers to effectively integrate technology, teacher educators must adopt the knowledge, dispositions, and practices associated with effective technology integration. Successfully integrating technology into a teacher preparation program includes, at a minimum, rethinking curriculum and methods of instruction, providing training and support for associated faculty members, and developing collaborative relationships between and among faculty, students, schools districts, and beyond. The key feature of these efforts at Brigham Young University is the development of curriculum design teams that are organized and supported to create technology-enhanced and problem-based curriculum. The process of faculty change is often complex (Abbey, 1997; Armstrong, 1996; Candiotti & Clark, 1998), but is most successful in the context of robust support structures and the provision of appropriate rewards (Dusick, 1998).

This paper reports on the work of an elementary portfolio design team supported by PT^3 activities. Through an in-depth case study, we will look at how this team worked to support their instructional goals using technology. The emphasis will be on how they learned to use technology to improve what they valued in their courses, not on how they forced technology into instruction as an add-on.

McKay School of Education: Understanding the Context

BYU graduates more than 1,000 teachers each year. These teacher education candidates enter the program in cohorts of approximately 30 students each and work together for two semesters of methods and certification courses. While in cohorts, these students share both on-campus classroom time and public school experiences. Services are provided by a cohort team that includes the university faculty supervisor, a Clinical Faculty Associate (CFA, an outstanding teacher from the public school spending two years on campus), several university methods teachers, and public school personnel (mentor teachers and teacher leaders who are building-level facilitators). The BYU teacher education program currently provides lab access to modern technologies for students and requires preservice teachers to take one instructional technology course. Prior to receiving the PT^3 grant, there was support for faculty who self-selected to use technology in undergraduate courses, but there was not a systematic effort to integrate technology into the overall curriculum. Given the importance placed on technology integration by accreditation bodies it was important that important to focus efforts and resources on moving more faculty to integrate technology into the curriculum.

Technology Integration Initiatives in the McKay School of Education

Based on this history and the perceived need to move the McKay School along in the effective use of technology, a concerted effort has been made to mentor faculty and build alignment around issues of technology integration. These goals have been achieved through three major project activities: (1) creating curriculum design teams composed of university education faculty, content specific methods teachers, and cooperating public school personnel; (2) holding yearly summer institutes and other training and collaboration opportunities that focus on the infusion of technology; and, (3) facilitating alignment among McKay School activities, cooperating districts, state office of education, and other teacher preparation programs in the state. In addition to these activities, informal lunchtime meetings provided venues for faculty to share their use of technology and allowed for just-in-time technical and instructional support to help the design teams as they learned to integrate technology.

Evaluation Method, Data Collection, and Data Analysis

We have conducted a situated evaluation of the processes of personal and institutional change associated with the technology integration initiatives at BYU. Situated evaluation is a process-oriented approach and focuses on identifying the ways in which systemic reform and technology integration is often complexly realized in the lives and practices of individuals (Bruce, 1997; Bruce & Rubin, 1993). To trace the complex personal and institutional processes associated with learning

to integrate technology, we developed case studies of curriculum design teams (Merriam, 1988). Case study data were collected during the 2000–2001 academic year and will continue throughout the project implementation. The data collected included detailed observations of the efforts of the PT^3 project management team related to the organization, support, and training of curriculum design teams, interviews with design team members, questionnaires from design team members, and an analysis of team products. As we discuss in the next section, we have identified important principles associated with the organization and support of the curriculum design teams. Our case study analysis demonstrates the ways in which the "curriculum design team model" facilitates systemic reform within the BYU School of Education and how these reforms reach affiliated schools and districts.

Curriculum Design Teams

In order to allow grant participants to select the ways in which they would begin to integrate technology into their instruction, they were encouraged by the PT^3 project management team to form teams that had common instructional goals. The project management team would then meet with these teams to discuss what the members of the teams valued in their courses and how technology might enhance their goals. From these discussions curriculum design teams "created themselves." They began to tell the PT^3 project management team what kind of activities would be helpful to them to meet their instructional goals. During the first year of the grant, the PT^3 project management team began to ask the design teams to create a contract that would outline their commitment to particular activities.

Participants in curriculum design teams defined these teams in various ways. For example, one faculty member said: "A design team is a cooperative group working together to produce a unit of instruction. A design team creates an integrated curriculum task using technology that works." Another design team concluded: "A design team is a lot like a fashion consultant. The team members are involved in creating a product, reshaping and synthesizing this product, and, in many ways, creating a new fashion. To be a part of a design team means that you design and redesign." Yet another defined the design team as "a collaborative group working together and building a community."

