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Learning Generation: Fostering Innovation with Tomorrow's Teachers and Technology

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We discuss the context, conception, implementation, and research used to refine and evaluate a systemic model for fostering technology integration in teacher education. The Learning Generation model identifies conditions where innovations for using technology emerge in small group dialogues. The model uses a multifaceted implementation with programmatic reform, enhanced infrastructure, technology enriched field placement, ongoing technical support, robust web communications, and Innovation Cohorts. Ideal cohorts include teacher education and liberal arts faculty, preservice student(s), practicing teachers and K-12 students. Cohort development evolves through seven stages: (1) genesis, (2) consultation, (3) planning, (4) initiation, (5) action, (6) assessment, and (7) celebration. Cohort topics include: Technology Integration, Legislative Tracking, Making Hope Happen, Technology in Science Teaching, Foreign Language, and Choral Music.

Phase one of the research involved a survey and interviews on uses of technology. Survey results with student and faculty found significant differences between six subscales: word processing ($M=3.84$), basic computer skills ($M=3.61$), online activities ($M=3.49$), software use ($M=2.99$), presentations ($M=2.84$), spreadsheets / database ($M=2.77$); F (5, 244) = 173.11, $p < .001$. The lower scores on presentation and spreadsheets/database software are worth noting because these uses are often the most successful in supporting inquiry and constructive learning activities. Survey results also found that the confidence of women was lower than men in basic computer skills ($p=.004$) and use of presentation software ($p=.002$). In the interviews, several faculty members (36%) specifically mention the importance of modeling the use of technology in their instruction. Further research is needed to investigate the relationship between faculty modeling of technology use on teacher education students across gender.

An audit of the cohorts' products and faculty interviews indicate that the Learning Generation goals were achieved. Faculty report that their technology skills improved and they embraced the collaborative grass-roots nature of cohorts. Learning Generation is a flexible model that can be adapted to the unique needs, culture and capacities of diverse teacher education institutions.

In this article we discuss a systemic model to support innovations with technology in teacher education. We classify a model as systemic if it possesses these qualities: (a) the motivation and innovation originate from the students and faculty in the program; (b) the model fosters multiple solutions that address diverse needs and situations; (c) the impact of the model is pervasive; and (d) The model encourages ongoing innovation. Educational systems have long been criticized for ignoring the value of experience and choosing instead to, in John Dewey's (1915) terms, "teach by pouring in." Rather than prescribing a one size fits all workshop approach to technology integration, this systemic model draws upon the unique skills and experiences of all participants and adapts as educational needs and information technologies continue to change.

We named this systemic model Learning Generation. It features Innovation Cohorts where teacher education students, university faculty, and K-12 teachers work together in a group to discover solutions for integrating technology that serves their unique teaching and learning needs. Typically, the solutions are but one step in each group's ongoing effort to reflect, disseminate, and sustain their cohort's innovations. We will begin by discussing the national and local context that led to the conception of the model. We then describe the model with examples of the cohorts' activities, implementation, and the research that was used to refine the model and to assess attainment of the goals.

The National Context: Rapid Change in Technology and Teacher Education

The development of Learning Generation was supported in part through the U.S. Department of Education's Preparing Tomorrow's Teacher to Use Technology (PT3) initiative. PT3 began in 1999 when our nation was in a period of extraordinary growth in information technologies. Schools, businesses, and governmental institutions were engaged in massive efforts to upgrade their computer systems and avert potential Y2k problems. The Tele-Communication Act's e-Rate (Fulton, 1998), along with other factors propelled the rapid development of a network infrastructure to connect all businesses, schools, and universities. Many recognized that these new digital technologies held the potential to transform our schools and universities (CEO Forum, 2000).

The need for advancing the role of technology in teacher education was clear in 1999 as it is today. The U.S. will see enrollment increase by three million students this decade while half of our teaching force retires (Recruiting New Teachers, 2002). Our nation will need over two million new teachers who will be responsible for preparing students with the new literacies required for success in a changing society that is increasingly influenced by digital technologies and globalization (Rosenthal, 1999; Tyner, 1998). Yet, many teacher education faculty members possessed only a limited understanding of how to use information technology in their teaching.

In 1999, approximately 54% of higher education classes used e-mail, 39% used Internet resources, and 28% had a website (The Institute for Higher Education Policy, 2000). Higher education faculty were beginning to use technology more in their teaching (West, 1999). Internet access had increased markedly and nearly all faculty and students accessed the Internet at least once per day (Milliron, 1999). School teacher's skills in using technology were evolving. According to Davis (cited in Duhaney 2001), only 20% of teachers felt confident in their ability to integrate technology in their teaching. The National Center for Education Statistics (NCES) polled public school teachers and found that only one third of teachers felt "well prepared" or "very well prepared" to use computers and the Internet in the classroom (NCES, 2000). According to NCES (2000), 45% of teachers who had three or fewer years of teaching experience felt either well prepared or very well prepared to use technology in the classroom. The perceived preparedness of thes new teachers was significantly higher than teachers with 10 to 19 years of experience (31%), and teachers with 20 or more years of experience (27%).

The Readiness for Change in the Teacher Education Program

During the early phases of the model development a core group of our education faculty were addressing the need to increase the preparedness of preservice teachers. The School of Education's faculty at large were also revising the teacher education curriculum. The teacher education curriculum, then and now, includes a specific educational technology course. This course provides students with technology literacy skills and examples for integrating technology in their teaching that are similar to the objectives of many educational technology courses in teacher education curricula (Hargrave & Hsus 2000). The educational technology course is aligned with the National Education Technology Standards (NETS) for Teachers (International Society for Teacher Education [ISTE], 2002). It provides students with technology literacy skills, strategies for integrating technology in teaching and encourages the students to use technology in all aspects of their teacher education program. Teacher education faculty view this course as an essential aspect of the program because not all faculty can stay abreast of the rapid change in technologies, and the course serves as a path for infusing new ideas and skills into the program. One significant change was moving the educational technology course from a senior level to a junior level. This is intended to aid both in assessing the students' technology skill level as they first enter the program and in identifying potential students for cohorts.

