The Stanford Technology in Teacher Education Project:

Supporting Teaching and Learning

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The Stanford project focused upon five key objectives: 1) Implement new approaches to teacher education aimed at the development of powerful teaching through the use of technology**;** 2) Provide teacher candidates with the ability to develop and teach units that integrate technology into the teaching of core content; 3) Develop and test technology-based curriculum materials and units for use in other teacher education programs and schools; 4) Provide candidates with the scaffolding and ability to use appropriate computer-based technology to facilitate the learning process; and 5) Develop learning communities between Stanford and partners.

The Stanford Technology in Teacher Education Project sponsored by PT3 helped the Stanford Teacher Education Program (STEP) redesign its technology-related curriculum and respond to the advanced technology standards required for an effective and innovative teacher education program. In designing and implementing the project, we adopted an approach that was integrative, performance based, and product driven. Project evaluation documented that STEP teacher candidates learned to use computer-based technology in the classroom appropriately and showed competence in using computer-based technology infused throughout their university- and school-based curricula. From email communication to technological resources that facilitate teaching and learning, from developing skills in basic applications to critically examining a variety of educational technologies, STEP teacher candidates actively and frequently engaged in using technology at the university as well as in their field placements. The project had a deep and broad impact on teaching and learning in STEP. In this chapter, we describe aspects of the uses of technology by teacher candidates, faculty and staff, cooperating teachers in placement schools, and high school students. We highlight how the use of technology benefited teacher candidates and schools – and most importantly, students in those schools.

Context: The Stanford Teacher Education Program (STEP)

STEP is 12-month course of postbaccalaureate study for prospective secondary teachers. The program combines a full year of student teaching with graduate coursework leading to a Master of Arts in Education and a preliminary California Professional Single Subject Teaching Credential. STEP's small size (between 60-75 candidates), access to top faculty, university supervisors, and cooperating teachers, as well as its purposeful design offer highly focused instruction interwoven with hands-on teaching experience, sustained mentoring, and personalized advisement. Constant communication among members of a relatively small team of instructors and staff brings strength and coherence to the curriculum.

At the university, candidates have access to well-resourced computer labs that have multi-media capabilities, are rich in hardware and have a wide selection of software and educational applications. In field placements, candidate access to technology varies. However, STEP teacher candidates have access to laptops, probeware, digital cameras, projectors, and other equipment they can check out from the university and bring with them to their schools. In addition to exploring the multi-faceted challenge of identifying how technology supports teaching and learning through coursework and field placements, STEP teacher candidates participate in skill-based workshops offered throughout the year, one-on-one coaching sessions, and individual, small group and project-based assignments.

Many on-line course resources are used by faculty and students (e.g., Blackboard, Coursework). Over half of the courses require group projects and thus the use of collaborative tools. STEP teacher candidates develop a deep grounding in content pedagogy, understanding of learners, and the learning process in their Curriculum and Instruction (C&I) courses. During their C&I courses, each preservice teacher prepares a curriculum unit. Appropriate uses of technology are included as one of the evaluation criteria for the unit. In designing their unit candidates need to:

1) explore and examine software and web resources to evaluate their effectiveness and alignment with content- and teaching-standards;
2) analyze best practices and research findings on the use of technology;
3) design lessons that demonstrate effective use of technology; and
4) reflect on their practice by examining student work and the feedback they received from students to guide their subsequent instruction.

To assess the use of the unit and to revise it as needed, candidates videotape selected lessons to analyze, review and reflect upon with their supervisors and colleagues. It is during fall quarter that candidates become acquainted with specific technology resources in their respective C&I courses and then experiment with these resources in their field placements.