Several basic principles seem to underlie the support and development of curriculum design teams. First, early efforts must be made to understand the needs of key stakeholders involved in the teacher preparation program. Second, a project management team, led by faculty must be organized and function to initiate the institutional change activities. Third, curriculum design teams should be organized according to naturally occurring alliances in the teacher education program and should build on the projects and interests of faculty members. Fourth, flexible support structures, including access to instructional technologies and training, must be provided to support the various needs and interests of teacher education faculty and design team members. Fifth, for curriculum design teams to be successful they must be committed to the idea of technology and systemic reform. Sixth, it is important to foster collaboration between and among curriculum design teams (Fullan & Stielgelbauer, 1991). Each of these principles will be discussed later in this paper in light of the findings from our case study.

In the first year of the grant, six design teams signed contracts; in the second year, nine designed teams signed contracts; and in the third year, fourteen signed. The total number of participants went from 15 to 57 in three years. The teams participated in a variety of development activities: enhancing problem solving instruction by developing WebQuests for their teacher education courses and for K–12 curriculum; enhancing access to art and music by creating CDs for use in public school classrooms in conjunction with a local art museum; enhancing communicating with their students using e-mail and Web sites; assigning action research projects using Internet research to student teachers looking at educational issues in their schools and creating electronic presentations for local school board meetings. This paper focuses on an elementary portfolio design team that sought to increase preservice teachers' reflection on classroom teaching through the analysis of video for portfolio development.

Elementary Portfolio Design Team

In conjunction with the national call for educational reform two decades ago, and, in particular, with the related emphasis on performance assessment, educators have begun to look more closely at the commonplace practice among artists, photographers, architects, and designers of displaying their best work in a file or portfolio. Portfolios as measures of competent performance first appeared in school classrooms as ways to showcase student growth and development to parents. In recent years, as teacher preparation programs, encouraged by accrediting agencies, have embraced a performance-based model for assessment, teaching portfolios have become more commonplace in considering the readiness of prospective teachers to enter classrooms (Zeichner & Wray, 2001).

At BYU we incorporated portfolios (initially in a somewhat haphazard and entrepreneurial fashion) as part of our field-based elementary cohort program in 1993 to provide opportunities for preservice teachers to represent themselves and their practice more clearly and in greater depth. As we refined our portfolio process, we asked our students to tell the story of their growth and development, not to generate a comprehensive record of their achievements but to capture the highlights. These evolving selective and reflective collections of artifacts demonstrated their knowledge, skills, and experience. This case study will relate the story of the electronic portfolio design team with a particular emphasis on their early pioneering efforts to use electronic media to construct portfolios for teacher education candidates. Their early efforts became the impetus for the momentum within the School of Education to move portfolios beyond a single, course-based assessment activity and to develop a program-wide electronic portfolio that would incorporate the standards of the Interstate New Teacher Assessment and Support Consortium (INTASC) and ISTE.

Design Team Background

The core participants, and in fact the leaders in this design team, consist of two BYU faculty members who teach the elementary general methods courses. Neither of these faculty members has an extensive technology background, but they see the technology as a tool to enhance the teaching skills of their preservice students. Roger Olsen and Dave Dimond have been working together for more than three years implementing and refining electronic portfolios. Prior to coming to BYU, Roger Olsen was a teacher and administrator in the public schools for many years and has been involved in teacher education for eight years. Similarly, Dave Dimond taught in the public school for more than 20 years and has been involved in teacher education for two years.

Activities Prior to PT³

Roger and Dave had been actively working on the use of portfolios well before the PT³ grant and before the establishment of the faculty design team concept emerged. Prior to the PT³ grant, the department chair had challenged them to integrate technology into their teaching methods courses. They decided they would begin developing *electronic* portfolios. Their initial project was to "create videos of teachers modeling different teaching strategies to be used in the elementary methods course and to help students create electronic portfolios." Roger described their project in the following way: "Students gather evidence of their teaching skills in an electronic portfolio (created as a presentation in PowerPoint). They integrate video clips, scanned images of evaluations and student samples, lesson plans, a management plan, and an evidence of learning plan into their portfolios." Their first attempt at constructing portfolios was a disaster. Students did not have access to the right technology and had many technical problems. Added to this, the limited personal skill level of design team members led to many mistakes. These problems were frustrating for the team members as well as their students. Without the expertise of a department colleague with expertise in digital video and burning CD-ROMs, the electronic portfolio experience would have been even worse. The team also drew on the support of the instructional computing lab within the School that helped them and their students a great deal. Despite the challenges of this initial effort, they had an increased desire to improve on the implementation of portfolios. When asked why they continued, they reported that working as a team helped them to continue to be motivated.