While an educational technology course was viewed as essential, the teacher education faculty also knew that a more comprehensive strategy was needed to prepare students to integrate technology throughout their teaching career. The ongoing revision of the teacher education program offered an opportunity to consider such an approach. The faculty reviewing the integration of technology in the curriculum knew that researchers (Abdal-Haqq, 1995; Willis & Mehlinger, 1996; Office of Technology Assessment [OTA], 1995) have recognized the need for more faculty modeling of technology integration in courses. They also knew that earlier research had found that the majority of teacher education faculty reported that they, "do not model technology use, do not use information technology to accomplish the objectives in the courses they teach, and do not teach students how to use technology for instructional purposes" (OTA, p.165). More recent studies indicate that this problem persists (Cooper, 2001; Ledermand & Niess 2000; Hargrave & Hsus, 2000; Willis, Thompson, & Sadera, 1999). Moursund and Bielefeldt (1999) reported that "Faculty IT skills tend to be comparable to the IT skills of the students they teach; however, most faculty do not model use of those IT skills in teaching." The challenge then was to design a way to enhance the faculty's instructional technology skills, and to increase their willingness to use these newly acquired skills in their teaching.

Conception of the Learning Generation Model and Goals

The development of the Learning Generation goals began with an understanding that Rogers (1995) and others (Boyer, 1990; Tavalin & Gibson, 2000) have identified as critical to the adoption of innovation. A central tenet is that innovation is more likely to be adopted when the constituents who will implement the change are actively involved in the decision making, are engaged in learning with others, and view the innovation as congruent with their needs. As Cuban (1986) observed, the changes teachers have embraced solve problems that the teachers identified as important.

The basic idea for the cohorts in Learning Generation emerged in an instructional design course where the students often worked with faculty members as their "content expert" clients. In this course students worked with teacher education faculty to create instructional products that addressed the faculty member's needs. Procedures were refined over several semesters with faculty serving as content expert and students providing technical skills, knowledge of instructional design, and suggesting strategies for technology integration. The Learning Generation model has since expanded to a broader constituency with more collaborative sharing of ideas that extend the ownership and sustainability. For example, the successful Generation Why project (Coe & Ault, 2001) influenced the inclusion of K-12 students and teachers in the cohorts.

The Learning Generation conceptual development was also influenced by the desire to develop a model for integrating technology that includes a broad range of constituents for ongoing collaboration and innovation. According to the Association of American University Women (AAUW, 1998), women are especially unprepared to use technology while men tend to gain confidence and enthusiasm regarding computers (AAUW, 1998; Khine, 2001; McLester, 1998). Sustainable reform must involve systemic conditions where representatives from the diverse stakeholders are actively involved in developing and owning the innovation.

The goals developed for Learning Generation focus on creating the conditions where diverse innovations for integrating technology in teacher preparation will emerge. The key goals are:

1. to assess the teacher education candidates perceptions and abilities concerning technology and to attract diverse candidates to the teaching profession who are interested in integrating technology in teaching and learning;
2. to significantly improve the technology literacy competencies of teacher education faculty and preservice students;
3. to empower faculty, teacher education students and cooperative teachers with the tools, skills and technical support for extending best practices in integrating instructional technology in their teaching;
4. to engage cohorts consisting of teacher education students, university faculty, practicing teachers and K-12 students in adopting and developing innovative approaches for integrating technology in teacher education;
5. to apply information technology in improving communication and collaboration with placement schools; thereby providing more immediate understandings of the issues, preferences and needs impacting K-12 teachers and students; and
6. to use a variety of strategies for disseminating innovation in integrating technology in teacher education including: conference presentations, publications in refereed journals, and the main Learning Generation web site with resources highlighting best practices and innovations.

Implementation of the Learning Generation Model

The Learning Generation project implementation involved a multifaceted plan where technology acts as a catalyst for innovation in teacher education. When we implemented the model the following conditions existed: (a) a core group of faculty were interested in advancing technology integration in teacher education; (b) an ongoing effort was underway in revising the teacher education program; (c) a successful placement program including a strong Professional Development School Alliance was in place; (d) our School administration was supporting technology integration by enhancing faculty equipment, internet connectivity, computer labs, classroom technology and personnel resources; (e) an educational technology course that was part of the teacher education curriculum and other educational technology courses were available; (f) Excellent technology assistance and online resources were available through the eLearning Design lab (htttp://elearndesign.org), High Plains Technology in Education Consortium, (htttp://hprtec.org), and the School's technology support group; and (g) there were large differences in the amount of faculty use of technology in their teaching.

The Innovation Cohorts represent the heart of the Learning Generation model and are the means to design, implement, and assess how technology is being integrated into teaching. As originally conceived, the ideal cohort consists of: (a) a member of the School of Education faculty; (b) teacher preparation student(s); (c) a faculty member from the liberal arts; (d) a practicing teacher; and (e) a K-12 student. This structure was designed to bring together diverse groups who have a stake in the effective integration of technology in a subject area or theme. While this is the ideal structure, cohorts have been formed with various permutations of these five constituencies.

Following is the process that cohort's follow in developing implementing and disseminating innovations for using technology to benefit teacher education.

Step 1—Genesis of a cohort. The genesis of a cohort begins when the cohort team comes together to discuss and generate ideas. Typically, a faculty member lacks technology skills necessary to bring an idea to fruition and the time required to develop these skills. The model provides an opportunity for faculty to form a cohort with preservice teachers and others to address their needs. While the faculty member often serves as the catalyst, in some cases an idea spontaneously arises when a group of students and faculty meet in a gathering.