For example, during the years of the project, in the Science C&I led by Dr. Schultz, candidates explored the uses of "probeware" in their university course and also with students in their field placements. In English C&I, candidates made a Quicktime movie for an assignment that asked them to demonstrate their assessment of a student's reading strategies. In Foreign Language C&I, candidates began to build their curriculum unit which relied heavily on multimedia resources. In Mathematics C&I, candidates analyzed and critiqued a comprehensive review of various applications that enhance the teaching and learning of mathematics at the secondary level (e.g., graphing calculators, Geometry Sketchpad). In Social Studies C&I, sessions were devoted to the analysis of primary and secondary sources with particular attention to such documents available on-line.

The course entitled "The Centrality of Literacies in Teaching and Learning" is taught during summer quarter. Among the main purposes of this course is to introduce teacher candidates to the challenge of teaching diverse student populations and expanding their repertoire to include multiple representations of content material. At the time of the project, integral to this course was a literacy case study where the candidates were asked to prepare a multi-media presentation of an adolescent as a literate individual. Alphabetic literacy was to be used minimally. Instead, art, music, sound, photography, video clips, charts, and graphs were to be presented to illustrate the adolescents whom candidates observed and tutored during the summer school session. As part of this course and to learn how to fulfill the course assignment, candidates participated in the following skill-based tutorials: scanning and editing graphics and photographs; designing web pages; preparing presentations that incorporate graphics, text and video (Powerpoint), and uses of internet resources.

The four-quarter long Secondary Teaching Seminar (the Practicum) is the overall glue for the program. This sequence allows teacher candidates to complete their teaching assignment in a local high school or middle school and to make deliberate connections between the clinical experiences in these classrooms and their university courses. This year-long sequence also allows the teacher candidates to practice and to deepen their methodological and technological skills.

Over the years of the project, teacher candidates and university supervisors became increasingly comfortable with videotaping classrooms and candidates' teaching. These videotapes became valuable data for specific feedback and grounded analysis of candidates' performances in the classroom. University supervisors participated in a number of professional development sessions designed to teach them how to use the video camera effectively and how to use the tool for purposes of feedback and support of candidates' learning.

Clinical placements in local middle school and high school classrooms allow teacher candidates to observe others and to experiment with the use of tools that facilitate their teaching practice. Increasingly, schools become more and more technologically well-resourced and cooperating teachers and their colleagues acquire stronger and stronger knowledge about uses of technology and are then able to use that knowledge in their classrooms. Thus, teacher candidates are better able to observe others and use the technological tools that enhance teaching and learning across subjects in their clinical placements. Candidates are urged to develop an inventory of technology resources at their school site. Since they are required to be in their field placements for at least 20 hours per week, they have opportunities to explore the resources at the school, interact with the staff in charge of media labs, and communicate with librarians and administrators regarding these resources. Using the frameworks presented to them in their courses, they can consider if and how content being taught best uses technological resources to support, manage, and enhance learning. They can also practice and demonstrate the ability to create and maintain an effective learning environment using computer-based technology. Furthermore, they communicate with their students and their parents using printed media and build web-sites for easy access to information about the courses they teach.

At the time of this project[1], the graduation portfolio represented the culmination of the candidate's work during the program. This portfolio was a digitized collection of materials and artifacts reflecting the candidates' theoretical and practical knowledge, pedagogical stance, teaching skills, and educational philosophy. It included multiple sources of evidence collected over time, organized, and refined to illustrate their professional growth and best work. As such, it was the integration of candidates' clinical work and coursework, providing a sense of learning that "adds up" across the program as a whole. For instance, key assignments from courses such as the literacy case, the curriculum unit, and the teaching event were designed to meet final portfolio requirements. In the process, the portfolio integrated evidence about teaching with evidence of student learning, thus reinforcing a teaching stance concerned with ongoing diagnosis of and responsiveness towards student needs, rather than teaching as mere implementation of routines. Candidates produced their portfolios and presented it at their individual portfolio exhibition.

