Filling the Gap with Technology Innovations: Standards, Curriculum, Collaboration, Success

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Abstract

Filling the Gap with Innovations is a study of a higher education professional development model used to infuse a teacher education program with technology innovations in order to address curriculum gaps. Professional educators at the university level are not traditionally collaborative. Yet, when an assessment of program alignment to state professional teacher standards identified six areas inadequately addressed by program content, instructors participated in a collaborative process to eliminate the deficiencies using innovative technology solutions. The three processes from the Concerns-Based Adoption Model (CBAM) helped instructors better collaborate during the change process as well as provided summative data. The results indicate collaborative practices had the most impact on the level to which the innovation was used and adopted by participants. (Keywords: professional development, community of practice, innovation, technology integration, curriculum alignment, collaboration.)

As they enter their university experience, the current population of preservice teachers are more equipped with technology skills than ever before, yet many of their instructors are unable to capitalize on technology's value due to lack of vision or limited understandings of the benefits that technology can offer to teachers in training (Owen & Demb, 2004). National Technology Standards for Teachers (NETS•T) and students (NETS•S), along with the adoption of technology integration guidelines at state and local levels have been created with the intention of guiding instructional design. Yet for some preservice teachers, these standards go by the wayside as they begin working with mentor teachers in the field, many who offer limited technology to their students. For these preservice teachers, the future implementation of their visions for technology integration feels hopeless, yet proponents of technology integration agree that all students should become technology literate as teachers, administration, and communities work together to change how teachers are prepared and ultimately held accountable to adopt technology. In a somewhat redundant report from the International Technology Education Association (2005) titled Realizing Excellence: Structuring Technology Programs, the association suggests that in the era of standards-based reform, agendas must include the preparation of technology teachers, the development of technology curricula, and measuring progress toward technology standards. It seems that this specific agenda has been proposed by other national organizations in the past, yet progress has not been widespread (National Staff Development Council, 2001; Fulton, Yoon, & Lee, 2005).

In traditional preservice programs technology integration standards are addressed by a specific course dedicated to technology. This approach has attempted to include both technology skills and instructional design within the technology integration framework. Seldom is technology integration substantially addressed within the context of the important core courses. Thus, students oftentimes don't see technology integration as a standard tool in their future classrooms. Instead, they see it as an optional addition when time permits.

In efforts to more fully infuse technology throughout all content areas in a teacher education program, to find uses of technology that add value to teaching and learning of core content areas, and most importantly to help make the use of technology be more meaningful for preservice teachers who will need to be risk-takers with respect to technology (Robinson, 2005), an innovative approach which coupled educational technology instructors with content area instructors was developed. The model's successes and limitations are the investigation of this study.

The Social Side of Change

Professional educators at the university level are traditionally not known to be collaborative, yet change of any magnitude is greatly dependent upon social influences. This could pose a problem to systems wishing to radically shift thinking in terms of how important knowledge and practices are addressed within a complex curriculum (Sawyer & Southwick, 2002; Wenger, 2001; Wenger, McDermott, & Snyder, 2002). Learning organizations willing to draw on their social capital and rely on each other's expertise might better be able to facilitate paradigm shifts in terms of delivery of curriculum (Hannan, 2005). An innovative curriculum and delivery method that emphasizes technology use for content-specific purposes, is consistent with constructivist pedagogy, and promotes discussions related to vision of technology integration needed in this age where technology could enhance many aspects of teaching and learning. Yet to take risks involved with adopting new technology within core content courses, faculty must sense that the technology proposed complements their teaching style and pedagogy, and they must feel they have the required technology skills (Finley & Hartman, 2004). These types of paradigm shifts and changes in content and delivery require champions (De Freitas & Oliver, 2005; Wenger, McDermott, & Snyder, 2002) and well-thought-out collaborative processes (Finley & Hartman, 2004).

Change and the community of practice. Rogers (2002) observed that although opportunities for individualized learning are increasing, there are sound educational advantages in group learning. The context for this type of environment is best constructed in collaborative environments where problem solving and multiple perspectives are represented (Pillay, 1997). Although change theorists agree that adopting new practices requires collaboration (Fullan, 1994; Hall & Hord, 2006; Bennis & Biederman, 1997), the social side of change can be tricky. New knowledge brought to a community must be carefully interpreted based on the particular situation of that community. In many cases, a boundary broker tackles the function of transferring reified knowledge by informing one community of practice (CoP) of the practices of another. When communities are of equal status, different expectations are normally reconciled. But when one community has more power, the less powerful CoP is constrained. This situation usually creates coherence and standardization at the expense of creative variation. As embedded into the community of practice model, this finding indicates that when creative energies are desired, top-down change mandates can stifle creative ideas (De Freitas & Oliver, 2005).

