Supporting Technology Integration in STEM Teacher Preparation:
Case Studies from across California State University Campuses

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Dedication

This publication is dedicated to Dr. Penelope Walters Swenson, Digital Ambassador from California State University, Bakersfield.

A visionary, a pioneer, and a champion for educational equity, Penny inspired us to be our best, and we will each carry forward her vision and passion.
Introduction

Within higher education, and specifically within the California State University system, a commitment to promoting faculty development as an ongoing, incremental, and cumulative process is essential. Unfortunately, the traditional model of professional development within higher education, and even in most K-12 settings, often relies on a one-shot workshop model (Desrochers, 2010) that is usually ineffective in supporting transformation of pedagogical practices. As faculty, we believe that one of the most effective models for professional development is the Faculty Learning Community (FLC) (Cox, 2004), in which faculty members create targeted spaces of support for their peers to learn about innovative and emerging practices on their respective campuses. The Faculty Learning Community then has the dual ability to create faculty leaders on individual campuses, helping to transform higher education across a system such as the CSU, based on an expanding network of engaged faculty. This duality is essential because today’s educators are required to be lifelong networked learners; for faculty, being connected to our local colleagues and our system-wide colleagues allows us to pursue lifelong partnerships with knowledgeable experts, skilled practitioners, and valued peers that a robust state-system like the CSU provides.

The Digital Ambassador Program was initiated as a system-wide FLC whose central focus was to transform teaching and learning within Science, Technology, Engineering, and Mathematics (STEM) disciplines and teacher preparation programs through the increased use of emerging technologies. With support from the CSU Chancellor’s Office and Google, the Digital Ambassadors were charged with designing and piloting professional development opportunities on their respective campuses, building bridges between educational stakeholders across the campus and local K-12 communities, while sharing best practices and strategies within the FLC. Within these three areas, we were to: raise awareness of the value of educational technologies within standards-based classroom practice; tailor strategies that engaged and inspired teacher candidates, colleagues, K-12 educators, and university leadership; and function as centralized resources for our respective academic communities.

The Digital Ambassador (DA) project is the first of its kind, as it is focused on developing cases of digital applications in teacher preparation that specifically address the Common Core State Standards in Mathematics (CCSS-M; http://www.corestandards.org/Math) and the Next Generation Science Standards (NGSS; http://www.nextgenscience.org/). The processes

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1 Within current professional development initiatives in higher education, the faculty learning community (FLC) is a phrase used to describe cohort and topic-based peer networks. Within K-12 settings, the most common phrase used to describe similar peer-networks is a professional learning community (PLC). We realize that there are connotations attached to both acronyms. In an effort to be inclusive of our K-12 partners, teacher preparation faculty, and staff, we use both phrases interchangeably in this paper.
developed and lessons learned in carrying out the program have significant implications for the many universities across California and the nation that prepare teachers. The DA project models approaches for preparing faculty to advance technology and pedagogical content knowledge for future STEM teachers. The unique positioning of Digital Ambassadors as peer-based leaders allowed us to be mentors, innovators, project leaders, and liaisons over the course of the academic year. In this article, we highlight exemplars of faculty development and educational technologies and reflect on the creation of our professional network.2

Context: Digital Ambassadors and the Faculty Learning Community

The thirteen Digital Ambassadors3 who participated in the Faculty Learning Community (2012-2013) all worked within the field of STEM Education, holding a position in either a College of Science or Education at a CSU campus. Nine College of Education faculty members were experts in either mathematics education, science education, educational technology, or educational leadership. Four faculty members were from Colleges of Science and experts from mathematics, geological sciences, chemistry, or biology. The ambassadors represented 13 of 23 CSU campuses and were distributed across multiple regions of the state: San Francisco Bay Area, Central California, and Southern California; six were from small campuses (85-300 FTE), one from a medium size campus (300-600 FTE), and six were from large campuses (600+ FTE). The Digital Ambassadors were at different stages of the tenure process, with five at the rank of assistant professor, four at the rank of associate professor, and four at the rank of professor.

Across the 13 campuses represented by the Digital Ambassadors, academic technology leadership and support varies greatly. Some campuses have a robust Academic Technology unit that takes into consideration and supports the many teaching, learning, collaboration, and assessment uses of technology. However, other campuses have less vision, leadership, and resources dedicated to help faculty effectively leverage technology across the many aspects of their teaching, research, and service duties. In these cases, instructors are left to self-develop on limited department resources. This often leaves the faculty member to work in isolation, causing frustration and discontent. Further confounding the situation, faculty teaching and research responsibilities related to the retention and tenure process (RTP) do not usually reward or acknowledge efforts in faculty development with technology (Swain, 2004); as such, to learn about new technologies is to engage in “invisible work” that is done on top of all the regular responsibilities (Kanstrup, A.M., 2004; Nardi & Engeström, 1999). The Digital Ambassador program, then, provides a much-needed pathway with incentives and recognition for faculty who want to develop and coordinate targeted professional development opportunities based on the needs and expertise of their colleagues.

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2 Excerpts from the Digital Ambassadors’ Cases of Innovative Digital Applications are included in this paper.
3 Appendix A lists the CSU Digital Ambassadors for the 2012-2013 academic year.
Digital Ambassadors’ Faculty Development Activities

The Digital Ambassadors met monthly online via Google Hangout and Blackboard Collaborate to coordinate efforts, share best practices, and discuss important events and opportunities. Additionally, Ambassadors facilitated smaller Google Hangouts to brainstorm ambassador activities and discuss key topics and timely issues in teacher education, including NGSS standards, online learning, and massive open online courses (MOOC); these discussions took place roughly twice a month and participation was voluntary. On each CSU campus, the Digital Ambassadors designed and implemented customized activities and events for faculty and local educational stakeholders. Table 1 outlines these activities and events.

Table 1: Summary Table of Digital Ambassador Activities and Events

<table>
<thead>
<tr>
<th>Activity or Event</th>
<th>Definition</th>
<th>Population Served</th>
<th>Digital Applications Utilized or Discussed</th>
</tr>
</thead>
</table>
| **Formal Needs-based Assessment**  
(N=4) | Using survey instruments to determine the needs of a department, school, or population | Faculty in Education or College of Science | ● Survey Monkey  
● Qualtrics  
● Google Forms |
| **Technology Workshop**  
(N=6) | Offering a workshop for a specific digital application or practice; the workshop’s focus is on learning a new tool or practice | Faculty, teacher candidates, and K-12 educators | ● Media production  
● Cloud-based resources such as Google Docs  
● Screen capture  
● Specific apps for iPads  
● LMS support  
● Presentation tools  
● Flipped Classroom model of instruction |
| Study Hall or Working Lunch (N=3) | Creating a space for educators to come together and focus on specific needs, concerns, or ideas; space is designed to allow focus of the informal gathering to come from the group | Faculty in Education or College of Science | • Cloud-based resources such as Google Docs and Dropbox  
• Screen capture  
• Specific apps for iPads  
• LMS support  
• Presentation tools |
| Change in Syllabi, Classroom Lesson or Lab (N=9) | Assisting faculty with changing a specific aspect(s) of a lesson, lab, or syllabus in order to promote the adoption of digital applications | Faculty in Education or College of Science | • Coding applications  
• Cloud-based resources such as Google Docs  
• Specific apps for iPads  
• Presentation tools |
| Departmental Meeting or Retreat (N=3) | Using a faculty meeting or retreat to discuss digital applications and digital ambassador activities | Faculty in Education or College of Science | • Google Docs  
• Inspiration software  
• iPad applications |
| School-wide or Campus-wide Technology Challenge or Showcase Event (N=7) | Coordinating a major school-wide or campus-wide event related to teaching and learning with digital applications | Faculty, teacher candidates, and K-12 educators | • Cloud-based resources such as Google Docs  
• ePortfolios  
• Media production tools  
• Specific apps for iPads  
• Presentation tools  
• Flipped Classroom model of instruction |