Production of the digital portfolio, a graduating requirement, was scaffolded throughout the practicum. Margaret Krebs, PT3 Director and Katie Miller, Technology Coordinator for STEP, conducted workshops and were responsive to the candidates on an "as needs" basis. During the workshops they reviewed the technology resources, tutored candidates individually and in small groups on specific technology tools, problem solved equipment and hardware failures. Both Ms Krebs and Ms Miller acted as important facilitators because they had the technical expertise and a deep understanding of the STEP curriculum and the graduation requirements. They were able to provide assistance and feedback both at the technical and at the substantive levels.

[1] The content of the STEP graduation portfolio has changed recently due to state-mandated changes in the requirements for credentialing. For a current format of the required graduation portfolio, the Performance Assessment for California Teachers, see www.pacttpa.org.

Candidates prepared two versions of their digitized portfolio: 1) a display version that presents best work and omits any items that may raise issues of confidentiality. (This version was used as an employment portfolio as well.); 2) a more complete version for credentialing purposes including quarterly assessments by supervisors and cooperating teachers, reflections of supervisor's observations, drafts of assignments demonstrating professional growth as well as finished products of the candidates' best work.

The portfolio provided a performance-based way for candidates to integrate the skills they had practiced throughout the year. In addition, candidates grappled with copyright, privacy and security issues around their own work as well as that of their students and cooperating teachers. To scaffold and support this work, STEP teacher candidates who needed extra support participated in a "Digital Portfolio Club" during the spring quarter. The meetings of the "club" were organized and facilitated by the STEP Technology Coordinator and candidates' participation was voluntary: some attended every meeting, others only selected ones. For each of the weekly meetings conducted in the computer lab, Ms. Miller prepared and published an agenda but also left ample time to address specific questions and to try out specific applications as needed.

Evidence of candidate learning and performance

The following table is a summary of the indicators of candidate technology use and the places where candidates were required to develop technology skills.

Table 1: Summary of Computer-based Technology Skills Used in STEP

Indicators of Technology Use	Course of Study	Demonstrated Evidence
Uses computer applications to manage	Practicum	Throughout program

records		
Uses computers to communicate through printed media	Practicum Classroom Management	Parent Involvement Plan
Interacts with others using email	Program requirement	e.g. STEP distribution lists
Is familiar with a variety of computer-based collaborative tools	Program requirement	Communications with colleagues and faculty
Examines a variety of current educational digital media and uses established selection criteria to evaluate materials	C&I Practicum	e.g. Software Evaluation Assignment
Chooses software for its relevance, effectiveness, alignment with content standards, and value added to student learning	C&I Practicum	Curriculum Unit Software Evaluation Assignment
Demonstrates competence in the use of electronic research tools	Program requirement	Course syllabi and assignments
Demonstrates the ability to assess the authenticity, reliability, and bias of the data gathered	Program requirement	Course syllabi and assignments
Identifies student learning styles and determines appropriate technological resources to improve learning	Centrality of Literacies, C&I	Literacies case study Curriculum Unit
Considers the content to be taught and selects the best technological resources to support, manage and enhance learning	C&I	Literacies case study Curriculum Unit
Demonstrates an ability to create and maintain effective learning environments using computer technology	C&I Classroom Management	Curriculum Unit Classroom management plan
Analyzes best practices and research findings on the use of technology and designs lessons accordingly	C&I Practicum	Curriculum Unit Software Evaluation Assignment
Demonstrates knowledge of copyright issues	General university policy	Digital portfolio
Demonstrates knowledge of privacy, security, and safety issues		
Uses a computer application to manipulate and analyze data (e.g. create, use, and report from a database; and create charts and reports from a spreadsheet).	Practicum Field placement	Digital portfolio