There are definite advantages for group interactions in professional settings. Collaborative experiences where communities naturally come together create unique learning environments where new practices emerge. This is partly because collaborative groups:

- can provide member support
- create challenges unavailable in isolated learning situations
- build more complex cognitive structures due to the representation of a variety of experiences
- are dynamic and can become a community of practice as it draws its members in (Rogers, 2002, p. 176)

Acceptance of new practices. King (2002) notes that for individuals, transformations take place in four stages: fear and uncertainty, testing and exploring, affirming and connecting, and new perspectives. These stages align with Hall and Hord's concept of level of concern (2006) as a way to measure individual perceptions on change and the developmental progression towards full adoption and renewal. For individuals, adopting technology innovations is developmental and ranges from the learning of basic operations to taking on leadership experiences (Hall, 2005).

"Innovating can be a rewarding experience, but it is unlikely to be so unless the institutions concerned make such efforts to enhance the learning of their students a high priority and back this in practice as well as in their rhetoric" (Hannan, 2005, p. 984). McGrail (2005) notes that initial motivation to become involved in the creation of a new innovation, or the adoption of a known innovation, requires that teachers have a positive perception of the impact on students as well as on their own instructional practices. This research also stresses that fear of becoming inefficient could inhibit interest. Individuals in an organization will generally have differing levels of interest in an innovation, some of which are dependent upon the content area they address. These individual differences make the adoption of technology somewhat unpredictable, especially since students adapt to innovations more quickly than faculty (Owen & Demb, 2004). In a learning organization where individual variables greatly impact social interactions, it is imperative that these needs be met (Sawyer & Southwick, 2002).

Viewing change holistically, both individuals who might adopt the change and their administrators all contribute to change efforts. But, instead of viewing individual issues associated with the adoption of change, administrators see technology integration as an optimal goal. Those administrators who recognize that their leadership plays an important role in enabling communities of practice to innovate will empower members to take risks, getting rid of obstructions, and will most likely progress toward their organizational vision (Hannan, 2005). Notable researchers of organizational change recognize that individuals within a system do not function in isolation, and that institutional vision and support are also required for lasting change to occur (Fullan, 1994).

Senge, a noted expert on organizational change, suggests that leaders take a stance against prescriptive models and instead begin to identify and understand the environments where a practice takes place. In an organizational development approach, relevant professional development is connected to the individuals within a practice in a comprehensive manner, and is focused on systems development. In his work with schools, Senge (2000) isolated five disciplines (practices) that contribute to the development of professional learning in schools:

1. Systems Thinking—Focusing not on particular practices, but on building collaborative relationships and structures for change.
2. Personal Mastery—Learning to keep both a personal vision and a clear picture of current reality in view.
3. Mental Models—Analyzing the images that we carry in our mind about ourselves, other people, institutions, and every aspect of the world.
4. Shared Vision—Setting an example of fearless and open community inquiry to change the practices of a school.
5. Team Learning—Developing quality relationships where people learn to work together in an ongoing process to learn new ways of teaching.

Organizational change and professional development experts suggest that collaborative mentoring relationships should be utilized and nurtured. These types of relationships that involve trust and place a high value on reflective dialogues are more likely to develop the type of social norm where learning and inquiry permeate everything. (Darling-Hammond, 1998; Fullan, 1994).

Mentoring. Scaffolding (Vygotsky, 1978), or mediated learning, can occur only through social interaction within collaborative environments. The mentor in any given situation can assist novices to work at a level in which they cannot yet function alone by guiding activities and modifying the type and amount of support. When mentoring takes the form of "joint participation in authentic activity, the primary purpose is to accomplish the task. The novice's learning results from his or her participation with the mentor in this activity" (Feiman-Nemser & Beasley, 1997, p. 110).

Gurus are experts who are identified by others within a CoP as experienced and capable of influencing novice practitioners wishing to explore possibilities and refine their work. Individuals can be gurus in one CoP, yet novices in another, based on the expertise needed within a particular situation. Mentors cannot be assigned or created by administrators. Instead, administrators within an organization have limited control over these interactions, but can help cultivate supportive cultures and influence the development of leadership skills to encourage mentoring relationships (Wenger, McDermott, & Snyder, 2002).