Pedagogy Enhanced With Technology for Educational Reform (PEWTER)
The education sector has embraced the concept of FLC to support teachers’ professional development in individualized and low-cost ways. The FLC concept is one that was embraced at two campuses: California State University, Northridge (CSUN) and California Polytechnic State University, San Luis Obispo (Cal Poly-SLO). Dr. Matthew d’Alessio, CSU Northridge, created the PEWTER acronym to describe the initiatives he developed on his campus following the Google Faculty Institute in August 2011. He developed the “PEWTER Plate Lunch series” that acted as a study hall for any faculty member in the College of Science and Math and offered a catered lunch and chance to win an iPad. Their mission is to implement course changes with the assistance of the lunch organizers and their colleagues. Twenty-five full time faculty and five part time faculty attended for a total of about 130 person-hours of training, with more than half of the participants attending three or more sessions. The PEWTER website they developed offers a helpful overview of the program and many resources they created and shared. This program was particularly successful in light of some of the challenges Dr. d’Alessio notes below.

CSUN has a superb faculty development program; it is well respected and well executed, but there is a problem. Science and math faculty rarely attend Faculty Development-sponsored events. Within a two-semester period, only six science and math faculty attended Faculty Development events and none attended more than one; science & math faculty attend at a much lower rate than their colleagues in other Colleges. Our first PEWTER Faculty Study Hall attracted more faculty from our college than an entire year's worth of Faculty Development at the university level, and a great fraction of our attendees return for multiple sessions. In total, more than 20% of our College's tenure-track faculty attended. Perhaps surprisingly, the majority (60%) are tenured. I am proud of the commitment of our faculty to improving their teaching.

--Dr. Matthew d'Alessio

California Polytechnic State University, San Luis Obispo (Cal Poly-SLO) decided to build on the successes of Dr. d'Alessio’s work and developed a Digital Ambassador program around the PEWTER concept with a Professional Learning Community (PLC) at the core of the project in the fall of 2012. With Dr. Liz Meyer as facilitator, the PLC met three times in the fall and twice each in the winter and spring terms. The PLC combined a 20-minute “showcase” of a current example of technology integration and then 30 minutes of workshop time for attendees to ask questions, play with tools, or develop their own new technology implementation lesson. We developed the Cal Poly-PEWTER wiki to document the showcases and resources shared during these sessions. Some of the challenges experienced at Cal Poly-SLO included: identifying a meeting time that accommodated the schedules of everyone interested, recruiting faculty to showcase their current uses of technology, and getting the presenters to post highlights of their presentation on the wiki.

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4 Appendix B outlines the faculty projects funded by Google through the Google Faculty Institute (2011-2012).
Surveys

California Polytechnic State University, San Luis Obispo
At Cal Poly-SLO, Dr. Meyer created a SurveyMonkey instrument (with questions adapted from the Technology Implementation Questionnaire from Wozney, Venkatesh & Abrami, 2006). Thirty-five faculty affiliated with teacher education programs were invited to complete the survey and everyone who participated was offered a $15 Amazon gift card. Nineteen individuals completed the survey and most of them indicated a strong interest in using technology for personal and instructional purposes. The most common uses of the learning management system (LMS) Moodle, which is called PolyLearn, included posting readings and lecture notes on the course site and communicating course updates through emails and forum posts. The least used tools included quizzes, wikis, and rubrics or marking guides. The technologies most frequently modeled in courses included web research assignments and presentation software such as PowerPoint, Keynote, Google Presentation. Social Media and interactive software were integrated the least. Participants were also asked what objectives were being targeted with technologies in their courses, and how often. The most frequently used forms were communicative, expressive, and informative. Creative and analytic purposes were targeted by some, but not used regularly during the quarter. Although this survey gives a helpful overview of the ways technology is currently being used by a portion of our faculty, this does not give us a good understanding of the needs and interests of the sixteen people who did not respond and who may need greater support to integrate technological tools into their teaching practice.

California State University, Northridge
CSU Northridge also conducted a survey to help evaluate the impacts of their program. The images below provide a snapshot of some of the issues they were trying to address through the PEWTER Plate lunches program targeting STEM faculty. They were trying to meet the needs of STEM faculty and provide an opportunity to implement ideas for course innovation and reform with an emphasis on integrating new technologies. Their findings indicate that the lunch sessions did appeal to STEM faculty due to the specific STEM focus, and the support provided by the organizers and other colleagues present did allow participants to accomplish their goals.
Figure 1. Who attends traditional University-wide Faculty Development sessions at CSUN?

Figure 2. From whom do teachers get help during the study halls?
Sonoma State University
At Sonoma State University, Dr. Jessica K. Parker conducted a survey of faculty needs based on Dr. Meyer’s SurveyMonkey instrument. Twenty-seven out of 31 education faculty affiliated with the teacher education programs completed the survey. Twenty respondents indicated a strong interest in using technology for personal and instructional purposes. Faculty attitudes toward integrating new technologies in their classrooms included: a) being enthusiastic about the positive outcomes of integrating technology and wanting to be a leader in helping to model and coach their students and colleagues to effectively use technology to enhance learning, b) being committed to multimedia literacy as an essential skill and wanting to model effective ways to integrate appropriate technologies in the classroom, and c) being intrigued to explore various approaches in their classrooms. The most common uses of the LMS Moodle included posting readings and lecture notes on the course site, using discussion forums and chat rooms, student submission of files and assignments, and communicating course updates through emails and forum posts. The least used tools included quizzes, wikis, and rubrics or marking guides. The technologies most frequently modeled in courses included web research activities, presentation software such as PowerPoint, Keynote, Google Presentation, etc., and online content and videos such as YouTube, Khan Academy, and iTunes U. Interactive software and social media were integrated the least. Participants were also asked what objectives were being targeted with technologies in their courses, and how often. The most frequent forms were communicative and instructional technologies. Evaluative and creative technologies were targeted by some, but not used regularly during the semester. Recreational and analytical/programming technologies were integrated the least.

San Diego State University
At San Diego State, Dr. Donna Ross collaborated with department committees to conduct and follow-up on a survey of teacher education faculty. The focus of this survey differed somewhat from those at Sonoma State, Northridge, and Cal Poly SLO. As the Digital Ambassador program was beginning, unrelated factors in the College of Education were leading toward the decision to eliminate the Educational Technology course from the multiple subjects (elementary) teacher
preparation program and to integrate the material into other courses within the academic year. The San Diego State survey focused on identifying how faculty members were using technology within their existing courses to better understand how prepared they were to integrate the educational technology content and pedagogy. The questions were developed using the Educational Technology standards for the Commission on Teacher Credentialing. Follow up questions asked faculty members to explain how they addressed the standard or how they could do so. For example: Do you prepare teacher candidates to design lessons based on best practices for the use of technology? If yes, explain in what ways you address the standard in each course and be sure to include the course number. If not, are there ways you might address the standard, and if so, how and in which course?