Communicates through a variety of electronic media	Program requirement	Parent Communication Plan
Interacts and collaborates with others using computer-based collaborative tools (e.g. threaded discussion groups)	Program requirement	e.g., STEP distribution lists
Demonstrates competence in evaluating the authenticity, reliability; bias of the data gathered; determines outcomes and evaluates the success or effectiveness of the process used.	STEP curriculum	Course syllabi and assignments
Optimizes lessons based upon the technological resources available in the classroom, school library media centers, computer labs, district and county facilities, and other locations.	C&I Practicum Field placement	e.g. Quarterly Assessment: Standard 6: Professional Educator
Designs, adapts, and uses lessons which address the students' needs to develop information literacy and problem solving skills as tools for lifelong learning	Literacies C&I Field placement	Literacies Assignment Curriculum Unit Quarterly Assessment
Creates or makes use of learning environments inside the classroom, as well as in library media centers or computer labs, that promote effective use of technology aligned with the curriculum	Practicum Classroom Management Field placement	Literacies Assignment Curriculum Unit Quarterly Assessment
Uses technology in lessons to increase each student's ability to plan, locate, evaluate, select, and use information to solve problems and draw conclusions.	C&I Practicum Field Placement	Curriculum Unit Quarterly Assessment Digital Portfolio
Uses technology as a tool for assessing student learning and for providing feedback to students and parents	Literacies C&I Practicum	Literacies Assignment Curriculum Unit Digital portfolio
Monitors & reflects upon the results of using technology & adapts accordingly	C&I Practicum	Digital portfolio
Collaborates with other teachers, mentors, librarians, resource specialists, and other experts to support technology-enhanced curriculum	Field Placement	Quarterly Assessment
Contributes to site-based planning or local decision making regarding the use of technology and acquisition of technological resources		

Over the course of the three-year project, during the first week of orientation to the program, STEP teacher candidates completed a survey regarding their computer literacy skills and technological proficiency. Data from this survey allowed us to plan for the personalized and individualized help needed by the different candidates. Furthermore, it allowed us to construct heterogeneous working groups of candidates who could serve as technology resources for one another. This overall norm of mutual help and collegial support was and continues to be strongly emphasized and supported in all aspects of the STEP curriculum. This sharing of expertise among candidates was also evident during the "digital portfolio club" meetings.

At the end of the academic year, post-surveys were administered to candidates asking them to rate their proficiency on selected indicators. Table 2 shows the percentage of candidates who rated themselves as either "proficient" or "expert" in terms of their ability to use aspects of technology for instruction. Overall, data indicate that for each of the indicators, a significantly higher percentage of STEP students rated themselves as "proficient" or "expert" after their experiences in the program. For example, by the end of their program, almost 80% of candidates who completed the program in 2003 rated themselves as proficient or expert in their ability to use multimedia tools to provide multiple representations of content material, an increase of almost 60% when compared to their self-ratings at the beginning of the program. Similar increases are evident across all years of the project, on all dimensions. Moreover, candidates believed their experiences in STEP helped prepare them to design lessons that used technology effectively. Each year, there was a significant increase from the beginning to the end of the program in the number of candidates who rated themselves as "proficient" or "expert" when they were asked to describe their ability to "design lessons that encourage students to use a variety of information resources and technology tools to build their own understanding of content". For example, almost 70% of candidates from STEP in 2003 rated themselves as "proficient" or "expert" on this dimension, compared to only 16% at the beginning of the program.

Table 2: Candidates' self-rated ability to use technology for instruction.

Instructional Uses of Technology	Beg '01	End '01	Beg '02	End '02	Beg '03	End '03
A. Uses technology to provide students with problem-based activities	4%	54%	8%	57%	14%	59%
B. Designs lessons so that students have equitable access to available technology to successfully complete the assignment	10%	60%	8%	57%	7%	67%
C. Uses technology to communicate in ways previously not possible (i.e., exchanging email with parents, posting student work on the school web site)	25%	70%	28%	71%	16%	67%
D. Uses multimedia tools to provide multiple representations of content material	8%	81%	15%	85%	21%	79%
E. Uses specific criteria to select software that matches grade level, content, and instructional outcomes	10%	44%	6%	37%	16%	44%
F. Uses technology to provide students with real-world problems, including an audience or resources outside the classroom	10%	49%	8%	46%	20%	52%
G. Designs lessons that encourage students to use a variety or information resources and technology tools to build their own understanding of content	10%	68%	10%	69%	16%	69%
H. Encourages students to use technology to develop and solve authentic problems, often including contact with outside experts and audience	10%	49%	8%	38%	17%	49%

