An Academic Technology Initiative for Teacher Preparation Candidates: Implications for Preservice Teacher Programs

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Abstract

Schools of education (SOEs) are experiencing increased pressure to prepare teacher candidates for the effective and innovative integration of technologies. Lack of both ubiquitous on-campus access and effective modeling by SOE faculty are two often-cited barriers to reaching this goal. The Academic Technology Initiative (ATI) at a large Northeastern university provided laptops and support for all preservice teachers and faculty in an attempt to address these barriers. Using a grounded theory, ethnographic approach, this study examines how the removal of access and infrastructure barriers affects technology integration and faculty technology modeling. Our findings may help inform new technology strategies at both this and other universities designing such programs. We expect to identify new barriers and limitations that hold important implications for the future of the ATI and teacher preparation programs in general.

In recent years, schools of education have experienced both increased pressure and support to enhance and improve the integration of technology in teacher preparation programs. Organizations such as the National Council for Accreditation of Teacher Education (NCATE) and the International Society for Technology in Teacher Education (ISTE) have established standards for accreditation in an effort to promote the technology proficiencies of teacher candidates. Federal programs such as the Preparing Tomorrow's Teachers to Use Technology (PT3) initiative provided funding for SOEs to help better prepare teacher candidates to effectively integrate technology—such as wireless laptops—into the K–12 curriculum. At the same time, a surge of statewide K–12 laptop initiatives, including those led by Florida and Maine, serve notice that SOE graduates will increasingly be expected to teach with these tools (Laptops for Learning Task Force, 2004; Great Maine Schools Project, 2004).

However, despite increased availability of laptops and growing pressure, successful integration into the preservice curriculum remains a challenge for SOEs. This article describes the integration efforts of one such SOE at a large public Northeastern university, where a mandatory laptop policy for all preservice teachers was instituted in 2005-2006. We discuss the implementation and critically examine the first year results of the initiative. The present study examined the following questions: (1) With access and infrastructure barriers removed, how do instructors of preservice teachers use technology? (2) What implementation issues were overlooked or not anticipated? (3) What barriers, including those identified by Ertmer (1999), still remain? (4) How do these detectable barriers impact technology integration in preservice teacher courses?

The laptop initiative fit into the larger goal to produce graduates who can wisely integrate technology (including laptops) into teaching and learning. Research has repeatedly shown that to accomplish this objective, higher education faculty must model technology use in content and methods courses (Benson, Farnsworth, Bahr, Lewis, & Shaha, 2004; Hargrave & Hsu, 2000; Office of Technology Assessment, 1995; Panel on Educational Technology, 1997; Pope, Hare, & Howard, 2002; Willis & Mehlinger, 1996). Faculty modeling technology in these classes can provide both motivational and instructional information by reducing candidate anxiety, promoting confidence, and supporting the future use of technology in the classroom (Benson et al., 2004; Ertmer, 2005; Schunk, 2000). Personal and vicarious experiences shape the connections between teachers' pedagogical beliefs and classroom technology integration (Ertmer, 2005). Vicarious experiences with technology such as these relate to increased self-efficacy and increased technology integration (Ertmer, Conklin, Lewandowski, Osika, Selo, & Wignall (2003); Lumpe & Chambers 2001; Wang, Ertmer, & Newby, 2004). Effective technology modeling in methods courses can reinforce preservice teacher interest in technology and augment integration of subject-specific technology during the student teaching experience (Benson et al., 2004; Zhao & Cziko, 2001). Pope, Hare, and Howard (2002) further advocated requiring the use of technology throughout preservice programs in an effort to prepare teachers for the technology they may encounter in their own classrooms. And basic familiarity with technology, according to Zhao, Pugh, Sheldon, and Byers (2002), is prerequisite to using it to achieve higher-order learning goals. When coupled with opportunities for belief exploration and consideration of new practices, low-level technology use has the potential to develop into higher-level uses (Ertmer, 2005). In their evaluation of a PT3 implementation model, O'Bannon and Judge (2004) found the ISTE essential conditions of access, support, and professional development fostered instructors' ability to integrate technology for student learning.