Step 2—Consultation with experts. Once the cohorts form their ideas, they consult with Learning Generation personnel, which consists of faculty members, staff and graduate students with expertise in instructional technology, to discuss the feasibility and refine initial ideas. This consultation allows technology experts with the Learning Generation project to provide advice, identify similar projects from which to learn, recommend technology solutions and help the new cohort team avoid potential problems that arise when a cohort takes on ambitious tasks.

Step 3—Develop a plan. After consultation, the cohort then develops a plan that articulates the vision, membership, goals, support needs, timeline, deliverables, and evaluation strategies. This plan becomes the framework for the cohort's activities. The planning phase is crucial because it provides the cohort with guidance and a sense of cohesion. During the planning phase the Technology Infusion Group (TIG) support group provides cohort web space where they document their work.

Step 4—Initiation of plan. Initiation occurs when the cohort plan is approved and the Learning Generation support package is created. The cohort faculty leader meets with a member of the Technology Infusion Group to make sure the project is understood and the resource and technical support needs are communicated.

Step 5—Action. Once the plan is developed, the cohorts enter the action phase where work begins according to their plan. The teacher education student(s) often serve as the engine for the action. Cohort members meet regularly and share products through their website. The cohort's products remain publicly available beyond the active phase as one way to sustain the cohort's innovation.

Step 6—Assess results. As a cohort concludes its action phase it implements assessment strategies as specified in the plan. During the assessment phase the cohort analyzes the group process and the final products. Each cohort is encouraged to share details of the assessment on the web site. Assessment assists the cohort members in understanding the salient aspects of the process and the functioning of the cohort. The assessment phase also provides insights for refining the overall cohort process.

Step 7—Celebrating and showcasing the results. The cohort has a celebration following the completion of the plan, which gives the cohort an opportunity to share their work. Celebrations may take the form of a product release, a round table discussion, showcase, or conference presentation. The celebration also communicates the innovation and encourages others to form cohorts. The celebration helps culminate the cohort's efforts and acknowledges the significance of the cohort's accomplishments (Figure 1).

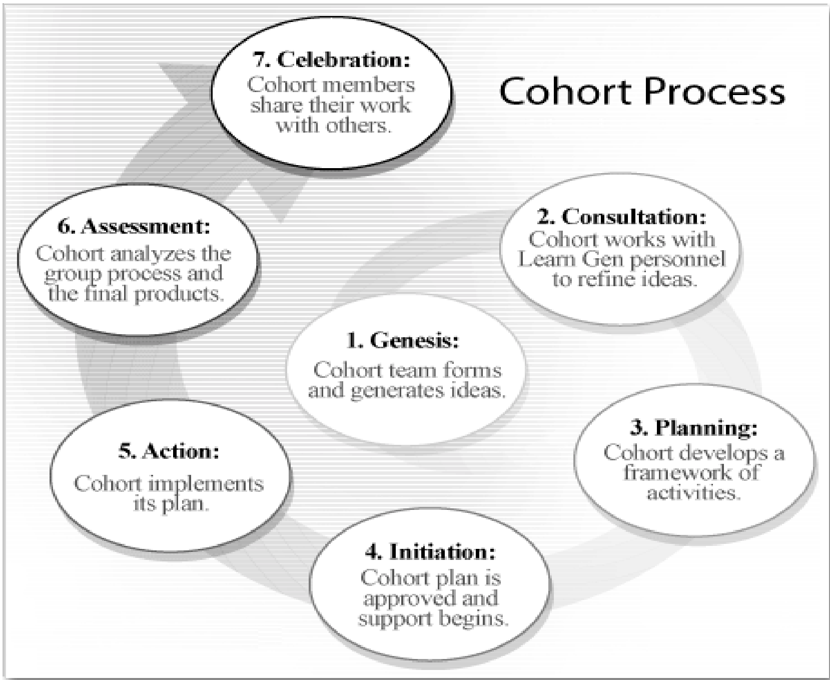

Figure 1. The cohort's process of developing innovations for integrating technology in teacher education

A Case Example: Online Legislative Tracking with Teacher Education & High School Students

The following example illustrates how a solution for integrating technology emerged systemically as part of the cohort activities. The solutions developed by each cohort are unique. An early Learning Generation cohort formed to create an online assignment for teacher education students and high school seniors in a government class (http://learngen.org/legtrack). The faculty member generated the idea, the two high school teachers assisted with the planning and classroom application, and two teacher education students created the online resources. The faculty member had worked with the teachers on prior occasions and had one of the two teacher education students as a student in a course.

Genesis. The first time the cohort met, the faculty member presented the idea. The teachers discussed the feasibility of implementing it with their students and addressed details such as speed of access to the Internet. A teacher education student with expertise in programming discussed what was feasible about designing the online parts of the assignment.

Consultation. The faculty member met with the project director to discuss the idea and determine what resources were necessary. The teacher education students met with technology experts to determine their training needs.

Planning. The faculty member, one of the teachers and one of the teacher education students devised a plan that outlined the parts of the assignment, a timeline for the design, implementation and assessment of the assignment, and the delineation of tasks that each person was to complete. After this meeting, the faculty member and one teacher coordinated the cohort's efforts and worked with the other teacher and the teacher education students

Initiation. The assignment was placed on a website intended for non-cohort teacher education students enrolled in a one-hour credit course. The assignment consisted of three online components used in a three-step instructional process: an online survey, a collection of online sites, and an interactive letter to a legislator. The faculty and teacher education members reviewed the design, the instructional process, and technology integration issues with the teachers concerning and discussed the technical requirements for and implementation of the website with TIG members.