If experienced teachers opt to become mentors to novice teachers (Meyer, 2002), a variety of interactions can occur. Strong and Baron (2004) found that mentors focus on the elements of which they are in most control, that of the specific practice itself. Effective mentors tend to share their expertise without making direct suggestions or giving advice. The type of interactions that help novice teachers think about, interpret, make choices, and create values are not merely focused on learning new behaviors (Wang & Paine, 2001; Wang, Strong, & Odell, 2004), but on the construction of practices important to their profession. Those mentoring relationships which focus on the broader contexts of a practice (Wang, Strong, & Odell, 2004) incorporate co-engagement in authentic activities where participation between novices and gurus (Lave & Wenger, 1991), are thought to instigate lasting change in organizations (Foulger, 2005) and support the transition from novice to guru.

Overview of the Study

Background of the Study

Educational technology instructors were aware that faculty would need to focus on the learning needs of students in order for them to be most motivated to make changes in their curriculum, especially related to the integration of technology. To help create this internal motivation, faculty of a teacher education program were asked to assist with in an intensive analysis of the entire curriculum by first reporting the content taught in each individual course based on the Arizona Professional Teacher Standards (APTS), the standards by which education students would obtain their credentials. The specific standards addressed in each course were compiled to demonstrate the entire teacher credentialing program. The program's curriculum was checked against APTS. The analysis was then reported back to faculty so they could become aware of the level to which each performance objective was addressed, and which course(s) addressed them.

The analysis demonstrated that there were 14 performance objectives that were minimally addressed by instructors, but students were not expected to achieve them at the proficient level. Of those 14 performance objectives, educational technology faculty determined that six of the objectives might be addressed with technology tools. These performance objectives were brought to the attention of the faculty. With the advisement of educational technology instructors, suggestions for addressing four of the objectives through technology integration in appropriate content area courses were recommended. Four instructors representing four different courses volunteered to work with educational technology faculty during the upcoming semester to collaboratively address those standards using technology tools within content area courses. The goals of the collaboration experience were made clear to all participants: to strengthen the entire curriculum to more fully address the APTS standards and simultaneously integrate technology, to strengthen collaboration between educational technology faculty and the content area faculty who adopt new technologies supportive to their courses, and to increase technology skills of both educational technology and content faculty participants.

Filling the Gap investigated the social factors that influenced the adoption of new practices when instructors of educational technology pair with instructors of other courses, the concerns of instructors and how they changed as they adopted new practices, and finally the extent to which innovations took place.

Method

This study took place in three phases: (1) identification of program curriculum gaps and the most appropriate courses where each gap could be addressed, (2) brainstorming of possible technology solutions for identified gaps by educational technology instructors, and (3) filling the gaps by planning for and integrating innovative technology uses in content courses.

To determine the gaps in the elementary education preservice program, all elementary education faculty participated in an online survey which reported the level to which instructors addressed each performance outcome of the APTS. They reported on 77 performance objectives within the nine standards by indicating a range on a Likert scale from "not addressed" to "proficiency." This individual data was aggregated and reported back to the faculty. As curriculum and activities normally vary from instructor to instructor of the same course, data from those who taught the same course were correlated and reported back. Each group of instructors was asked to reach consensus regarding the degree of proficiency for each APTS by submitting one group response to the survey. Using the consensus data, six performance objectives were identified as not adequately addressed anywhere in the program at the independent or proficient level.

The four fulltime educational technology faculty worked collaboratively to match each of the six performance objectives identified as a "gap" with a course most likely to address that content and/or skill. Innovative technology solutions were identified as appropriate for addressing four of the six identified performance objectives. Each technology instructor took responsibility for collaborating with instructors of one of the four courses identified as having a possible technology solution for the identified curriculum gap. Instructors were approached to participate in the *Filling the Gaps with Innovation* project; five instructors volunteered across the four courses.

The collaborative process between the instructors of educational technology and the instructors of other content courses included the following five steps:

1. Meetings were conducted to understand the learning needs within the content course.
2. Educational technology instructors obtained technology tools and explored their capability to meet the learning needs.
3. The innovative technology strategy was integrated into the educational technology course during an "innovations day" where tools were explored, kinks were worked out, and dealing with chaos of innovative practices was modeled.
4. After this experience, the instructor pairs were equipped to plan for adoption and integration of the innovation in the content course.
5. Educational technology instructors assisted instructors of content courses as the innovation was used in the content course.