Twenty-seven faculty members responded to all or part of the survey, including at least one instructor for each of the different discipline-specific methods courses in the multiple subjects program. Results suggested a wide range of comfort with the integration of educational technology into the teacher preparation program. Nearly all of the responses indicated faculty members demonstrate and/or provide opportunities for students to use collaborative, computer-based tools, such as discussion boards or Google Docs. It was also evident that most are comfortable with presentation tools such as PowerPoint. However, the examples provided in the latter part of each question suggested that the technology was more often demonstrated by the instructor than used by the students. Questions asking about student use of technology for particular goals, such as differentiating instruction, had far fewer faculty members reporting early integration within their courses. Following the survey, Dr. Ross asked for volunteers to meet with her and discuss the degree to which they felt prepared to integrate educational technology into their coursework. She spoke individually with seven of the faculty members, each of whom indicated a moderate level of comfort with technology. Two of the seven were confident and ready to integrate the new content into their existing courses. Five of the seven indicated that professional development and additional resources would be necessary to prepare them to adequately shift from modeling technology to a true integration of educational technology pedagogy within their discipline. Three of the faculty members noted they believed it could be a better model to have the educational technology tightly connected with their discipline, but only if they had the tools and training to integrate it well. Based on these findings, current efforts are underway to develop a college-wide program to support technology teaching and learning for all students.

Summary of Survey Responses
The results of the SSU and Cal Poly-SLO surveys suggest that most faculty are motivated to learn about and adopt new technologies to improve instruction and student learning. The use of the learning management systems on both campuses suggests that faculty are making classroom materials and resources accessible. Two activities that could provide more student-based interaction and collaboration and further student learning are the adoption of wikis and rubrics or marking guides; opportunities for faculty to learn about these specific LMS tools and
pedagogical implications are needed. Additionally, faculty seem to be adept at using web research activities and presentation tools in their instruction. Interactive software such as game-based learning and virtual worlds and social media such as Twitter, Pinterest, or Tumblr are two areas in which faculty development resources should be targeted.

**Pre-Service Classroom Activities**

**Tech Minute**
At Cal Poly-SLO, the Digital Ambassador integrated a “tech minute” into a required first quarter course for all Single Subject Credential students titled, *Access to Learning in a Pluralistic Society*. This tech minute required each student to work with a ‘tech buddy’ to develop a 3-5 minute presentation of a free or low-cost new technology that would promote student learning, engagement, or a teacher’s own professional development. Students were placed in heterogeneous groupings by self-reported level of comfort with computers; for instance, students with higher levels of comfort and experience were paired with students with less comfort and experience. Following their presentation, the students then had to post a one-paragraph summary of their tool with a hyperlink to the main page. We are unable to post a link to this wiki in this report as it is a private wiki for the teacher candidates in that program. A sample of the tools that were presented include:

- Edmodo
- Prezi
- Quizlet
- Lesson Plan Builder
- Polleverywhere.com
- Khan Academy
- Free Rice
- Rubistar
- Wolfram Alpha
- PHET
- Docs Teach

**Digitally Enhanced Classroom Project (DECP)**
At California State University, Stanislaus, the Digitally Enhanced Classroom Project (DECP) was both a project and a competition that invited pre-service teacher candidates to foster, develop, and teach an innovative lesson or unit that aligned to the common core mathematics standards (CCMS) or next generation science standards (NGSS) while integrating either a flipped-classroom platform or an application from the web-based suite, Google Docs. The project was developed so that it could be maintained for future semesters enabling: a) teacher candidates to practice the development of innovative lessons that integrate technology, b) faculty
to become exposed to the current trends in classroom technology through student presentations and workshops, and c) faculty to access an online database of video resources that can be used in their coursework with teacher candidates that effectively integrate technology into K-12 classrooms.

The DECP was developed at CSU Stanislaus to address several questions that affected faculty and students in teacher education programs:

1. How well can multiple and single subject teacher candidates in the CSU Stanislaus credential program develop and teach K-12 lessons that integrate specific areas of technology that align with the CCMS/NGSS Standards?
2. How can teacher education faculty at CSU Stanislaus demonstrate and teach teacher candidates to become more familiar with instructional technology that is aligned to the CCSS/NGSS standards?
3. How well can a video database of exceptional teaching (which incorporates technology in alignment with the CCSS/NGSS standards) support teacher education faculty and teacher candidates in their methods courses?

In an effort to address each of the aforementioned questions, the DECP was developed with the intent of having teacher candidates focus on specific areas of instructional technology each year. This year, the project focused on Google Docs and the flipped classroom model because of the versatility each resource provided at both the elementary and secondary grade levels. Google Docs was chosen as an available resource due to its versatility in supporting cooperative learning environments by allowing students to collaborate with each other on the same electronic document in real-time, while giving students experience and practice in using cloud based technology and online resources. Alternatively, the flipped classroom model was also chosen as a possible resource for this year's competition because of its versatility in allowing teachers to develop more constructivist-based classroom practices while students were actually in the classroom, while holding students accountable to more directive learning experiences on their own through instruction that can be accessed online in the form of text, sound bites, or online videos.

At the launch of the program, Dr. Daniel Soodjinda advertised and marketed the program’s details through distributing flyers and creating a website that could be viewed through the CSU portal. Once faculty and students were informed of the project, short presentations were made in all student teaching courses, which invited students to develop lesson plans or units that aligned to the CCMS or NGSS and integrated either the flipped classroom model of instruction or Google Docs. Once students submitted lesson plans for the DECP, each lesson plan was scored by a committee using a lesson plan rubric aligned to instructional technology standards. Based on these scores, the top three teacher candidates, and their respective lessons, were chosen and the students were awarded an iPad. Additionally, the top three teacher candidates were informed
that they would be required to teach their lesson in a classroom in front of K-12 students while it was videotaped. Once all lessons were recorded, the taped lessons were added to a database on the CSU Stanislaus server where faculty can access the resource for their methods courses as a point of reference when discussing instructional technology. Finally, towards the end of the semester, awardees were also asked to present their lesson during a College of Education workshop meeting, where Google Docs and the flipped classroom model of instruction were discussed and demonstrated.

Although faculty involved with teacher education attempt to demonstrate and integrate various pedagogical strategies that involve instructional technology in their courses, resources and experiences with technology are limited and challenging. Budget constraints have prevented the College from purchasing technological resources, such as interactive whiteboards, that can serve as useful tools for students before they enter into student teaching. It is important that faculty understand the scope of resources available to them at their institution, and then decide which tools they would like to integrate. Once resources have been chosen, faculty must also familiarize themselves with resources and model them in various lessons. Additionally, teacher candidates are quite busy during the semester/quarter; it would be beneficial if lessons relating to the DECP were required by instructors of teacher preparation courses, or as a recommendation for a sample lesson used in the Teaching Performance Assessments (TPAs) for the State of California. Finally, once awardees have been chosen, faculty should work closely with teacher candidates and their cooperating teachers to develop effective lessons that support student learning while maximizing technological resources.