In addition to the surveys, data were collected through interviews with Candidates in year three. Referring to requirements of their university coursework (e.g., the curriculum unit, the literacy case described earlier), the candidates perceived that the application of technology within the context of their assignments was as a meaningful way to learn how to integrate technology into instruction. Moreover, this modeling of technology-embedded assignments was an effective way for STEP to encourage candidates to learn how to create a curriculum for their students that also embeds technology. The findings showed that candidates were leaving the program well prepared to integrate technology into their teaching.

Evidence of changes in faculty's practice and perceptions

Faculty members teaching in STEP were interviewed as to their use of technology in their courses. Consistent with research at the K-12 level, data suggest that organizing the C&I courses to include technology had been easier for some STEP faculty members than for others. For example, one faculty member was rather skeptical and said, "I am not sure there are the same kind of materials at the secondary level that are better than what teachers can do without technology." In contrast, another faculty member felt strongly that all teachers in his content area should be well-versed in the use of the internet to find resource material and he consistently modeled technology use in his instruction. He stated, "Technology is absolutely essential to the content of their instruction. . . . How can you have legitimacy in teacher training in my subject area if you are not fluent yourself?" Still another faculty member stated that being asked to integrate technology into her course "changed [her] thinking . . . and opened [her] eyes to something different." These quotes reflect the variability in faculty's willingness and commitment to address and model use of technology for prospective teachers.

Securing a PT3 grant brought important human and financial resources to STEP and allowed for initiating, planning and implementing training of faculty and staff. Margaret Krebs, PT3 Director, devoted much time, energy and effort to understand the program well: the needs of teacher candidates and faculty, the STEP context and its curriculum as well as the guiding national and state technology standards. She encouraged and mentored faculty members in using technology. She requested proposals and funded small, technology-related projects connected to the work with teacher candidates. She helped faculty develop action plans, provided workshops, visited classes, and made available subject-specific resources and software applications. She reached out and made connections among STEP faculty and other faculty in the Stanford School of Education involved in other programs such as the Learning, Design and Technology (LDT) master's level program. For example, graduate students from this program made presentations to STEP candidates and provided assistance and feedback on the technology component of the curriculum units developed by the candidates. Ms Krebs also connected STEP faculty and staff with PT3 participants from other universities. She emphasized the importance of this work in the context of STEP meeting specific national and state technology standards for the credentialing of teachers.

These efforts produced important results for faculty and candidates as reported earlier (see Table 2 above). However, interviews also suggested that the barriers to using technology by STEP faculty were similar to barriers facing teachers at the K-12 level. For example, one faculty member commented about the difficulty her students had in gaining access to reliable computers. She stated, "I find it amazing that even at Stanford, computers were failing. I know some of [the students] probably caused the problems because they were novice users, but I had a lot of experienced students and they had problems with the hardware." Moreover, during the early phases of our project before the full launch of our activities, faculty reported that they, too, had trouble accessing rooms with technology in which to teach, as this quote illustrates: "Most of the classrooms I taught in didn't have access to technology. . . at that point, didn't have smart panels, so actually doing any of these things wasn't easy. There were very few classrooms. . . that had the technology in the rooms." Clearly, without sufficient access to technology for both students and teachers, even well-trained, highly motivated faculty will not be able to integrate technology effectively into instruction.

Although the PT3 project offered resources and training opportunities for faculty, some faculty reported scheduling and time constraints as challenges to taking advantage of these opportunities. As one faculty member stated in an interview, "It takes a long time to learn this stuff." Another agreed: "I went to one of the summer workshops, but . . . it was right before we had this intensive class. I couldn't afford the time.. timing was bad." The project also provided valuable ongoing support for faculty. One faculty member stated that her ability to integrate technology into her course "wouldn't have happened to the extent it did" without PT3 support which she called, "a godsend" because PT3 staff "kept things moving." Other faculty members, though appreciative of the efforts of the PT3 staff, felt that even more subject-specific support would have made a difference, as this quote illustrates: "[One PT3 staff member] was interested in finding technology for teaching [my subject area], but she didn't find a lot. If there are things out there that would be great for teaching [my subject area] that I don't know about, it would have been great to have more support finding them."