First Year of PT³ Grant

During the 2000–2001 academic year, the McKay School was awarded the PT³ grant, which among other things focused on developing curriculum design teams. Roger and Dave expressed interest in participating in grant-related activities and were an obvious choice given their previous experimentation with electronic portfolios. Additionally, key stakeholders such as the dean and department chair supported their continued development efforts.

The PT³ grant provided the portfolio design team with focused training on technologies such as iMovie and PowerPoint, which solved the problems they had experienced in previous efforts. For example, iMovie training helped them understand how to easily digitize and manipulate video. With their newly acquired skills, they assisted their students in simplifying the portfolio development process. They also learned how to use PowerPoint, which provided them with an easy solution for students to organize their videos and artifacts into a portfolio. During the first year of the PT³ grant, they also participated in six days of training where they discussed with public school teachers how they were using technology in their classrooms. They also shared their work with other design teams that were exploring ways to enhance instructional goals using technology. During this training they worked together as a design team to develop their portfolio ideas and expanded the team by sharing what they were doing with other teaching methods faculty members.

In addition to developing technical skills, Roger and Dave developed a greater appreciation for electronic portfolios as a tool for improving the quality of teacher education. They were funded to attend a workshop led by Dr. Helen Barrett at the Society for Information Technology and Teacher Education (SITE) 2001 conference. During their participation, they experienced what they described as an epiphany about the power of electronic portfolios to help students reflect on their own teaching. After the workshop, they saw electronic portfolios as works in progress rather than finished products and learned to connect portfolios to standards.

Summer Institute

When the portfolio design team joined the PT³ project they committed to improving their technical skills that would support their instructional goals. Two main goals were to (1) increase the reflection of their students as they spent time in the public schools and (2) increase high level thinking in their instruction and in the lesson written by their students. The summer institute consisted of electronic portfolio implementation, including the inclusion of video in electronic portfolios within teacher education courses. Dr. Helen Barrett was the major facilitator. Barrett was invited in part because of the momentum this curriculum design team had developed among McKay school faculty and a desire by the PT³ team to continue the discussion about electronic portfolios. When asked about the electronic portfolio sessions, Dave Dimond said: "It's been a good overview of a variety of uses of portfolios and how to develop good portfolios." Similarly, Roger Olsen indicated that he had developed a greater vision of what portfolios can do for students and gained new ideas to implement in course work. Both core members of this design team said that they were planning to align what they were doing with INTASC standards and hoped that the department would support revising their course to better match these standards. They also both agreed that the summer institute provided them with a greater vision for how electronic portfolios including video could be used for improving student reflection and the quality of teacher education.

Dave and Roger also attended sessions in the summer institute that focused on Internet research, Internet communications, and integration standards. Both commented that these sessions opened

up a greater set of possibilities and applications. In particular, they learned the importance of using technology to promote higher level thinking in teacher education candidates. In a later interview, the design team members reflected on their participation in the summer institute and pointed to the summer institute as a turning point in which they were able to reflect and collaborate about integrating technology into their teacher education curricula. It was also a time where they expanded membership in their curriculum design team to include other methods instructors and clinical faculty associates.

Second Year

Based on the work in the first year, the portfolio design team planned to spend a significant amount of time developing their skills and finding ways to align the portfolios with their instructional goals of reflective teaching. The team related that they had already made plans to begin a collection of videotapes on good teaching practices and specific teaching strategies that they could make available to their students. Their participation in various PT^3-grant-related activities helped improve their technical skills, increased their understanding of using video analysis in reflecting about teaching experiences, and developed their understanding of how to better implement video into the teacher candidates' portfolios. During the second year of implementation, the design team also became more involved in School and statewide initiatives to implement electronic portfolios as part of the first year of the teaching mentoring program. The expansion of their efforts beyond their particular class and students is particularly noteworthy because it is evidence that their efforts are leading to wider systemic reform.

To increase their technology skills, both Roger and Dave took the instructional technology course designed for preservice teacher education candidates (IPT 286). This is a project-oriented lab course that familiarizes students with various kinds of instructional technologies through a series of tutorials. Additionally, there is a lecture component that focuses on issues of instructional design and technology integration. Taking this course helped Roger and Dave become more aware of the kinds of technologies they could expect students to use in their electronic portfolios. They also mentioned that by taking this course they were able to better learn the technology skills presented to them, and that they have found ways to better integrate those skills to their own courses and research. The traditional conference/workshop model opened their eyes to possible uses of technology, while the faculty-as-student model gave them the skills needed to produce technology-enhanced products, model those products, and write meaningful assignments for their students.