Action. In the first step of the plan's implementation, the teacher education and high school students identified 10 issues that the state legislature was considering. The faculty member and the teacher created an interest survey (http://learngen.org/legtrack) and the high school seniors took an online survey. The teacher education students reviewed the survey results and selected the five key legislative issues that were ranked highest by the seniors. The teacher education students then located online sites that provided information about the key legislative issue and used the Track Star program (http://trackstar.4 teachers.org/trackstar/) to post summary arguments for and against the issues. They also linked to the home page of a legislator involved with the key issue. The high school students then used the Track created by the teacher education students to research a legislative issue. The seniors also answered questions written by the teacher education students on a password sensitive site. The teacher education students then drafted, and posted online, letters to the legislator that contained arguments both in support of and against the bill. The high school seniors read the letters and electronically signed one or the other and provided reasons for their choice.

Assess Results. Upon completion of the course, the cohort continued to meet and discuss what was learned. They also modified the assignment and added online resources including a home page for the assignment; a tutorial for the teacher education students; a system for register the URL for their group's track and a discussion board.

Celebration. The faculty member, one of the teachers and the teacher education students took a slightly different approach to the idea of a celebration by presenting their work at several national conferences. This provided an opportunity both to showcase their work and to open discussions about the website and its future direction.

Organization and Implementation Support

A core group of faculty served as the administrative council. A project coordinator guided organization and implementation and an outreach coordinator assisted with the activities in the schools where the teacher education students were placed. A mix of graduate and undergraduate students with technical expertise served as the Technology Infusion Group (TIG). TIG members provided the cohorts with technology assistance, development of the cohort web sites and the resources in the main Learning Generation web site. Students were paid a stipend to participate in the cohorts but they did not receive credit for their cohort activities. While the aforementioned conditions and organization worked well for this implementation, they are not required for a successful implementation. The primary requirements are: (a) an organizing body or individual to assist with the development of the cohort teams and their plans; (b) a means of providing technical skills and enrichment. This might occur through a combination of courses, online training, and possibly a Technology Infusion Group; and (c) a way to reward participation in the cohorts. This might include a stipend, course credit, or travel to a conference to present results.

Research Design

This section describes the research used in refining and evaluating the Learning Generation model. The first phase included a quantitative survey and qualitative interviews that provided insights into technology skills of faculty and students, current conditions, capabilities, and needs. This research was used to refine the model's focus, cohort procedures, and the nature of the technical assistance. The second phase used an analyses of products produced on the cohort web sites and faculty interviews to assess the attainment of project goals.

SURVEY OF FACULTY AND STUDENT TECHNOLOGY LITERACY SKILLS

Method

Participants. Participants consisted of 244 (92%) students, 16 (6%) professors, and 5 (2%) graduate teaching assistants. Most of the participants were women (73%). All the students, instructors, and graduate teaching assistants (GTA) were recruited from School of Education courses. The majority of participants were Caucasian (94.4%); African-American, Asian, Native American, and a number of international students were also represented. The students' ages ranged from 19 to 50 (M = 22.44, SD = 4.74). The professors' and GTAs' ages ranged from 21 to 53 (M = 34.89, SD = 10.28).

Instruments. The survey consisted of 30 items covering various technology skills. Participants received a total score as well as scores on the following six subscales: basic computer skills, online activities, presentations, software use, spreadsheet and database, and word processing. Alpha coefficients suggest acceptable internal consistency for the total scale and the six subscales. The alpha coefficient for the total scale was a = .957.

The basic computer skills subscale consisted of seven items such as "Open and exit programs; including starting up and shutting down the computer properly" (a = .836). Online activities consisted of five items such as "Access the Internet; including performing searches, setting bookmarks (favorites), following links, and saving web pages" (a = .770). The presentations subscale consisted of five items such as "Create programs and presentations using multimedia authoring programs; including creating linear/nonlinear programs, incorporating text, graphics, audio, and video" (a = .865). Software use for instruction consisted of five items such as "Prepare lesson plans that involve the specific use of software to accomplish classroom goals" (a = .795). The spreadsheet and database subscale consisted of four items such as "Create charts and/or tables using spreadsheets and databases; including publishing the information in the most appropriate form" (a = .871). Finally, the word processing subscale consisted of four items such as "Perform the following operations in a word processing program; select, cut, copy and paste text; change font size and styles; and spell check documents" (a = .783).

Participants responded to the items using the following Likert scale: "No experience" = 1, "I am able to do this but need assistance" = 2, "I am able to do this but not to its full capacity" = 3, "I am able to do this routinely to its full capacity" = 4, and "I could teach others to do this" = 5. Therefore, possible total scores could range from 30 to 150. The survey also gathered demographic information such as date of birth, sex, ethnicity, major, and minor.

Procedures. The researchers recruited student participants from various teacher preparation courses. We obtained instructors' permission to administer the technology survey during class time and student consent for participating. The instructors of those courses also signed an informed consent document and completed the survey. Each session took approximately 15 minutes.

Results

A one-way repeated measures ANOVA was used to compare the scores on the six subscales: basic computer skills, online activities, presentations, software use, spreadsheets/databases, and word processing. The Wilkes Lambda procedure indicated a significant finding, F (5, 244) = 173.11, p < .001. Eta squared was used to determine the effect size. The effect of the subscales accounted for 78% of the variance in scores. Because post hoc analysis consisted of a large number of paired-samples t-tests, the Bonferroni correction procedure was used. Fourteen of the pair-wise comparisons were significant. Only the spreadsheet/database and presentations comparison was not significant. Table 1 shows a list of comparisons. Table 2 shows the means and ranking of technology literacy skills where the faculty and students had more confidence in their ability to use word processing (M=3.84) than in their ability to use spreadsheet and database programs (M=2.77).