Data were collected and utilized for formative and summative means to analyze each research question. All three processes from the Concerns-Based Adoption Model (CBAM) helped technology instructors better collaborate with other instructors during the change process (Hall & Hord, 2006). The three tools from this model have been used for more than 30 years in educational settings to help understand the social side of change. To ensure validity of the study, CBAM tools were used to provide vision, measure successes, and understand concerns. Numerous researchers in multiple fields have used these instruments successfully. CBAM assumes that a proactive stance on change can help facilitators lead a cause that is responsible and beneficial (Hall & Hord, 2006). There are three useful tools essential to the model: Innovation Configuration (IC) mapping, Stages of Concern (SoC) questionnaire, and Levels of Use (LoU) interviews.

Innovation Configuration mapping was used in this study to analyze the social interactions throughout the project. IC maps are visual representations of major components of innovation with descriptors of the observable variations of each component. Technology instructors, along with the other instructors and administrators involved, created an IC map to provide a vision, create plans, design interactions, assess progress, and set goals. As visioning is dynamic, the map was revisited and revised periodically throughout the process.

Stages of Concern questionnaires were administered twice during the study to determine participant concerns and how they developed through the stages. The concerns are divided into categories: stages 0-2 identify concern for self, stage 3 represents concern for the task, and stages 4-6 represents concern with the impact itself.

- Stage 0 (Awareness) little concern
- Stage 1 (Information) concern to gain general understanding
- Stage 2 (Personal) concern for personal demands
- Stage 3 (Management) concern for attending to processes, tasks, and best use
- Stage 4 (Consequence) attention to impact on students; ownership of practices
- Stage 5 (Collaboration) focus on collaborating and cooperating with others
- Stage 6 (Refocusing) focus on exploration and revising/replacing use

Subscale scores were calculated using a multi-variant, repeated-measure analysis of variance.

Table 1: Innovations Configuration Map

Curriculum	Occurred at the Program Level	Occurred at the Individual Level	Introduced to Program Faculty	Did Not Occur
Elementary Education (EL ED) Curriculum: All APTS are met to independent or proficient levels by graduation.		POST	PRE	
Individual Course Curriculum: APTS met to independent or proficient level are consistent among multiple sections of like courses.	POST		PRE	
APTS needs drive changes in teaching and learning.		POST	PRE	
New technology is integrated in core courses to meet APTS.		POST	PRE	
Additional technology (beyond the APTS) is utilized for instruction when it enhances teaching and learning.		POST	PRE	
Elementary Education Faculty	**Occurred at the Program Level**	**Occurred at the Individual Level**	**Introduced to Program Faculty**	**Did Not Occur**
Interactions between educational technology course instructors support technology integration beyond technology courses.		POST	PRE	
Authentic community of EL ED instructors develops because instructors support each other's real needs.	POST	PRE		
Common EL ED identity is defined and represented publicly.		POST		PRE
Faculty Associates are integral part of the culture and events, and understand their teaching requirements.			PRE & POST	

Levels of Use interviews with content area instructors allowed educational technology instructors to identify varying levels of adaptations. Behavioral differences among identified levels of use were analyzed pre- and post-research, then dissected further through qualitative methods. As standard with this tool, nonusers were subdivided into nonuse, orientation, and preparation; users were subdivided into mechanical use, routine, refinement, integration, and renewal. These interviews were conducted and initially rated by a non-involved, third party who was trained in the tools administration and interpretation. The two researchers listened to recorded interviews and rated each interview independently. Scores were validated by all three reviewers. This process allowed for the researchers to make substantiated interpretations about effectiveness, progress, and institutional changes.

Results

What social factors influence the adoption of new practices when instructors of educational technology pair with instructors of other courses?

Collaboratively, an Innovations Concept Map (IC-Map) was initially created and subsequently modified during three formal meetings and several informal conversations of the Technology Instructor CoP. Initial conversations centered on what the innovation or change would look like once implemented. Using this shared vision, members of this CoP worked over several sessions to develop measurable criteria that would identify the level to which participants had implemented elements of the innovation. Once consensus of the IC Map was reached by the Technology Instructor CoP, the initial positions on the map for each criterion were identified. Throughout the project, the IC Map was revised based on participant feedback in order to promote buy-in among participants and expand the shared vision of innovation. The IC-Map, shown as Table 1, includes the final criteria crafted through this collaborative process and illustrates the outcomes expected of the *Filling the Gaps with Innovations* process in two categories: Curriculum, and Elementary Education Faculty. Upon completion of the project, each criterion was re-assessed as a) occurring at the program level, b) occurring at the individual level, c) introduced to the faculty, or d) did not occur. Pre and post assessment of the criteria are indicated in Table 1.