Large-Scale Professional Development Events

One way to support faculty development is through a showcase event, digital day, or technology challenge. These large-scale events can support a number of goals including: a) improving faculty collaboration and sharing of existing expertise and emerging knowledge, b) introducing innovative ideas to faculty interested in integrating technology into their teaching, and c) exhibiting best practices in educational technology. Additionally, these events offer an opportunity to invite teacher candidates, K-12 educators, and other local educational stakeholders to present and/or attend. A majority of faculty believe this strengthens their teacher preparation program and their partnerships with local teachers and districts in the service area.

Sonoma State University’s Teacher Technology Showcase
At Sonoma State University’s (SSU) Teacher Technology Showcase event (2012), faculty presented alongside in-service teachers and teacher candidates in the first phase of their program. Since the focus of a showcase can be tailored to a specific concept or theme such as pedagogical practices or student learning, the presenters at SSU shared how they have used or plan to use technology in their classrooms. The showcase event was then framed as an informal gallery walk
in which everyone was a learner, thereby encouraging faculty, teacher candidates, and in-service teachers to share their ideas and inspirations.

Examples of showcase presentations from SSU included a middle school science teacher using Google Maps to highlight plate tectonics and numerous earthquakes; a teacher candidate in social science employing a Flickr gallery to analyze Russian propaganda during the Cold War; and a high school math teacher using Google Earth to have students learn about the Pythagorean theorem by measuring distance. Faculty found the showcase to be “fabulous” and a “tremendous success.” Dr. Karen Grady commented, “(The Showcase) supported our school partners and School of Education faculty in being smart and deeply thoughtful about integrating technology in teaching.” The event has become so successful (see Figure 4 below) that it is now an annual event that requires the School of Education to reserve one of the largest venues on campus to hold the growing number of presenters and attendees.

The logistics of running a large-scale event requires an intense amount of time, energy, and communication. It is helpful to gain support from campus administrators and ask for assistance from colleagues in order to plan, implement, and evaluate the event efficiently. SSU also benefitted from the participation of local educational organizations (e.g., Google; KQED, a local-PBS affiliate; and Edutopia) as they partnered with the School of Education and provided giveaways and increased visibility for the event.

These resources provide more information about Sonoma State’s most recent Teacher Technology Showcase (2012):

- Video of the Showcase
- Program for the Showcase
- Flickr photostream of the Showcase
- In the News: Teacher Technology Showcase at SSU
Figure 4: Infographic based on the presenters and attendees of the Teacher Technology Showcase at SSU in December 2012. Infographic designed by Pamela Van Halsema.
California State University, Bakersfield’s Google Symposium

At California State University, Bakersfield (CSUB), Dr. Penny Swenson coordinated a CSUB Google Symposium in which teacher candidates shared their geospatial learning objects projects with faculty and colleagues. Geospatial learning can assist students with chronological and spatial thinking, such as comparing the present with the past, analyzing change at different rates at different times, and interpreting human movement through patterns of migration. Fifteen candidates from the Edvention Fellowship Program developed a Google Earth learning object and a technology infused, standards-based lesson plan. To prepare students for this project, Dr. Swenson facilitated Google Earth and LitTrip workshops as well one-on-one sessions. She created rubrics to evaluate the learning objects and lesson plans, and she provided feedback and guidance for students to create a product worthy of presenting.

“The geospatial project has impacted my outlook on student learning and motivation in ways I never thought possible. The project challenged me to create a technology-based lesson that would accommodate different types of learners. I then used the technology I learned through this project, including Google Earth, throughout my student teaching and in my own classroom today. Most of the students I have worked with are English Language Learners. As a firsthand witness, I can safely say that the iPad facilitated student motivation and dialogue in the classroom. By putting the iPad into my hands, Dr. Swenson equipped me with a powerful teaching tool that has transformed the manner in which I engage my students.”

--7th Grade English Teacher

CSU Bakersfield and the School of Social Sciences & Education will continue to support the work of Dr. Swenson. Starting in fall 2013, all credential students will have an opportunity to participate in Google Earth workshops.

These resources provide more information about CSUB’s Google Symposium (2012):

- Teacher candidates’ [geospatial lesson plans](#) and learning objects
- [Photo gallery](#) of the event
- Google funded [BirdsEye Detective Project website](#)

Sonoma State University’s Tech Infusion Challenge

As part of Sonoma State University’s ongoing effort to improve student learning for all, the School of Education launched its first Tech Infusion Challenge in fall of 2012. Coordinated by Dr. Sandy Ayala, teacher candidates and graduate students partnered with one Education faculty member to collaborate on developing a technology-infused learning activity or lesson. The focus of the challenge was to use digital technologies to enhance explanations of a concept, illustrate a topic, or deepen students’ understanding of subject matter.
Lessons were judged by a panel comprised of Digital Ambassadors and local education partners. Judging criteria for the learning activity or lesson included:

- **Content** – The importance of the content for student learning and if the principle goals and objectives are supported through the use and application of the technology.

- **Pedagogy** – Choice of teaching method and if the goals for Universal Design for Learning (UDL) are reflected in the use and application of the technology. UDL is an approach to learning in which curriculum designers have considered the scope of students’ abilities and learning styles. Are students given the opportunity to engage in and synthesize the material through technology?

- **Technology** – 1) Innovative use of technology including (but not limited to) the use of video, audio, graphics, tablets, handhelds, Internet, virtual reality, and desk/laptops. 2) Does the technology enhance and extend student engagement with the material?

- **Presentation and Collaboration** – Is the lesson high quality, clear, engaging and easily understood? Is the level of collaboration between faculty and student partners reflected in the final product?

- **Assessment** – How is student learning evaluated (through the use of technology within the lesson or beyond the use of technology in the lesson)?

- **Accessibility** – Have accessible features been considered and/or provided for the lesson?

Four groups of students and their faculty collaborators were recognized for their work on revising lessons in both credential and graduate courses. Rachel Marshall, a special education teacher candidate, and Dr. Jessica K. Parker won first prize ($600)\(^5\) for their revised lesson using Google Draw to analyze the social and emotional growth of the students in Danling Fu’s (1995) ethnography, *My Trouble is My English*. Sam Thurston, a special education teacher candidate and Dr. Paul Porter won second prize ($400) for their revised lesson using mind mapping applications such as Popplet and Inspiration to promote legal protocols for specific educational issues. The third place prize ($300) was a tie: Kristina Manuselis, a graduate student in early childhood education, and Dr. Chiara Bacigalupa won for their revised lesson that included developing a Jeopardy game-presentation to support videatives on how children use play to learn, while Alex Templeton and Lisa Park, both graduate students in Teachers of English to Speakers of Other Languages (TESOL), and Dr. Karen Grady won for creating digital jumpstarts (Rance-Roney, 2010) using Voicethread to promote academic reading and language development.

Teams Enacting Classroom Innovations Symposium, California State University, Fullerton

The Teams Enacting Classroom Innovations (TECI) project, coordinated by Dr. Cherie Ichinose, recruited and supported teams of teacher candidates and mentor teacher(s) in the development and implementation of short curriculum modules (typically 2-3 days) that integrated technology-rich innovations to support student learning of mathematics through reasoning and sense making.