Table 1
Post Hoc Analysis of Repeated Measures ANOVA on Technology Skills Subscale

Pair-wise Comparison	***t* – test**	
Word Processing—Spreadsheet/Database	t (260) = 23.52,	p < .001*
Word Processing—Software Use	t (256) = 18.68,	p < .001*
Word Processing—Presentations	t (260) = 22.09,	p < .001*
Word Processing—Online Activities	t (256) = 9.84,	p < .001*
Word Processing—Basic Computer Skills	t (256) = 6.17,	p < .001*
Spreadsheet/Database—Software Use	t (256) = -4.66,	p < .001*
Spreadsheet/Database—Presentations	t (261) = -1.61,	p = .109
Spreadsheet/Database—Online Activities	t (257) = -15.42,	p < .001*
Spreadsheet/Database—Basic Computer Skills	t (257) = -18.66,	p < .001*
Software Use—Presentations	t (256) = 3.57,	p < .001*
Software Use—Online Activities	t (252) = -12.04,	p < .001*
Software Use—Basic Computer Skills	t (252) = -14.60,	p < .001*
Presentations—Online Activities	t (257) = -14.86,	p < .001*
Presentations—Basic Computer Skills	t (257) = -16.32,	p < .001*
Online Activities—Basic Computer Skills	t (253) = -3.77,	p < .001*

Note: * Indicates significant difference.

Table 2
Ranking of Student and Faculty Overall Means on Technology Literacy Skills

	Technology Skill	*Mean**	*SD*
1.	Word Processing	3.84	.818
2.	Basic Computer Skills	3.61	.785
3.	Online Activities	3.49	.782
4.	Software Use	2.99	.970
5.	Presentation Software	2.84	1.06
6.	Spreadsheets / Database	2.77	1.06

* 1 = “No experience” ... 5 = “I could teach others to do this”

A series of *t*-tests were used to compare the men’s and the women’s total scores as well as their scores on the six subscales. Bonferroni correction was used to control the error rate. Men scored significantly higher than the women on the presentations and basic computer skills subscales. The difference on the total scale approaches significance. The other comparisons were not significant. Table 3 shows comparisons of the technology skills means across gender.

Table 3
Comparison of Men and Women Understandings of Technology Literacy Skills

Skill Subscale	Means Men	Means Women	Standard Deviations Men	Standard Deviations Women	*t*-test
Word Processing	4.00	3.77	0.88	0.79	t (244) = 1.92, p = .056
Basic Computer Skills	3.86	3.51	0.83	0.75	t (244) = 3.08, p = .002*
Online Activities	3.64	3.43	0.83	0.75	t (244) = 1.96, p = .051
Software Use	3.20	2.92	1.09	0.89	t (243) = 2.07, p = .040
Presentation Software	3.14	2.70	1.19	0.98	t (244) = 2.93, p = .004*
Spreadsheet/ Database	2.94	2.67	1.12	1.03	t (244) = 1.74, p = .083

Note: * Indicates significant difference.

T-tests were also used to compare the instructors' and students' total scores as well as their scores on the 6 subscales. Bonferroni correction was used to control error rate. Because the sample sizes were small the professors and the GTAs have been combined into one group called instructors. There were no significant differences between instructors' and students' scores. Table 4 shows comparisons, means and standard deviations on the technology skills sub-scales.

Table 4
Comparison of Instructor and Student Understandings of Technology Literacy Skills

Subscale	Means Inst.	Means Student	Standard Deviations Inst.	Standard Deviations Student	*t*-test
Word Processing	3.91	3.84	.95	.81	t (260) = -.351, p = .726
Basic Computer Skills	3.96	3.60	.76	.78	t (260) = -1.97, p = .049
Online Activities	3.44	3.50	.97	.76	t (260) = .279, p = .780
Software Use	3.17	2.99	1.10	.95	t (260) = -0.82, p = .414
Presentation Software	3.00	2.83	1.38	1.04	t (260) = -.658, p = .511
Spreadsheet/Database	3.32	2.71	1.32	1.02	t (260) = -2.49, p = .013

Participants' total scores ranged from 42 to 150 (M = 98.36, SD = 23.54). Most of the participants scored 3 (I can do this but not to its full capacity) or higher on the word processing (87%), online activities (75%), and basic computer skills (82%) subscales. Less than half of the participants scored 3 or higher on the spreadsheet and database (42%), software use (49%), and presentations (44%) subscales. More than half (64%) of the participants scored 3 or higher on the total scale.

INTERVIEWS OF FACULTY ON USES OF TECHNOLOGY IN TEACHER EDUCATION

Method

In follow up interviews 20 professors and 6 graduate teaching assistants from the School of Education responded to 11 open-ended questions. The interviews considered the following topics: familiarity with information technology, advantages and disadvantages of information technology, technology skills that teacher education graduates need to have, ideas about technology integration, how they use information technology in their classrooms, barriers and resources, and personal teaching style. The same interviewer conducted each face-to-face interview that lasted about 30 minutes each.

Descriptive Analysis

Participants were asked about the advantages of using information technology for teaching. Nearly all of the participants (89%) indicated that information was obtained more easily and more quickly and that the information obtained was more timely than using other methods. Other common comments included: access to a large variety of resources (35%); greater access to people outside of the classroom such as community members (23%); keeps students' attention (19%); and the ability to individualize instruction (19%). A sample of typical comments follows.

> Technology provides access to information; appeals to different learning styles and intelligences of students.
>
> It increases the interaction between people and increases access to a more diverse populations and decrease feelings of isolation.