Curriculum. Progress occurred toward the shared vision of better curriculum alignment and technology innovation in the elementary educational teacher education program, as evidenced by the significant differences between pre and post IC Map data. Generally, change related to curriculum occurred at the individual level. As faculty identified the APTS in course curriculum, individual faculty members and small groups of faculty teaching common courses worked together to revise curriculum to better address teaching and learning needs. Additionally, technology tools were implanted to facilitate student learning toward the APTS by some faculty. Significant change took place when consensus was reached by all elementary education faculty deciding which APTS would be addressed in each course. This programmatic change solidified the core content of each course, which is particularly important when multi-section courses are taught by a variety of instructors. The common APTS addressed at the independent or proficient levels are included in course syllabi and now easily communicated to new or adjunct faculty. The collective efforts of the elementary education faculty also facilitated the creation of common assignments and assessments across multi-section courses that represent student learning toward the APTS.

Faculty. Movement toward the shared vision in the category of Elementary Education Faculty was less consistent. Stronger CoPs formed throughout the processes because of the authentic needs for collaboration as faculty came together to discuss the curricular changes. While some Content Area CoPs were more functional than others, all fulltime faculty and some faculty associates participated in part of the collaborative activities. Two criteria were noted as occurring at the individual level. The Technology Instructor CoP's interactions with the four participants who addressed curricular gaps with technology helped to bridge the integration of technology tools to the Content Area CoPs with whom the participants interacted. The support provided by the Technology Instructor CoP to the participating instructors established scaffolding for further technol-