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\(^5\) All award monies went to students, not faculty.
The TECI Symposium participants created a multimedia slideshow that included the following elements:

1. How does the lesson align with a larger curriculum unit and California math standards?
2. Learning activities: What was planned and why? How did technology support and enhance student learning?
3. Data about student engagement and student outcomes: What kinds of evidence did you collect that highlights students’ process and what they learned? Include examples of student work (e.g., scanned images, audio/video recordings).
4. Innovations, challenges, and lessons learned: How is the revised curriculum module different from a traditional approach to mathematical reasoning and sense making? What did not go as planned? Why? Based on what you learned, what will you do differently next time?

Teacher candidates made use of the Popplet, PowerPoint and SlideRocket presentation software and GeoGebra in their lessons. GeoGebra is a dynamic interactive geometry, algebra, statistics, and calculus software. Lessons included GeoGebra to make discoveries of basic and more advanced Geometric properties. For example, one teacher candidate wrote:

“GeoGebra allowed the (secondary) students to understand that the Pythagorean Theorem is more than just a formula and it was derived from geometric shapes and area. GeoGebra engaged the students and allowed them to manipulate the right triangle to show them that it works for all right triangles. It also allowed them to see that the Pythagorean Theorem does not work for non-right triangles by using counter examples.”

Finally, teacher candidates created video tutorials, in the style of Khan Academy videos, to share with each other via YouTube.

Combined Pre-Service and Faculty Development Activities

Science and Technology Showcase, San Diego State University

Bringing the educational community together and showcasing remarkable science education and technology accomplishments were two of the goals this year for San Diego State. One of the most motivating methods for achieving these goals was the showcase event hosted twice by Dr. Ross. In both instances, she invited local, urban high school students to come and share their favorite uses of technology from their secondary science classes. The audience for the first showcase was exclusively university students in the teacher preparation program, but for the second showcase university students, faculty members, local teachers, and a few community members were in attendance. The showcases by the high school students were approximately an
hour and were connected to a networking and social time. Food was served and participants had the opportunity to share ideas during the informal portion of the evening.

The high school students were invited to choose their own examples and develop their own presentations on the use of technology in learning science. During the presentation period in each of the two showcase events, the high school students showed science movies they had edited including a rap music video, several narrated screencasts, a Google Earth assignment, a Google map tour, and examples of how they have used Polleverywhere.com, StoryBird, Voki, Quizlet, greenscreens, Lego Mindstorms, Wordle, Google Spreadsheets and Forms, Popplet, Educreations, and more. An audience favorite was a narrated screencast of facilitated diffusion in which the students adopted accents and urban slang to describe the scientific process as an animation played on the screen. Here is short video of one of the showcase presentations.

Viewing the enthusiasm and comfort level of the high school students as they used the technology, inspired faculty members and teachers stated,

“I know you told us the kids could do this, but I didn’t really believe you. It was awesome.”  --Pre-service teacher candidate

“(The high school students) were so articulate and capable with the technology. It just shows me that I need to transfer more of the responsibility to the students. You have inspired me to try some new things. Thank you.”  --Local teacher

“I guess we need to step up our game if the high school kids are already doing all of this!”  --Faculty member

Although there are additional logistical issues related to connecting the large events with the broader community, the rewards made it worthwhile. The presenters, urban high school students in this instance, were very proud. The local teachers viewed the university as a relevant, accessible partner for new ideas. And, most importantly, everyone who watched the Showcase was convinced that this integration of science and technology was exciting, educational, and realistic for urban high school girls. Following the first Showcase, Dr. Ross never again had any of the attending teacher candidates doubt that the K-12 students were capable of using technology in their science classes.

Transforming Teaching and Learning Through Technology (T2L2T), California State University, Long Beach
At California State University, Long Beach, a professional development activity for STEM pre- and in-service teachers includes enrolling in a hybrid course designed to transform teaching and learning through technology (T2L2T). During the T2L2T course, teachers learn to identify technologies that align with their fields of interest, develop and refine ways of using these
technologies in their teaching, and then begin integrating the new technologies into their classrooms. The course emphasizes the use of free software and Open Educational Resources. It utilizes a set of videos from innovative thinkers in the field, as well as extensive resources including science and math resources from the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) platform. It also strongly encourages collaboration and utilizes social networking tools for peer collaboration and networking. Importantly, the course serves not as an endpoint for instruction but as a catalyst for change—change that includes ongoing teacher professional development practices and peer support. The overall program is part of a long-term vision to develop sustainable online professional learning communities throughout California that will encourage teachers to become innovative leaders in the use of technology in STEM instruction.

At California State University, Long Beach, Dr. Stephen Adams piloted the Transforming Math and Science Teaching and Learning through Technology course in spring 2013. Twenty-one teachers were enrolled in the course, seven from grades 4-6, seven from grades 7-9, and seven from grades 10-12. In the 3-unit course, participants learned about pedagogical innovations in math and science teaching using technology by reviewing theoretical perspectives and best practices; planned, implemented, assessed, and refined technology-based and standards-based lesson(s) in math and science teaching; and used Internet and social networking tools for ongoing professional learning. Assignments in the course, according to Dr. Adam’s syllabus, included setting up personal learning networks, engaging in webinars and online discussions, researching promising resources and strategies for integrating technology, and implementing, testing, and evaluating a lesson project in their own classrooms and collaboratively writing up the results using Google Docs.

Specific examples of the lesson plans that teachers tested in their classrooms included:

1. **Force and Motion**: A group of four middle and elementary teachers collaborated on a project in which 8th graders created videos to teach 3rd graders concepts about the physics of motion. They used Aurasma software with an iPad to bring science vocabulary to life.

2. **Earth science**: Two teachers used an online geology lab together with Google Forms to assess students’ learning. Teachers reported that using Google Forms provided more rapid assessment than is possible with conventional methods. They made a video discussing their project using Google+ Hangouts.

3. **Mobile audience response systems**: A group of four teachers collaborated to use a mobile audience response system in multiple subjects and grade levels. They used the Poll Everywhere system in which students respond to teacher questions using cell phones or computers. The responses are then immediately aggregated for the teacher. For example, a middle school teacher created a project in which students formulated their own research
questions and designed their own online surveys to answer them. In order to create the surveys, students first needed to create testable hypotheses. The teacher found it was challenging for students to create their own testable hypotheses. He used the mobile response system to guide students through a series of steps in which they practiced formulating testable hypotheses.

This pilot demonstrates a variety of pedagogical innovations created by teachers. The teacher-created projects discussed above were all successful in that teachers covered new ground in using technology in teaching in STEM subjects. The pilot validates the overall approach taken, including the emphasis on teacher collaboration. For future efforts, one piece of advice would be to form courses like this to include groups of teachers who share a common interest or work at the same school. That said, teachers reported they also found it valuable to interact with teachers at different grade levels.