Constraints on time and work capacity were also concerns of faculty members in teaching teacher candidates how to use technology. One faculty member explained, "We have such limited time in teacher education. You constantly have to make choices. What is the most important thing to prepare people to go out and teach? . . . When you ask students to do something and you know that they will encounter frustration, I weigh that. They are already over stressed, so think really carefully about the value." Another faculty member agreed, stating, "To use any of those [technologies] meaningfully is a huge investment of time." Despite this, however, the faculty member recognized the necessity for these types of assignments, stating:

"On the other hand, if they don't make the investment of time there is never going to be a chance for them to do it in the classroom. So, I can see the wisdom in [the technology requirements]."

A case study from the Science C&I

We describe in more detail the experience of the Science C&I because Dr. Susan E. Schultz, one of the authors of this chapter, served as the instructor for the three-quarter sequence during the period of the project. This case study illustrates how a specific application was infused in the course and how candidates documented the impact of its use on their teaching and their students' learning.

After considering a number of computer-based tools, Dr. Schultz selected Probeware by Venier as an appropriate technology resource for use in her science methods courses. Probeware used with laptops enabled teachers and students to investigate a variety of topics that were not easily understood through direct observation. For example, it enabled students to replicate data that were unachievable by conventional laboratory techniques, such as detecting motion or monitoring heart rate, thus bringing real-world problems into the classroom. Teacher candidates learned how to use the new technology to augment the teaching of science and developed lessons in collaboration with their cooperating teachers at the school sites. The teacher candidate/ cooperating teacher team applied the technology in their science classrooms and with their students. Students engaged in meaningful work and learned first hand how to collect and analyze data and how to use technology to compare and interpret their data. The "real world" nature of this work served as a powerful way to engage students in a truly authentic gathering of data over a period of time. Ultimately, teacher candidates investigated, evaluated and produced curricula and teaching models that utilized a collaborative system combining the resources and goals of teacher education programs and local high schools.

Schultz conducted a study to examine how the 19 teacher candidates in her class used computer-based technology to enhance their teaching and the influence of this technology on high school/middle school science students' learning. The two guiding questions for the study were: (1) How did the candidate design a lesson integrating this technology and evaluate the effectiveness of the lesson to support powerful teaching? and (2) How did technology support student learning in the content area?

Sources of data for the study included candidates' lesson plans, reflection papers, samples of student work, videotapes of the lessons, and interviews. Data analysis focused on the effectiveness of using Probeware to create learning opportunities and the impact of technology on student learning**.**

In her evaluation of this intervention, Schultz (2003) found that STEP teacher candidates successfully designed and implemented lessons using Probeware to teach specific content to students. Types of probes used in the teacher candidates' lessons included motion detectors and photo sensors in Physics; temperature, conductivity, and pH probes in Chemistry classes; and EKG probes in Biology/Physiology classes.

Not surprisingly, in their interviews teacher candidates identified scarcity of time, collecting and organizing equipment, piloting the lessons, and preparing students to use the technology tools as some of the biggest challenges. An additional challenge was the necessity to teach students supplemental information to understand what the probe was measuring and how the collected data related to the lesson. A typical example was captured in a candidate's quote, "In terms of the technology, the most difficult part was for me to take freshmen and sophomores with little experience and understanding about cardiac health and fitness and make the EKG a useful tool for students because it's a very complicated measure, in terms of where you put the leads and how you read it, and what it really means."