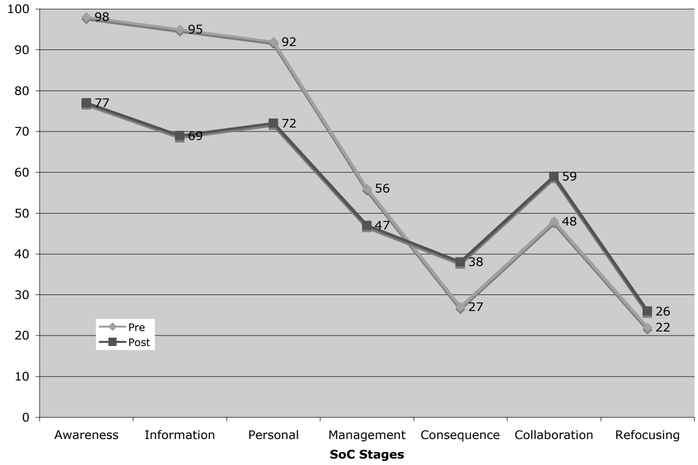

Figure 1.1: Pre-post comparison of SoCQ: P1

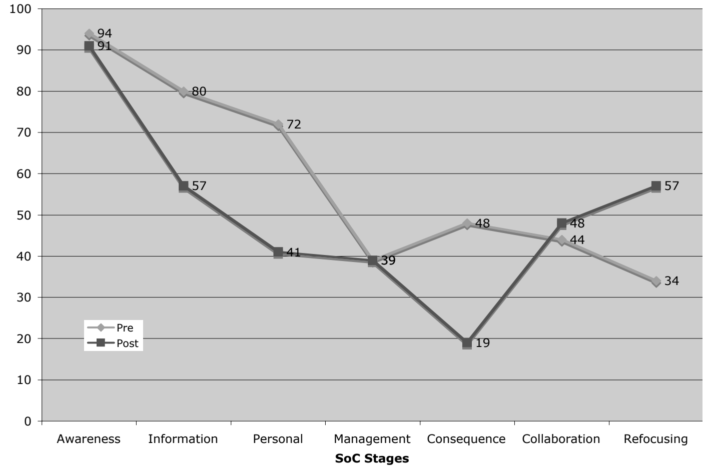

Figure 1.2: Pre-post comparison of SoCQ: P2

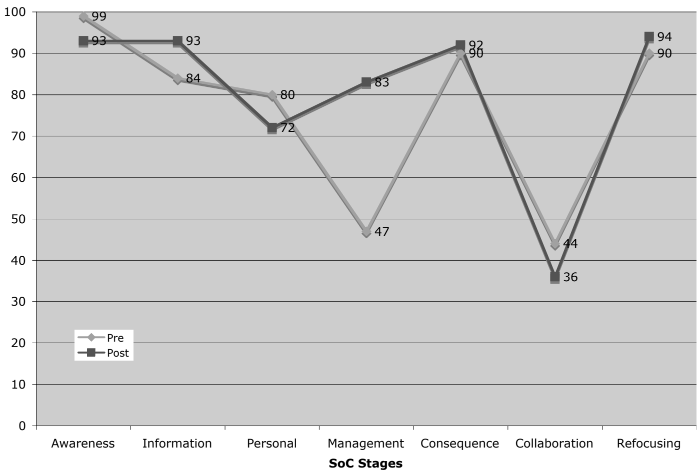

Figure 1.3: Pre-post comparison of SoCQ: P3

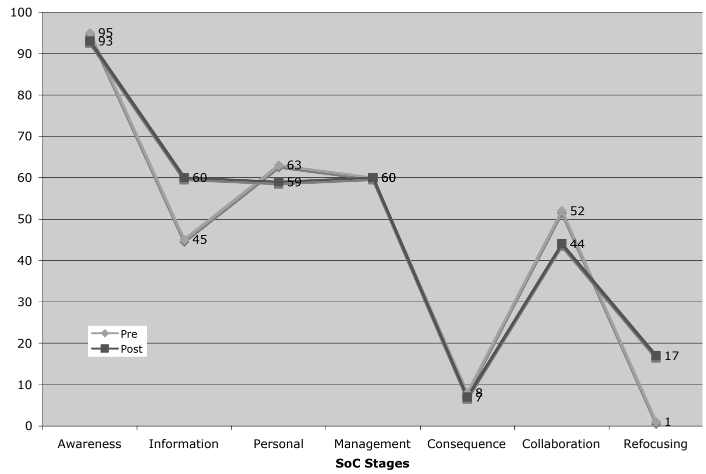

Figure 1.4: Pre-post comparison of SoCQ: P4

ogy implementation in content area courses. Additionally, a common identity surrounding technology integration began to build, but was not established at the program level during the time limitations of this study. Elements related to the evolving curriculum (e.g., technology rich instruction, course experiences in the field, student-centered instruction) were noted by faculty as key descriptors of the elementary education program, but a common identity was only shared by established CoPs. Involving Faculty Associates in the program alignment and innovation projects was introduced to the faculty, but was not accomplished. However, awareness of the need to and process for involving Faculty Associates was established.

How do concerns of instructors change as they adopt new practices?

The results of the Stages of Concern Questionnaire (SoCQ) provided an overview regarding content area instructors' concerns for change and innovative practices. Each of these four instructors represented in Figure 1 exhibits a unique profile, yet all remained at the initial stages. All four instructors initially expressed relatively high concern in the awareness stage, and 3 out of 4 participants expressed relatively high concern in the information and personal stages. This indicates that they were just becoming aware of the details of the innovation and concerned with what it involved and how it would impact them; the concerns were related to "self." There was little movement from this position evident in the post-survey. Overall concerns related to the task (Stages 3 and 4) and the impact of the innovation (Stages 5 and 6) remained relatively low. The ideal goal of a concerns-based implementation would have profiles representing lowest concern for self and highest concern at Stage 4 (consequence) and Stage 5 (collaboration). Participants were least concerned with the consequences of the innovation (Stage 4). However, 3 out of 4 participants expressed greater relative concern for collaboration.

All participants identified time as a concern for implementing the innovation. Two participants expressed concern about coordinating time with the students. Participant 2 wrote, "I am concerned about coordinating a time for telling the students about [the innovation] and how it works. I am balancing losing class time with what the students will gain by this experience." All participants also expressed a desire to know what personal benefit they would acquire by implementing the innovation. "What's in it for me" became a motivation and an obstacle in working with the participants during this project.

To what extent do innovations take place?

During the pre and post interviews participants responded to questions related to the categories in the Levels of Use. The results of each interview are represented in Table 2 (page 112), illustrating the beginning level and ending level for each participant in each category.

Figure 2 (page 112) illustrates the number of levels gained by each participant in each of the identified categories. Two of the participants showed significant growth gaining four or more levels in five of the seven categories. Participants transcended the least in Planning and Status Reporting. Participant 4 (P4) exhibited the least growth across the levels.