Los Angeles Urban Teacher Residency, California State University, Los Angeles

At California State University, Los Angeles (CSULA), one of the most innovative programs has been the Los Angeles Urban Teacher Residency (LAUTR), which is a program where teacher-residents complete their secondary credential in mathematics or science as well as their Master’s degree in Education in fourteen months. LAUTR is a collaboration between CSULA, The Center for Collaborative Education (CCE), and Los Angeles Unified School District (LAUSD). Dr. Sabrina Mims-Cox has assisted the LAURT program with enhancing collaboration and communication through the innovative use of Taskstream and Moodle. Since LAUTR is a collaboration among a variety of individuals, some from the university, some from the school district, and others from the Center for Collaborative Education (CCE), a challenge has been to provide access to the same tools for program management and assessment. Moodle is open to university faculty, but not to the school district. Dropbox and Google Docs are open to all, but not easily adapted for program management and assessment purposes. Through Taskstream, we have been able to create a system that is accessible to all stakeholders for program management, evaluation, and assessment.

Teacher-residents are able to upload their coursework to Taskstream, and it can then be evaluated by district personnel such as mentors, university field supervisors, LAUTR program staff, and faculty members. Each stakeholder now has access to assessment rubrics and student work, and this has helped with calibrating scores. In addition, the field component of the teachers’ residency is also being managed on Taskstream. Communication between key personnel in the field assignment such as the mentor teacher, university supervisor, field director, induction director, and school principal, has been streamlined. Another promising component is that the school district and LAUTR personnel have access to all of the Taskstream resources for their own classes and programs, including lesson plan and rubric builders, standards, and online support.
The LAUTR Program has also been developing and collecting signature assignments for its credential and Master’s coursework. Two portfolio templates were designed on Taskstream to allow teacher-residents to upload their signature assignments and build their e-portfolio. A digital video library is also being planned for the 2013-2014 academic year which will also be accessible to all stakeholders through Taskstream.

**Small-Scale Faculty Development Activities**

From our perspectives as Digital Ambassadors, the most commons reasons for faculty to not engage in professional development opportunities are often due to a “lack of time” or “scheduling conflicts.” Although these responses point to a systemic problem within higher education and the teaching profession in general, it is possible to provide faculty with small-scale activities that are relatively easy to implement and low in cost. Plus, these activities are a wonderful alternative to the traditional skill-based workshop model.

**Technology Tips and Tools Email Communications at Sonoma State University**

Email communication is a driving force on many university campuses for it allows administrators, faculty, and students to quickly and easily send a message to the masses or a tailored response to individuals. It is common to find a faculty member’s inbox completely full during the academic year. Although adding to the massive number of email messages with a tech tips and tools email might seem counterproductive, a “technology tips and tools email” is quite informative since faculty can choose to read, ignore, and delete the email without being judged for their decision or lack of response. Because the email can be framed as a voluntary endeavor for faculty, the communication can provide timely tips and tools from a trusted colleague or internal source and be sent every other week to not burden faculty inboxes.

At Sonoma State, Dr. Parker sent out a biweekly email to her colleagues via the school’s listserv that included three different tech tips or tools. The email was then posted on the school’s website to ensure that if faculty deleted the email, the information was housed online. Faculty were invited to share their own tips and tools with Dr. Parker and she included ideas from informal conversations in these email communications as well. Here is an example from spring 2013:

*What's one of the best things about living in the digital era? With access to the Internet, we can all be authors! This wasn't always the case. I grew up a consumer and I watched TV and listened to the radio. The only things I created were mixed tapes and video recordings of athletic events. Today, youth grow up as prosumers, both consumers and producers. Why not capitalize on this by having students create media texts! Here are three powerful tools that students can use to author their own content and demonstrate understanding.*
1. **Storybird**: Storybird is an online collaborative storytelling tool that gives users the ability to read, create, and share books online using original art and their own writing ideas. Students can make visual stories with artwork from illustrators and animators around the world! Storybird can inspire anyone to turn images into narratives. Want to learn more? Here is a [digital handout](#) on Storybird designed by School of Education Master's students Kristina Beltz and Carol Wise (and inspired by Educause’s 7 Things You Should Know About).

2. **Capzles**: Curate your own multimedia presentation with images, audio, and video with capzles! Dr. Carlos Ayala is using capzles to have his students discuss important historical events in education.

3. **Jing**: Use Jing to take free screenshots or make screencasts. Have credential students annotate aspects of student work or images of their classroom walls. Have math students talk through their process of solving a problem by recording their own computer screen. Give directions for homework by annotating the document using Jing. You will need to download the software, and Jing saves all your work to your computer.

When Dr. Parker surveyed her colleagues about the tech tips and tools and if the email communication should be continued in Fall 2013, all faculty members responded yes. Specifically, her colleagues were interested in learning more about a) creative technologies such as digital video, desktop publishing, graphics, and images; b) instructional technologies for tutorials, practice, and content delivery; and c) expansive technologies for simulations, experiments, and brainstorming.

**Individual Coaching and Mentoring**

**California Polytechnic State University, San Luis Obispo**

In addition to running a PLC at Cal Poly-SLO, Dr. Meyer also offered one-on-one coaching to assist colleagues interested in developing more skill and comfort with various technologies. Four faculty members relied on one-on-one coaching; they were willing to learn to use new technologies, but did not know where to start. The coaching topics were chosen by the learner and included Google Docs, Dropbox, and Moodle (e.g., discussion forums, assignment submission, and gradebook). These were 30- to 60-minute sessions that focused on a particular tool. The Digital Ambassador demonstrated a few features of the tool, assisted the learner in creating or activating an account (several were responding to invites from colleagues to use collaborative tools), and discussed how these might be used in the university classroom and transferred to K-12 settings.

**San Diego State University**

Following the first Showcase event at San Diego State University, Dr. Ross also offered one-on-one coaching, although it was primarily to interested future teachers who had attended the
Showcase and wanted to know more about the technology tools highlighted during the presentations. The coaching sessions ranged from 15-60 minutes and were usually with one pre-service teacher, but in one of the five sessions, there were 3 participants. On each occasion, the participants chose the coaching topic. They included screencasting, Lego Mindstorms, Vernier Probeware, and basic movie editing. In all instances, participants were interested in implementing a lesson that integrated science and technology in his or her field placement. While practicing with the technology, we discussed how the technology could be transferred to a different context. We also discussed the science and the purpose for the lessons.

**Teacher Preparation: Challenges and Changes in the Field**

In a climate so focused on technology as an agent of change in education, as Digital Ambassadors we run the risk of prompting an agenda that asks educators to unequivocally jump onboard if we focus too heavily on technological tools as instruments of change. Yet, research within teacher preparation program argues that unless faculty effectively integrate technology into their courses, teacher candidates are unlikely to use technology effectively in their own K-12 teaching (McCoy, 2000; Yilmazel-Sahin and Oxford, 2010). Drent and Meelissen (2008) found that the values of “personal entrepreneurship” impacted teachers’ uses of technology in K-12 classrooms. Personal entrepreneurship is defined as “the amount of contacts a teacher educator keeps for his own professional development in the use of information and communications technologies (ICT)” (p. 195). They found that teachers who were identified as “personal entrepreneurs” more consistently modeled innovative uses of ICT. A related study (Mueller, Wood, Willoughby, Ross, & Specht, 2008) identified differences between teachers who were identified as “full implementers” vs. those who were seen as “limited implementers.” Factors that made a difference included: positive teaching experiences with computers, teachers’ comfort with computers, beliefs supporting the use of computers as an instructional tool, training, motivation, support and teaching efficacy. Meyer, Abrami, Wade, & Scherzer (2011) also noted that having the support of school administrators, supportive colleagues to collaborate with, and a personal investment in the project also positively impacted teachers’ effective implementation of new technologies and new pedagogies in the classroom.