Participants were also asked to list any possible disadvantages to using information technology. The three most common comments were too time consuming (30%); not everyone has access (30%); and some people are reluctant to learn or have a fear or anxiety of technology (30%). Several

(27%) also mentioned that there are too many problems with the technology and they do not have the troubleshooting skills to deal with the problems. Other common responses included: evaluating information is difficult and time consuming (19%); there are no real disadvantages if the technology is used properly (19%); and using technology is impersonal or removes the teacher from the classroom (15%).

The participants also discussed the technology skills that they felt teacher education graduates need. Many participants (48%) indicated that teacher education graduates should be able to teach effectively with technology and know how to find appropriate resources and information. Several individuals mentioned that teacher education graduates should have certain basic skills (44%) and that they should be able to teach those skills to others (12%). Other comments included knowing the dangers of using technology (12%) and be able to integrate technology into their teaching (24%).

The interviewer also asked how information technology could be integrated into the teacher education program. Several participants (36%) felt that instructors should model technology use in their courses. Additionally, 36% of participants mentioned that technology should be integrated into existing courses rather than rely solely on a technology specific course. Participants also specifically mentioned (20%) that a technology course is needed. Other comments included the need for more faculty training (36%) and increase access to technology in the classroom (20%). A sample of typical comments follows.

> Instructors need to model IT more often (e.g., information technology should become a major component of methods/content courses).

> Have projects that involve the Internet specifically (make the Internet essential to the assignments); increase group assignments in which the Internet is used.

> Should have specialized courses for students to learn how to use computers.

Participants also discussed how they have used technology for teaching their courses. Half of the participants stated they didn't really use technology much or used it a very basic level. Many of the participants (69%) indicated they use e-mail to communicate with students. A number of instructors (42%) had assignments that required students to use technology. Several individuals used videos or overhead projectors (27%) and PowerPoint (19%). A few participants (23%) had websites for their course where their syllabus and assignments were posted. The following are some typical comments.

> I have a website with all information regarding classes (assignments, e-mail…); web pages so that students can see all the information about their class, usually have handouts on the web, links that are of interest to students and to other teachers.

> Have not really used a lot of information technology and have not attempted to embed it into courses taught because I do not have the time, knowledge or skill to do so. Primarily just used e-mail at a very basic level.

> PowerPoint presentations for lectures and students must give PowerPoint presentations.

Finally, participants discussed the resources and barriers to integrating information technology. Several participants mentioned a need for more training and technical support resources (64%). A few participants also felt there was adequate access to equipment (29%) and that funds were available to support technology integration (18%). The barriers listed included: lack of time to learn how to use technology (52%); lack of access to equipment (72%); lack of training opportunities and support (40%), fear/anxiety towards technology (36%); and lack of funds (20%).

Discussion of the Survey and Interviews on Use of Technology

The survey findings suggest that students and faculty felt confident in their ability to use various technology applications. They were especially confident in their ability to use word processors, online resources, and basic computer functions. The participants were slightly less confident in their ability to use spreadsheets, databases, and presentation software This is worth noting because these uses of technology often support learning activities involving inquiry (using spreadsheets to organize and analyze data) and project-based constructive learning (using presentation software to report interpretations). We provided technical support and resources to encourage many of the more recently established cohorts to integrate technology in ways that will support inquiry and constructive learning.

Table 5

Summary of Instructor* Interviews on Uses of Technology

What are the advantages of using technology in teacher education?	
Information was obtained more easily	89%
Access to a wide range of resources	35%
Greater access to others outside of university	23%
Keeps students' attention	19%
Ability to individualize instruction	19%
What are the disadvantages of using technology in teacher education?	
Too time consuming	30%
Not everyone has access	30%
Fear or anxiety of technology	30%
Too many technical problems	27%
Evaluating information is difficult and time consuming	19%
No disadvantages if technology is used properly	19%
How should technology be integrated in teacher education?	
Instructors should model technology use	36%
Integrated technology in all courses	36%
How do you use technology in your teaching?	
Use e-mail to communicate with students	69%
Use technology only at a very basic level	50%
Have assignments that require students to use technology	42%
Use videos or overhead projectors	27%
Have a class websites	23%
Use PowerPoint	19%
What are the barriers to integrating technology in teacher education?	
Need for training and technical support resources	64%
Lack of access to equipment	72%
Lack of time to learn how to use technology	52%
Lack of training opportunities and support	40%
Fear/anxiety towards technology	36%
Have adequate access to equipment	29%
Lack of funds	20%
Sufficient funds available	18%

* Results from interviews with 20 professors and 6 graduate teaching assistants.

The survey findings indicated a gender gap where men reported higher confidence in their basic technology and presentation skills than women. Models for integrating technology should address the needs, interest, and abilities of diverse learners. Learning Generation is a collaborative, democratic, and noncompetitive model that focuses on peer support and networking. The model is conducive to equitable involvement and support for all participants. Learning Generation has been successful in recruiting female students to work in cohorts, however initially there were very few female faculty members involved in cohorts. We increased our efforts to recruit female faculty while retaining the already high female student participation. Modeling effective use of technology by female faculty may be especially effective in mentoring.

Several faculty indicated that instructors should model the use of information technologies in courses. The survey suggests that most faculty members have good technology skills. However, the interview indicated that many faculty were not using their technology skills in their teaching.