Another important activity during the second year was attending a Classroom Connect[2] conference in Las Vegas, Nevada. This was organized and funded by the PT^3 project management team and designed to bring teacher education faculty, district personnel, and mentor teachers together to discuss technology and teacher education. There were organized activities prior to, during, and after the conference to facilitate alignment between the goals and practices within the McKay School and within the participating schools and classrooms. This was particularly useful to the portfolio curriculum design team because they were able to discuss with mentor teachers and district technology specialists how to best prepare BYU teacher education candidates. According to the design team members, meeting with public school personnel allowed them to better align their portfolios to curriculum and technology integration standards.

Current Status

This curriculum design team made a great deal of progress in learning to use technology and in learning about the power of video analysis in portfolios to improve the reflection of teacher education candidates. Through the support they received from the PT^3 grant and the project management team, the curriculum design team developed a greater understanding of the value of technology to enhance their instructional goals. It is also interesting that administrators and other faculty increased their interest in using a program-wide electronic portfolio partly because of the pioneering work completed by this group. Indeed, because of their students' early successes with reflective analysis of their teaching using video analysis in their portfolios, there was a greater interest within the School from administrators and other faculty to develop a program-wide electronic portfolio.

The elementary portfolio design team members are further refining their implementation of electronic portfolios and finding new and easier ways to construct electronic portfolios. This will be an ongoing process of improvement and development. Additionally, the core team of Roger and Dave continues to expand to include other clinical faculty associates and methods instructors. What remains to happen is the acceptance and adoption of electronic portfolios by all content area faculty members. Members of this curriculum design team are now participating in a school-wide effort to integrate portfolios into the teacher education program. They have been an important voice on this committee given their experience with implementing portfolios and their training in technology integration.

Members of the design team are also participating in a statewide initiative to use portfolios for licensure and certification. The timing of this team's activities over the past months has been most opportune as we have also been able to proactively engage the Utah State Office of Education in the design of a licensing portfolio for entry level teachers that is congruent with the preservice portfolio. Much of this work would not have been possible without the pioneering work of this curriculum design team.

Challenges

Although they have made progress, members of this design team agree that there are many challenges facing further implementation of electronic portfolios. For example, technical and infrastruc-

[2] Classroom Connect provides regional professional development conferences. See http://www.connectedclassroom.com.

ture problems continue to plague their implementation efforts. Another constraint of this particular design teams is that many of its members are temporary for two to three years. There are new members of this design team yearly, making it difficult to coordinate and sustain activities over time.

In spite of these challenges, they have received positive feedback in exit interviews from many of their students, who indicate that developing their portfolios has been the most important way to synthesize the elements of their teacher preparation program. They stated that what they learned about themselves and their teaching came from the time they spent reviewing and editing their videos. They also reflected about the lessons that had written as they selected the ones that showed they could include high-level thinking in their instruction.

Technology Integration Principles to Facilitate Curriculum Design Teams

The previous case study has demonstrated the ways in which curriculum design teams have worked together to integrate technology into their preservice teacher education curriculum. We now turn to an in-depth discussion of the principles that we think were key to the support and development of the portfolio curriculum design team.

First, we made early efforts to understand the needs of key stakeholders involved in the teacher preparation program. Meeting the needs of key stakeholders was crucial for the early success of the implementation of the portfolio design team. For example, we discovered from our analysis of faculty responses to a questionnaire that there was a need to help faculty members enhance their instructional goals with technology that would support their goals. The faculty also needed help developing their technology skills. This was apparent with the portfolio design team in their lack of knowledge with video editing software and their limited knowledge about portfolios in teacher education. Understanding these needs led to the selection of particular workshops and training opportunities that allowed them to learn important skills and dispositions that increased the quality of their projects.