We authored this paper to highlight ways that we have engaged faculty in more than just learning about technological tools: we have engaged faculty in examining their own philosophical beliefs concerning teaching and learning, discussed how to change pedagogical practices, attempted to shift focus from faculty teaching to student learning, and analyzed how best to nurture relationships with campus and community stakeholders. As faculty, we do not believe that technology is a panacea that will cure our educational ills (Cuban, 2001; Mishra, Koehler, & Kereluik, 2009). Only changed people and changed practices, and eventually a changed system that prioritizes faculty development and praxis, can help to re-imagine teaching and learning in the 21st century and allow faculty to understand what it means to come of age in a digital world.
Below, we outline a few of the challenges we still face in teacher education and discuss some of the ways that educators can work collaboratively for campus-based and system-wide change.

Digital Natives and Digital Immigrants: Dispositions Towards Technology

Today’s college classroom is often filled with “digital natives” (Prensky, 2006), students who utilize the power of technology for entertainment, social networking, and research purposes. These students attend college courses with the newest mobile technologies, state-of-the-art laptops, and a plethora of Internet research tools that can be accessed at the touch of a button. Quite often, however, many of these classrooms are led by “digital immigrant” faculty who dismiss or are unaware of the current trends with technology, and in doing so fail to utilize a platform of instruction/pedagogical infrastructure compatible with how students engage with new information and knowledge that can support student engagement. In teacher education programs, this new digital divide may exist between faculty and teacher candidates and constitute a double-edged sword in which teacher candidates are left to explore current technologies to support K-12 student learning on their own, while also placing faculty in a position where their methods of instruction can be viewed as antiquated and tedious. In an effort to engage candidates and create innovative and rigorous learning environments, teacher education faculty must take it upon themselves to understand how emerging media technologies can offer alternative modes of communication, connection, and learning (Ito, 2009; Ito, et al., 2013). Therefore it is imperative that K-12 educators and university faculty are offered opportunities to develop dispositions towards and practices of using technology to support student learning. This requires a commitment on the part of K-16 administrators and a coordinated campus effort to create a culture of teaching (and learning) as an experimental and iterative experience.

Digital Disconnections between University Faculty and K-12 Classrooms

As school districts equip themselves with the latest technological tools that support student learning in the classroom, it is important that faculty from teacher preparation programs become familiar with the resources available to their teacher candidates in the local area. Unfortunately, this is not always the case, since much of the teacher education faculty is unaware of the current trends in instructional technology, and is disconnected from what is available to candidates in

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6 Although generational labels are popular [e.g., “digital native” (Prensky, 2006), “Millennials” (Pew Research Center, 2010), “Generation M” (Kaiser Family Foundation, 2005), “net generation” (Tapscott, 1998), etc.], we believe there are both strengths and weaknesses in its usage. On the one hand, employing these terms suggests that youth are using media and technology in important and interesting ways and faculty and K-12 educators should take note. Additionally, these terms can call attention to a potential gap between “digital natives” and “non-natives” in terms of technology use. On the other hand, describing a generation tends to obscure difference within a population as there is variation in the ways youth use media and technology in their everyday lives. As educators, we do not want to overestimate students’ media and information literacy skills based on assumptions about generational attributes.
local K-12 classrooms. For example, as a means to deliver material in an innovative and engaging fashion, pedagogical practices that integrate the use of Internet resources, online streaming videos, and interactive online games are often discussed in elementary methods courses. However, many K-12 classrooms nationwide have Internet filters that restrict access to sites like YouTube and Google Docs as well as other websites that can promote interactive student learning. Conversely, many K-12 schools have been furnished with interactive whiteboards (e.g., SMART boards or Promethean) in the classroom or are using one-to-one iPad programs, yet many teacher candidates fail to ever learn or use this technology in their methods courses because their teacher preparation programs lack the instructional technology.

It is important for teacher preparation programs to build strong partnerships with local school districts and community stakeholders, and this requires an understanding of any potential technological policies, resources, or limitations that might support and/or hinder such a partnership. These K-16 partnerships require reciprocity in that both parties can share expertise, research, and stories of successes and challenges in order to create spaces supportive of clinical practice. For instance, school districts and teacher preparation faculty can consult with experts in instructional technology from both parties, so that sound decisions can be made relating to the availability of and access to certain digital resources. Additionally, teacher preparation programs can better model the importance of utilizing instructional technology if they understand and have access to the digital resources that teacher candidates will use in K-12 classrooms.

A Current Trend: Eliminating Educational Technology Courses in Teacher Preparation

At several CSU teacher preparation programs, educational technology courses have been eliminated from the curriculum with the expectation that students will learn this information in their methods courses. This is problematic on multiple levels: 1) faculty who teach educational technology courses are considered experts in their field with the ability to access and study the latest trends in this area; 2) faculty who teach methods courses are experts in their respective areas, but are likely not experts with instructional technology; therefore, they are limited in their understandings of instructional technology and are likely to approach this area with little background information; 3) methods courses which include units pertaining to instructional technology will likely be superficial due to time constraints and faculty interest or background; 4) courses that focus on instructional technology provide an in-depth review of the latest advancements in this area, which can help teacher candidates develop dispositions towards using technology in the K-12 classroom; and 5) removing educational technology faculty from teacher preparation programs can also have ramifications related to opportunities for faculty members to learn from one another if their course loads and common responsibilities are not aligned.

The counter-argument is that as an isolated course, educational technology runs the risk of not being relevant to any discipline because it is not tightly aligned with the methods courses. In this
instance, teacher candidates might learn isolated technology skills, but never implement them in a classroom setting because they will never see themselves as teaching “technology.” In an ideal setting, the discipline-specific instructors and the educational technology instructors would work together closely as a team to make the learning relevant and meaningful. It is paramount that both faculty and teacher candidates are supported with learning how to use digital technologies and how to select technologies that will best support their learning goals (Nugent, Reardon, Smith, Rhodes, Zander, & Carter, 2008). Mishra and Koehler (2006) refer to this complex understanding as the intersection among knowledge of technology, pedagogy, and content or technological pedagogical content knowledge (TPACK). The TPACK framework represents a complex teacher knowledge required to use technology in contextually authentic and pedagogically appropriate ways (Abbitt, 2011), and it moves “beyond oversimplified approaches that treat technology as an ‘add-on’ instead to focus again, and in a more ecological way, upon the connections among technology, content, and pedagogy as they play out in classroom context” (Koehler and Mishra, 2009: p. 67).

Given these circumstances and trends, it is imperative that campuses find ways to include educational technology experts and their expertise in teacher preparation programs to support both faculty and their respective curriculums and teacher candidates and their clinical practice. The work of the Digital Ambassadors described in this paper offers an array of ways that faculty who are experts in educational technology and faculty who are subject matter methods experts can come together to best support each other and teacher candidates in their courses and clinical practice. Yet, we argue that a more concerted effort towards changing a culture of teaching that includes the responsibility for all faculty members to engage with digital technologies must occur as a response to the elimination of educational technology courses from teacher preparation programs.