Few would argue that technology integration by faculty across the preservice curriculum is optimal; however, education faculty face a multitude of barriers in their efforts. Ertmer (1999) identified barriers that prevent effective technology integration in K–12 classrooms. Ertmer categorized these barriers as first-order and second-order based on their characteristics. First-order barriers relate to issues of access. Second-order barriers relate to teaching pedagogy, strategy and skill and require more time and effort to address than first-order barriers (Ertmer, 1999). Ertmer (2005) has argued that even when first order barriers are addressed, additional barriers including teachers' pedagogical beliefs, may impact technology integration. When teachers feel they must adjust their pedagogy to accommodate the use of technology, they are less likely to integrate technology (Ertmer, 2005). It is a mistake to believe that by addressing Ertmer's first-order barriers that the second order variety will be any easier to overcome. While Ertmer's research focuses on K–12 environments, there is no reason to believe that the same barriers are not also present in preservice education programs at least to some degree. Technology integration is a slow and deliberate process for preservice teacher programs (Sandholtz, Ringstaff, & Dwyer, 1997).

Context

In an effort to more fully integrate technology throughout the preservice teacher program, a large Northeast university recently launched the Academic Technology Initiative (ATI). This initiative included the required purchase of notebook computers by all juniors who were beginning the school's Integrated Baccalaureate Masters' Program (IBM), a "five-year" program. The ATI provided additional support for these candidates including:

- A five-year subscription to an electronic portfolio service
- Unlimited access to Microsoft Office applications
- Access to the latest operating system
- On-site technical support

Each preservice teacher entering the program was assessed a technology fee and in return received his/her choice of a Mac or Windows notebook computer at the beginning of the junior year. The ATI also provided students with access to a wide range of educational resources and well-supported tools for communication, collaboration and learning. The laptop initiative, coupled with recently upgraded wireless capabilities on campus, addressed many of the infrastructure deficiencies that previously prevented faculty from integrating technology into their teaching.

Method

Participants. Ten of the 12 instructors who taught core courses or clinical placement seminars to the juniors during the first semester of the ATI implementation (Fall 2005) agreed to be interviewed regarding the interactions between the ATI, their course instruction, and student learning. These instructors' experience ranged considerably both in general teaching (1–19 years) and in teaching the core course or clinical placement seminar (1–12 years). Two of the 10 instructors taught an independent core course in the IBM Program; two shared responsibility for teaching one of the core courses. Six of the 10 interviewees, and the two instructors who were not interviewed, each taught one section of the same clinical placement seminar. The cited objectives for the courses considered can be classified into three general categories: (1) providing students with a wide introduction and awareness of how technology can enhance thinking and learning; (2) providing students with knowledge and understanding of learning theories and educational applications; and (3) providing opportunities to combine K–12 clinical placement with the core IBM courses.

Data Analysis. Interviews comprised of open-ended and multiple-choice questions were audio taped and transcribed verbatim. Pseudonyms were used to maintain confidentiality. Thematic analysis assisted researchers in deriving common patterns and themes from the interview transcripts while maintaining subjectivity (Lewis, 1995). The researchers used evidence from the interview transcripts to develop preliminary conclusions for each of the four research questions. Researchers then went back to the transcripts and searched for cases or instances from the interviews that might contradict the conclusions. After extensive searching, the reported conclusions were modified to account for negative cases. The researchers continued to revisit the transcripts, modifying the reported conclusions until they fully accounted for all negative cases. As a final measure of accuracy, member checking was conducted with the 10 interviewees. All 10 interviewees were contacted and asked to provide comments and feedback regarding the write-up. Three interviewees each identified one source of contention in the reported findings and the authors modified the write-up accordingly.

A grounded theory, ethnographic approach (Glaser & Strauss, 1967; Henwood & Pidgeon, 1994; Strauss & Corbin, 1990) was employed to analyze interview data and address the following guiding research questions:

- How do preservice faculty use technology once access and infstructure barriers are removed?
- What new implementation issues emerged?
- What barriers, including those identified by Ertmer (1999) still remain?
- How do these barriers impact technology integration in preservice teacher courses?

Interview questions are included in Appendix A. The interview data are summarized around the four research questions in the Results section that follows.

Results

Research question one states, "How do preservice faculty use technology once access and infrastructure barriers are removed?" Our findings indicate that instructors used an assortment of technology for instruction, including course management systems, competencies-based electronic assignments, Web page development tools, threaded discussion, electronic portfolios, e-mail, instant messaging (IM), presentation tools, personal response system, DVDs, podcasting, digital video cameras, Web cams, and electronic submission of coursework (See Table 1).