AUDIT OF COHORT WEB SITE ON GOAL ATTAINMENT

Method

The researchers accessed 20 websites associated with or created by members of the 21 Learning Generations cohorts. The cohort websites were evaluated for evidence of progress towards attainment of the goals of the Learning Generation goals. Specifically the researchers looked for evidence of:

- Increases in technology literacy competencies of teacher education faculty and preservice students (evidenced by materials created to deliver technology skills training and plans for technology training in a cohort timeline of activities).
- Instructional technology integration in teaching and learning (evidenced by examples or discussions of a new technology use by a faculty member in the School of Education).
- Engagement of cohorts including information that communicates the sustainability and replicability of the cohort model (evidenced by products designed to sustain the cohort innovation over time that demonstrate institutionalization of cohort innovation).
- Recruitment of technology literate students into the teaching program (evidenced by the presence of materials that reach out to high school

students with technology skills as well as procedures or projects that involve or are designed for high school students).
- Use of information technology to improve communication and collaboration with professional development and placement schools (evidenced by the inclusion of telecommunication technologies used to communicate with school-based personnel).
- Dissemination of new visions of teaching, learning and teacher preparation. (evidenced by conference presentations, local discussions or presentations, and academic papers).

Two researchers independently reviewed the cohort websites. Each researcher analyzed the cohort websites and products looking for evidence of attainment or progress towards project goals. After the independent reviews the two researchers compared analyses. Inter-rater agreement was confirmed in this comparison. A count was prepared to indicate the number of cohorts whose products included evidence of progress towards the goals of the project according to the independent review of the two researchers.

Results

Table 6 shows the reviewer's assessment of how well each cohort attained the project goals based on an analysis of the resources developed on cohort web sites.

Table 6
Assessment of Goal Attainment Based on Product Audit

	Goal	# of Cohorts who Attained Goal	Percent
1	Student Assessment and Recruiting	10 of 21	48%
2	Technology Literacy Competencies	21 of 21	100%
3	Technology Integration	15 of 21	71%
4	Cohort Engagement In Teacher Ed. Reform	10 of 21	48%
5	Communication with Placement Schools	10 of 21	48%
6	Dissemination	13 of 21	62%

Items in cohort websites that indicated progress towards increasing technology literacy competencies of teacher education faculty and preservice students included materials specifically created to deliver technology skills training and plans for technology training in a cohort timeline of activities. Each cohort website incorporated a variety of these resources including learning objects that were created by and for the cohorts. The learning objects provide step-by-step procedures for accomplishing various technology tasks. The learning objects created by cohorts provide assignments and evaluation strategies as well as examples. One cohort team created several procedures that were targeted specifically for the professional developmentof its faculty member. These learning objects were used to teach the faculty how to transform paper documents into online resources and other skills. Another cohort created a system of technology training that students may provide to faculty in the School of Education. For example, a cohort targeting the use of technology in music education developed a tip sheet for a popular web editor and used it to provide training to students, choral music directors of local schools, and others. One of the cohorts interested in supporting placement activities developed training to student teachers and their cooperating teachers on a popular multimedia development software package. This cohort then used this software in action research projects.

Evidence supporting attainment of goal two relating to the integration of instructional technology in teaching and learning included examples or discussions of a new technology-rich experience being used by a faculty member. One cohort’s website discusses the creation of a web-based community for use by preservice science teachers. Another cohort investigated the development of high-quality online course supports and produced numerous examples. One cohort produced a website with audio resources to provide examples of Spanish dialects for foreign language teachers. Another cohort investigated the use of a Classroom Performance System, which allows the instructor to use a technology augmented polling device in a lesson. And, a special education specific cohort worked to use a presentation program to help students tell social stories as a way to help the students learn and use positive behaviors.

A variety of examples existed that provided evidence of progress towards attainment of goal three relating to engagement of cohorts including information that communicates the sustainability and replicability of the cohort model. One cohort developed a process and an online survey tool that will be used in placing technology proficient student teachers in cooperating classrooms. The cohort working on gifted education has developed a web and CD version of a gifted education class that will be used and revised in an ongoing basis.

A cohort specifically targeting recruitment has developed a web site and marketing tools that describe how technology literate students use their skills in teaching careers. The recruitment goal is also being addressed by those cohorts who include high school students including a cohort that produced online classes about economics, the Spanish dialect site cohort, and a cohort that pairs teacher education and high school students in addressing social studies issues.

Many cohorts created web-based methods of communicating with schools in alignment with the fifth goal, using information technology to improve communication and collaboration with professional development and placement schools. Four cohorts created technology enriched communications with placement schools. Two were web-based and featured teachers and students in local schools creating website to communicate about current events. Another used video to bring examples of teaching practice into the preservice program.

While the websites alone could be considered evidence of dissemination, the researchers held a more restricted view of dissemination. Clear evidence of dissemination of new visions of teaching, learning, and teacher preparation were found in references to conference presentations, brown bag type events, and academic papers. More than 15 papers and presentations are available on the Learning Generation site, evidence of attainment of the sixth goal, dissemination of new visions of teaching, learning and teacher preparation.

FACULTY INTERVIEWS ON ATTAINMENT OF THE LEARNING GENERATION GOALS

Method

Interview transcripts came from a structured interview specifically designed to elicit responses from faculty members who had been a part of a Learning Generation cohort about their experiences. The interview protocol included 19 questions. These focused on the faculty members' reasons for being a part of a cohort, their expectations about the roles of the various members of the cohort, results of their cohort, sense of satisfaction with the cohort, and the effects on their teaching. These interviews were conducted face-to-face by two interviewers who developed the interview protocols. Each interview session took approximately 30 minutes to complete. The interview transcripts were reviewed for responses patterns and information about the need for and effectiveness of the cohort activities.

Results

The interview transcripts yielded data about the effectiveness of the Learning Generation cohort process in two broad themes. These included technology skills development and the effectiveness of the Learning Generation model and processes. The technology skills development theme was represented by several types of responses. Some faculty members reported learning specific types of technology and related skills as typified by the comment, “I learned more about data-based web-sites and how to construct them.” Other faculty members reported being able to accomplish a task. For example, “...now my syllabus and discussions are online.” Another reported increased “..knowledge and experience with web sites as a teaching tool.” Faculty somtimes cited increases in their skill and confidence in using specific applications including, “...Dreamweaver and iMovie.” Others point to skills development that are occurring on the part of students in the class such as, “...being able to identify websites that are relevant to the course.” In addition to increasing technology skills, working in the cohorts benefited faculty in other ways. For example, faculty report the benefits of “...getting to know more new technology and developing a closer relationships with undergraduate students in the cohorts.”