**Hopeful Change on the Horizon: Next Generation Science Standards**

One of the most exciting changes about the Next Generation Science Standards (NGSS) is that they focus on content as it relates to scientific practices and connections across disciplines (termed cross cutting concepts), moving teachers away from the old standards that focused on lower levels of knowledge as isolated facts that emphasized rote memorization. Instead, K-12 students will be asked to **demonstrate understanding of important concepts by engaging in scientific practices**.

> **Based on new standards in science, students in the 5th grade might be asked to develop a model to describe the movement of matter among plants, animals, decomposers, and the environment, or be asked to conduct an investigation to determine whether the mixing of two substances results in a new substance. In middle school, students might be asked to make and defend a claim based on evidence that inheritable genetic variations may result from new genetic**
It will be up to teachers to construct their lessons so that students have opportunities to perform and demonstrate their understanding. Technological innovations that allow students to communicate with each other, construct models, and collect, organize, and share data will be particularly useful. In addition, as technological tools increase communication and collaboration between students, these communicative experiences will assist students in engaging in the same practices that are important to scientists. More time can be spent making decisions about how to design the experiment and analyze the data, and less time spent waiting to enter numbers into a table or graph. The Next Generation Science Standards are rooted in the nature of science as a discipline. The interactions of science and technology are central to the importance of the standards for all students, because regardless of career choices, the rapid advancements in science and technologies will impact everyone. Our future teachers need to be prepared to educate the students who will be making decisions, voting, and working in a world filled with scientific and technologic advancements we can barely imagine.

Successes of Digital Ambassador program

The CSU Digital Ambassador program is grounded in three educational tenets:

1. Faculty leaders can emerge and thrive if provided a supportive learning community to engage in interests and activities that are relevant to their professional growth.
2. The creation of a culture of peer-based learning and experimentation is important when learning new technologies and discussing how to improve pedagogical practices.
3. The sharing of best practices, including ways to institutionalize activities and events, assists in nurturing collegial partnerships and promoting ongoing professional development.

As part of the inaugural cohort of Digital Ambassadors in the CSU system, we believe this model provides a powerful alternative to faculty development in an age of interconnectedness and rapid technological change. We are an example of how a small group of empowered faculty can make local changes on their respective campuses and come together to support one another regardless of rank, age, or area of expertise. Almost half of Digital Ambassadors were at the Assistant Professor rank and still learning about the cultural and professional expectations of their campuses and the CSU system. Having a group of colleagues engaged in similar work at other CSUs was a valuable support for many of these junior faculty. The input of the more established Digital Ambassadors as well as perspectives offered about what was happening at other

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Footnote: Included in Appendix C is an annotated list of instructional technologies the Digital Ambassadors used to support educators in thinking about new ways to teach and new opportunities for students to demonstrate their learning.
institutions provided helpful insights and support for all ambassadors, including veteran faculty. Also, having a direct line of communications with and the explicit support of the Chancellor’s Office made moving forward with these projects more possible. However, more direct support from each campus and related programs (such as release time for ambassador work), or ongoing involvement of administrators, including Program Chairs, Deans, and Provosts, would benefit the program even more.
References


Appendix A

List of Digital Ambassadors (2012-2013)

Stephen Adams, California State University, Long Beach
Matthew d'Alessio, California State University, Northridge
Bijan Gillani, California State University, East Bay
Cherie Ichinose, California State University, Fullerton
Jill Leafstedt, California State University, Channel Islands
Resa Kelly, San José State University
Terry McGlynn, California State University, Dominguez Hills
Elizabeth Meyer, California Polytechnic State University, San Luis Obispo
Sabrina Mims-Cox, California State University, Los Angeles
Jessica K. Parker, Sonoma State University
Donna L. Ross, San Diego State University
Daniel Soodjinda, California State University, Stanislaus
Penelope Walters Swenson, California State University, Bakersfield
Appendix B

Google Faculty Institute (2011 - 2012)

During August 2011, Google invited 39 faculty members within the field of secondary STEM Education, who held a position in either College of Science or Education at a CSU campus, to attend the Google Faculty Institute (GFI). The Google Faculty Institute was a 3-day intensive colloquium that offered case studies, group discussions, and project work to equip faculty with practical and innovative strategies to enhance their credential courses and teacher candidates’ learning experiences. The GFI encouraged faculty to develop actionable projects, and Google funded 10 research initiatives for the 2011-2012 academic year. The initiatives supported teacher candidates on 19 CSU campuses including UC Berkeley and Stanford. Maggie Johnson, Director of Education and University Relations at Google, reflected on the Google Faculty Institute in a blog post in July 2012.
Appendix C

Digital Ambassadors’ Resource List

We want to share the vast resources the Digital Ambassadors used over the 2012-2013 academic year. Below is an annotated list of the platforms, software, applications, and tools that were important in helping these educators think about exciting new ways to teach and new opportunities for students to demonstrate their learning.

Interactive Software

Geogebra – Free, interactive software for geometry, algebra, statistics, and calculus
National Library of Virtual Manipulatives – Library of uniquely interactive, web-based virtual manipulatives or concept tutorials for mathematics instruction
Geometer’s Sketchpad – Software for teaching mathematics using interactive whiteboards
Wolfram Alpha – Search engine that provides access to the world’s facts and data and calculates answers across a range of topics, including mathematics and science

Google in Education STEM Tools

Main Page – Additional Google tools to collaborate and share STEM resources
Trimble SketchUp – 3D modeling program for a broad range of applications designed for engineers, architects, filmmakers, and related professionals
Google Fusion Tables – Experimental data visualization web application to gather, visualize, and share big data

Coding Applications

Xcode – Suite of tools for developing software on Mac OS X
MIT App Inventor – Tool to create and develop applications for Android phones

Brainstorm and Mind Mapping Tools

Popplet – Tool to visualize and share ideas, graphic organizers, timelines, and other visual material
Twiddla – Online collaboration tool that uses a virtual whiteboard
Bubbl.us – Tool to make graphical representations of ideas

Innovative and Interactive Presentation Applications

Prezi – Web-based presentation application and storytelling tool that uses a single canvas instead of traditional slides
SlideRocket – Online presentation platform that lets users create, manage, and share presentations
Voicethread – Web-based application that allows users to place collections of media like images, videos, documents, and presentations at the center of an asynchronous conversation

Screencasting
Screencast-o-matic – Web application that creates free screencasts on Windows, Mac, and Linux operating systems
Jing – Tool that captures anything on the computer screen, as an image or short videos, and has sharing capabilities
ScreenFlow – Tool that records the computer screen, edits videos, and has sharing capabilities
Screenr – Tool that instantly screencasts and records videos to publish

Real-Time Feedback Applications
Google Moderator – Google service that uses crowdsourcing to rank user-submitted questions, suggestions, and ideas
Polleverywhere.com – Audience response system that generates participant responses and promotes discussion

Social Media Networking Tools
Twitter – A micro-blogging network whereby users can share information, resources, and tidbits using 140 characters
Google+ – Google’s social network to share information, resources, and tidbits
Pinterest – Pinboard-style photo-sharing website that allows users to create and manage theme-based image collections
LinkedIn – Employment-based social network to link to professional contacts

Google Web-Based Office Suite
Google Docs – Web-based word processor for collaboratively creating, managing, and sharing documents, forms, and spreadsheets
Google Earth – Virtual globe, map, and geographical information program
Google Draw – Online tool that allows users to collaborate and create representations