The Overall Level of Use is an independent category on the LoU interview protocol and not summative of the other categories. Participants who scored above level three on this item adopted the innovation and

Table 2. Level of Use Scores for Pre and Post Interviews

	Knowledge		Acquiring Information		Sharing		Assessing		Planning		Status Reporting		Performing		Overall LoU	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
P1	1	5	0	4	1	5	1	5	1	4	1	4	0	4	1	4
P2	2	6	1	6	1	7	2	5	2	6	2	5	1	6	2	6
P3	2	7	1	7	1	7	2	7	2	5	2	4	1	4	1	5
P4	0	2	0	2	1	1	1	2	1	3	0	3	0	1	1	2

made progress toward using it in their content classes. Two participants have plans to use the innovation tools without assistance from the educational technology faculty. One participant adopted the practice, but expressed a lack of comfort working independently with the innovation tools and students. "I see benefit to this. The students can do it and it's a valuable tool in the schools. I can do it as long as [educational technology instructor] keeps coming in."

Discussion and Conclusions

Although this model of professional development involving partnerships between instructors of educational technology and those in other content areas has proven to be very motivating and influential on integrating innovative technologies, another variable, that of collaboration, appeared to be one of significance worthy of investigation. For this study, varying degrees of collaboration took place. When looking at the data in light of this variable, the content area faculty who benefited most were those who participated in more interdependent and long-lasting interactions. Table 3 examines the relationship between adoption and collaboration.

The range of collaboration between the educational technology faculty and the content instructors varied from those who continually moved their agendas forward throughout the semester, to those who accomplished the project in a much shorter period of time. Ongoing communications allowed higher risk levels, more reflective thought, and higher comfort levels which greatly impacted content area instructors' willingness to adopt new technology. It was also evident that those partnerships where both parties equally committed to work together throughout the semester benefited the most in terms of personal satisfaction, level of adoption of new technologies, and commitment to future use.

The depth of collaboration also was noted to have impacted the adoption of new technologies. Those partnerships in which each relied on the other's expertise in terms of technology innovations (from the educational technology instructor) and the course content (from the content instructor) created situations where interdependence made way for thoughtful exchanges. It was in this environment of collaboration where new ideas were generated that were well connected with curriculum needs and utilized the power of technology tools. Interestingly enough, in one situation the understood needs of the students shifted to a more sophisticated venue, which has made way for yet another round of innovation.

This model of professional development and curriculum alignment is somewhat limited by the reliance on educational technology faculty to identify innovations, take on the chaos period by testing the innovations on their own students first, then working closely with content area instructors who wish to adopt the innovations. Although the educational technology faculty in this study are normally interested in the adoption of technology in other courses, there was a high level of dependence upon their social skills during the collaboration process. In all cases, collaboration surfaced as a prominent variable needed to reach