The PT^3 project management team also stayed in contact with program administrators interested in technology integration and noted an ongoing interest in pursuing a program-wide portfolio. This understanding encouraged the PT^3 project management team to pursue additional electronic portfolio training and led to the development of an electronic portfolio task force. This task force used the experience of Roger and Dave and applied it more widely within the teacher preparation program to enhance the instructional goal of helping teacher candidates be more reflective about the teaching practices. The attention to key stakeholders increases the likelihood that an initiative will move from individual interests to institutional change

Second, faculty members who are well respected by their colleagues as teacher educators lead the McKay School PT^3 project management team and directed the technology integration activities. One project management team member is a member of the elementary education faculty and an associate chair and the other is a secondary education faculty member with experience enhancing instructional goals with technology. It has been important that these change efforts be seen as organic and originating from the faculty, rather than the academic administration. Indeed, faculty members occupy a unique place as mediators between administrators, students, and district support staff and as such are important change agents.

The project management team worked behind the scenes to provide the various kinds of support needed for the success of the design teams. For example, one project management team member has worked extensively with those involved in the development of the electronic portfolios. Additionally, the project management team organized the summer institute, organized the Connected Classroom trip, and provided just-in-time assistance to many of the curriculum design teams. One of the big questions concerning the sustainability of these measures is the support of a project management team after the life cycle of the grant.

Third, curriculum design teams have been organized according to naturally occurring alliances in the teacher education program and have built on the projects and interests of faculty members. The portfolio design team consisted of teaching methods instructors, many of whom had worked together before the PT^3 grant was received. Building on these alliances and relations, rather than constructing new ones, allowed for the integration activities to quickly develop. Roger and Dave were already comfortable working together and were comfortable with their collaboration. Additionally, because they were both methods instructors and previously had been teachers, they shared a great deal both personally and professionally. Other design teams were constructed around similar personal and institutional relationships, which added to their success.

Fourth, the integration activities associated with the PT^3 grant provided flexible support structures, including access to instructional technologies and training and workshops. There was not a "one size fits all" approach to integration training. In the case of the portfolio design team, they received organized training on how to use particular technologies, on practices of technology integration, and on the uses and benefits of portfolios. In addition, they attended national conferences and workshops supported by the PT^3 project management team. They also received support to take the instructional technology course designed for their teacher education students.

There was also informal help from the PT^3 project management team, from each other in the design team, and from other faculty. For example, when they were first developing the portfolio they relied on a faculty colleague to help them digitize and manipulate the videos and later received help to burn the CDs. There was a combination of formalized training and "at the elbow" support that helped this group succeed.

Fifth, the key to this curriculum design team's success was their personal and collective commitment to use technology appropri-

ately to enhance instructional goals. The development of commitment came in two forms: this design team was committed to each other as a team, and they were committed to the idea of improving instruction and using technology when it improved the experiences of their students. In this way, they saw the possibilities of technology in teacher education and developed a vision of these possibilities in their own teaching. In the experience of the portfolio design team, the vision was instilled through the formal training, summer institutes, and sponsoring trips to conferences and workshops. These professional development activities were organized around building relationships and developing deeper commitment to the idea of technology integration.

Evidence for the portfolio design teams commitment includes their desire to continue in their technology integration efforts in the face of technical and institutional challenges. Even before their involvement in the PT^3 grant, they demonstrated a willingness to persevere when times were difficult. They have also demonstrated their commitment by presenting their electronic portfolio implementation to national conferences and to local audiences. Indeed, they are seen as leaders and pioneers within the McKay School in the area of electronic portfolio development in teacher education and how using an electronic portfolio supports reflection of teaching practice.

Sixth, it has been important to foster collaboration among curriculum design teams. The design teams shared their common goals for the teacher education program and discussed how each team was using technology to enhance these goals. It is only through this collaboration that systemic reform can take hold and lead to institutional change (Fullan & Stielgelbauer, 1991). We documented the collaboration within the portfolio design team and the widening reach of this group both within the teacher education program and beyond, into schools, districts, and even statewide initiatives. As this group expanded its reach, other design teams in mathematics, science, history, language arts, and literacy have begun to see the value of electronic portfolios and are adopting their methods. This collaboration has been fostered by formal presentations given by the portfolio team in the McKay School and less formal interactions in the hallway and during training sessions. Probably the most important outcome of this collaboration is a growing agreement among methods and content area faculty that a program-wide electronic portfolio would be both efficient and effective.

Conclusion

Taken together, these principles indicate that systemic reform is tantamount to cultural change. To change the culture of teaching and learning in preservice preparation programs, one must provide resources, rewards, well-thought-out experiences, and time for reflection. In the cases discussed above, we have demonstrated the ways in which curriculum design teams create a context of practice and reflection necessary for the personal and cultural changes desired to systemically reform the curriculum and integrate technology. Indeed, developing and fostering curriculum design teams creates the possibility for wider-scale change and sustainability over time.

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