When responding to prompts about how the use of technology enabled them to teach, demonstrate, or illustrate a specific concept, teacher candidates' most frequent responses focused on the use of instrumentation by field scientists, the ability to detect and collect a measurement not normally captured by traditional labs, display of a graphical representation of data, and the ability to store data collected from field sites to be analyzed later. The following response by a candidate focused on the ability to detect and collect a measurement, "The main part of the technology we used was photo-gates into the computer to capture velocities of actual matchbox cars. And you couldn't have done it with a stopwatch because they were just traveling too quickly and it wouldn't have been accurate enough. So, it was really essential for them to get the points of the motion in the X-Y direction."

Candidates were uniform in their evaluations that the use of technology helped students understand the relevance of the content being learned and how it could apply to everyday situations A typical candidate's response was as follows, "With the technology, it is a really powerful demonstration that these physics equations actually work in real life to predict real-life outcomes. I think that's really powerful for them and it wouldn't have happened without accurate timing." Candidates' perceptions were supported by communications with the cooperating teachers who felt that the high school students now had a better grasp of the content than students in previous years. After observing the use and the impact of probeware on student learning, five cooperating teachers asked to learn more about this new technology. Margaret Krebs and Susan Schultz organized a series of workshops for these teachers and additional ones from their departments focused on probeware. The workshops, supported by staff from Jasper Ridge, a biological preserve located on the Stanford campus, brought together STEP faculty, cooperating teachers, biologists and additional teacher candidates. After their initial skepticism towards technology in the classroom, these teachers became ambassadors and later mentors to other science teachers in the departments. Ultimately, more high school students gained access to investigating scientific concepts through the use of probeware.

In response to further interview questions, most of the candidates (80%) also reported higher levels of engagement with all portions of the lesson and a "feeling" of increased student motivation. This is captured by the following quote, "In terms of students having a higher level of motivation, I don't have a measure of it, but I had a sense of it and you could sense the environment in the classroom, which was, I think the students were pretty excited to do this lab, there's a lot of activity…The students were really involved in it."

Assessing student learning revealed the largest variation in candidates' responses. About two thirds of the candidates felt that they did not adequately capture what students knew and were able to do using their selected assessment tools. As one of them said, "I don't think I did a very good job of assessing their learning, because I didn't know what the hell I was doing yet. So, I don't know if I have a really good feel of how much they really understood it. They did well on completing the lab packet. And they did pretty well on a traditional quiz on it. I'm not sure how effective it was unfortunately, because I didn't – I didn't do a very good job of assessing their knowledge."

Other candidates (37%) talked about formal and informal methods of assessing what students knew and were able to do. One candidate said, "The technology portion of the lab was very effective. The graphs that students produced were accurate and if correctly analyzed could teach them all they needed to know about phase change. Interacting with students and asking them to explain the unusual shape of the graph I could informally assess their understanding of the lab. Most students could identify the point where the last of the ice melted as the point where the slope changed the first time and that the water started to boil when the curve reached its final plateau."

Sustainability

Like with all externally funded projects, sustaining activities at the original level of implementation is difficult to achieve. However, the Stanford School of Education has shown its commitment to continuing to integrate technology in the teacher preparation program by creating a staff position to support faculty and candidates in their uses of technology. The program continues to pay significant attention to the infusion of technology in both the university- and school-based curriculum. Uses of technology have become routine parts of the way the program functions and the way it prepares candidates. We are also continuing to raise funds for more projects that focus on technology.

The original grant allowed the STEP faculty, students and its partners the opportunity to dialogue, experiment and reflect upon effective methods of integrating technology into a teacher education curriculum. As the STEP faculty and staff began to explore what effective integration of technology in teaching looks like, it became more and more apparent that the next step in deepening this connection rested in partnering with discipline-based colleagues in other schools and institutions that could offer resources and training in content-specific applications of knowledge and technological tools. The significance of these efforts is the removing of walls that sometimes separate certain fields of study and practice, and the opening up new avenues for partnership and cross-disciplinary models for teacher education and preparation.

References

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