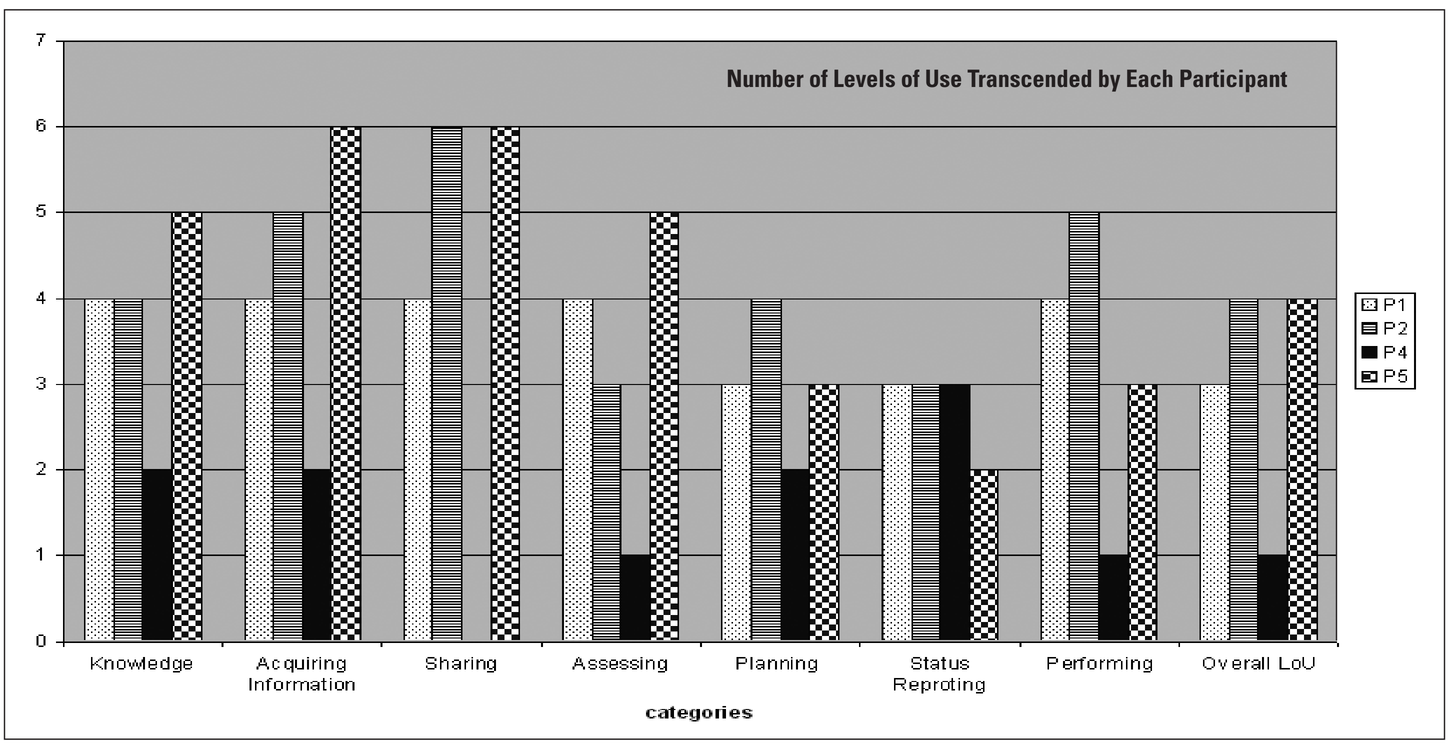

Figure 2: Pre-post comparison of innovative technology use based on the levels of use interviews conducted

Table 3: Comparison of Outcome and Collaboration among Content Area Participants

	Level of Application this semester	Adoption Expected	Collaboration Level (equal commitment from both partners)	Collaboration Amount (breadth)
Participant 1	Full, but was taught by the educational technology instructor.	Yes, as long as the educational technology instructor will assist in upcoming semesters	Shared needs and concern for student understanding of use of technology and fit within curriculum	Face-to-face throughout the semester
Participant 2	Full: taught to first section by educational technology instructor, taught independently to second section	Yes, at an independent level	Strong understanding of benefits of technology within an existing project, willingness to learn more	Mostly face-to-face with some email throughout the semester
Participant 3	Rejection of first technology due to lack of fit; partial adoption of an alternate technology which would better meet students' needs	Full adoption expected of second technology next semester	Strong understanding of technology provisions and curricular needs	Face-to-face and e-mail throughout the semester
Participant 4	None: Although self-exploration occurred, time did not permit use with students	Eventually, based on understanding of benefits to students	Strong understanding of connection to overall curriculum focus, but vague in terms of connection to specific topics or activities	Met at the beginning of the project, e-mail communication in the middle, then face-to-face toward the end of the semester

high levels of technology integration in the curriculum. Collaboration was more important than other contributing variables such as the need to align curriculum to APTS, integrate technology in courses beyond their own, or create an identity of technology for the college. Where strong collaboration existed, integration of technology was successful and common identity was fostered; those instructors that did not build a collaborative group, did not progress as far in the integration process or identity building. Thus, technology was not recognized as a part of the entire program's identity.

This model of aligning program curriculum to state-driven teacher standards in order to identify curriculum "gaps" and meet those needs with innovative technology has proven to be very successful but also very dependent upon collaboration. Level and amount of collaboration can be influenced by both time and skills. Unless both educational technology faculty and content area specialists meet these needs, success will be limited when using this model to adapt technology innovations.

Recommendations

If this model is expanded as an ongoing practice, taking place in new core courses each semester, it is expected that:

- further rounds of innovation would continue to refine technology used in each of the core courses currently under investigation
- rich technology uses would be evident in additional core courses of this program as more content instructors choose to participate
- students would benefit by seeing and using a large variety of technology used in ways which enhance their experience
- meaningful collaboration among instructors would increase, even for purposes beyond technology tools
- ultimately students would become users of technology with their future students.

However, this study showed that one very capricious factor, that of collaboration, must be cultivated. In order for this to take place, administrative direction and resources should be coupled with long-term interactions between educational technology and content instructors who work together. Further investigation is needed to explore what factors best foster stronger collaborative environments. This model should be tested under circumstances where the collaboration variable is more controlled.

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