The cohort model was effective for most faculty interviewed. In addition to skills development and an appreciation for the diversity of the groups that cohorts represented, the majority of faculty members interviewed reported that they would use a cohort like process on their own, perhaps in classes they teach in the future. When asked if they would use a cohort model in the future, a typical comment was, “Yes, I would like to do them in different grade levels.” When asked how well expectations were met one responded, “Wonderfully I’d do it again and would like to work in Innovation Cohort again.” Some faculty member reported that the cohort process was comfortable for them because “Team and collaborative teaching is what I am used to doing.” When asked would they use a similar cohort process in the future one replied, “Yes. It is in the nature of my work.” The Learning Generation cohort process was successful for several faculty members as illustrated by comments such as, “Everyone had expertise in different areas. Teachers did not need as much mentoring as originally thought. (There was an) increase in democracy of dispensing information.” Interview transcripts include generally positive comments about the process of working with students and others in the cohort process.

Evaluation of the Cohort Processes and Products

This evaluation found that the cohorts made considerable progress in attaining the goals used in developing the Learning Generation model. Numerous products are available on cohort websites that demonstrate current skills development and will likely contribute to future technology skills development. The product review found that many cohorts focused specifically on developing new ways to integrate technology in teaching and learning. Several faculty indicated that they plan to use cohort-like processes in the future, both in and outside of the classroom. This indicates that many of the initiatives begun in Learning Generation will be sustained. Many of the cohort websites present process information that makes it possible for others to understand and replicate. This increases the likelihood that more faculty at this and other institutions will consider adopting the cohort model. The potential recruitment of technology literate students is evident in the number of cohorts that work with high school students. The cohort specifically targeting recruitment is also developing a web site and marketing tools that seek how technology literate students can use their skills in teaching careers. Many cohorts include a technologically aided communications aspect to their work. Some cohorts made this a primary mission thus providing evidence to support the assertion that the goal related to the use of information technology to improve communication and collaboration is being met. Along with cohort websites, the numerous papers and presentations that are on the website point to success in the dissemination of new visions for teaching and learning.

This evaluation is somewhat limited because it represents a snapshot. Several of the cohort web sites are "works in progress." They have achieved much of what they had originally planned but work continues. This is desirable because it indicates strong local ownership and an ongoing quest to improve skills, ideas, and products. Further evaluation of the web sites products as well as follow-up questions for the interviews will be useful in revealing the long-term impact on learning and reform of the teacher education program. Another area for further examination is the long-term effect that the cohort process has on teaching practice. Several faculty reported that they would consider using a cohort process in their classes which may represent a significant departure in their teaching style.

Conclusion

With continuing advances in information technology and demands for more than 2 million new teachers this decade, there is a clear need for ongoing innovation in integrating technology in teacher education. Results from the survey on technology literacy skills indicate that student and faculty are relatively confident in their ability to use word processors, online resources, and basic computer functions but less confident in their ability to use spreadsheets, databases, and presentation software. Presentation software can be used as “shovelware” to replicate “chalkboard” displays of text and bulleted list in direct instruction. It can also be used in ways that support constructive learning where students research topics, form hypotheses and report conclusions in media rich presentations. When the cohorts received access to and minimal training in integrating spreadsheets, database, and presentation software and they often began to use these technologies to develop inquiry and project-based learning activities.

We also found that men scored higher than the women on their perceived understanding of basic computer skills and the use of presentation software. Interviews of faculty indicate that while some faculty (36%) recognize the positive influence that modeling has on their students’ use of technology, there is room for growth in this awareness. Further research is needed to investigate the relationship between faculty modeling the use of presentation software and other educational tools on their students across gender.

Learning Generation is designed as a systemic model for fostering technology integration in teacher education. The model is best understood in terms of its ability to sustain interest, ownership and collaboration in obtaining long-term reform rather than near term skills-based outcomes. Implementation of the model will benefit from several conditions including: a readiness for program reform in teacher education, a successful placement program, a supportive administration willing to fund technical and personnel needs, technology assistance, online resources, and an educational technology course. While an educational technology course is viewed as an important component, many of our faculty believe that students will benefit most when technology is integrated in their courses and throughout the teacher education program.

The Innovation Cohorts are designed to bring together faculty, teacher education students, practicing teachers and K-12 students in a group to create new ways of integrating technology in their teaching. The notion that gathering together in small groups is a productive way to advance reason is not new. Anthony Gottlieb (2001) described one of Socrates fundamental beliefs: "Philosophy is an intimate and collaborative activity. It is a matter for discussion among small groups of people who argue together in order that each may find the truth for himself." The intent is not to prescribe specific solutions but to create the conditions where innovation emerges as part of the group's dialogue. The audit of the products and interview of faculty affirm that the cohort model is advancing the integration of technology in the teacher education program. Faculty report developing a wide variety of skills and enjoying the collaborative grass roots nature of the cohort model. The web-based products, publication, and other dissemination strategies indicate that the model will be successful in sustaining the integration of technology across the teacher education program.

The nonprescriptive nature of the model leaves flexibility to institutions wishing to adopt a similar system. It would be possible for a single faculty member to support a small-scale implementation or there might be existing support structures in place which could be used to provide support to faculty and students who wish to work together in cohorts to drive technology integration. The model can be adapted to the support structure, goals and culture of different teacher education institution. Additional information about the model and examples can be found at the Learning Generation web site (http://learngen.org).

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