In the *Technology in Education* course, IM was used both during and outside of class, expectations were raised for student Web design and creation, online discussion cycles were moved out of class to save time, PowerPoint slides were uploaded to the course Web site, and the university's course management system was used as the primary delivery mode for all course materials. In the *Learning II* course, students searched the Web outside of class to locate teaching standards. The instructor for the *Learning II* course, Instructor A, went live to relevant Web sites during class, provided students with the URL addresses to use as practitioners in the future, and weighted technology-related assignments more heavily with the understanding that the laptops gave students unfettered access to computers and the Internet.

Instructors A, B, and C reported frequent and creative use of technology for student learning in the *Learning II course* and two sections of the *Technology in Education* course. For the *Learning II* course, Instructor A cited the incorporation of technology during each course meeting, and stated that technology was as a central component for three major student projects. According to the three instructors, technology use in these courses was firmly established prior to the ATI. While it seems that the introduction of student laptops did not fuel change, it may have supported faculty in using technology in new and creative ways.

Instructors D, E, F, and G could not comment on ATI-inspired changes to their course instruction as this was their first experience teaching the course. But discouragingly, they did not use the laptops at all. As Instructor D reported, "the short of it is that I didn't use the laptops in class as a way to supplement, complement or enhance pedagogy."

Interviewees were not asked directly to cite positive effects of the ATI, but often the discussion broached the idea of the changes that resulted from the ATI. Instructor C felt that the ATI supported increased dialogue with his students through IM. He discerned an improved level of communication with students; he believed that students shared more information through IM and e-mail than they would have face-to-face or over the telephone. Instructors A and C mentioned the enhancement of note taking as a marked improvement; and with their ability to upload notes to the Web prior to class, students could access, edit and print notes with ease. This ability greatly improved the dissemination of important information. Instructor A expressed her belief in the importance of the Initiative: "The use of technology as a tool is the most important innovation of the last 40 years. Why would we not use it? I'm going to continue to do even more in the future."

Table 1: Instructor Profiles and Use of Technology

	Years of Experience Teaching Course	Courses Taught	Technology Used in Course
Instructor A	7	Learning II	Competencies-based electronic assignments; e-mail; DVDs; electronic submission of coursework; presentation tools
Instructor B	2	Technology in Education	Course management system; competencies-based electronic assignments; threaded discussion; Web page development tools; Electronic portfolio; e-mail; personal response system; podcasting; Webcams; electronic submission of coursework; presentation tools; digital video cameras
Instructor C	11	Technology in Education	Course management system; competencies-based electronic assignments; threaded discussion; Web page development tools; electronic portfolio; IM; e-mail; personal response system; podcasting; Webcams; electronic submission of coursework; presentation tools; digital video cameras
Instructor D	1	Learning I	Competencies-based electronic assignments; e-mail; DVDs; presentation tools
Instructor E	1	Clinical Placement Seminar	Competencies-based electronic assignments; e-mail
Instructor F	1	Clinical Placement Seminar	Competencies-based electronic assignments; e-mail
Instructor G	1	Clinical Placement Seminar	Competencies-based electronic assignments; e-mail
Instructor H	2	Clinical Placement Seminar	Competencies-based electronic assignments; e-mail; electronic submission of coursework
Instructor I	2	Clinical Placement Seminar	Competencies-based electronic assignments; e-mail
Instructor J	2	Clinical Placement Seminar	Competencies-based electronic assignments; e-mail

Research question two states, "What new implementation issues emerged?" From our analysis of the data two new issues emerged: technical issues and program structure.

Technical Issues. The technical challenges cited by instructors centered primarily around wireless network capabilities and software restrictions on student computers. Seven of the 10 interviewees mentioned lack of access to the Internet as a major limitation; their courses were located in classrooms that either had no wireless Internet access, or could not support large numbers of students (>100) simultaneously. One instructor referenced an account of attempting to administer a final exam for students over the Web; with so many students accessing the network wirelessly from the same location at the same time, they were repeatedly dropped by the router in the middle of the exam. This same instructor cited the lack of a Web editor on student laptops as an impediment to student Web development for a course assignment. When asked what support would be required for further integration of the laptops in IBM student instruction, six interviewees cited securing wireless access to the Internet in the classroom and two mentioned improved access to the Internet with a large (>100) number of students (n = 2).

Program Structure. Instructors of both core courses and clinical placement seminars cited a lack of coordination between the core courses and clinical placement as a major limitation. In general, instructors wanted more dialogue and coordination between clinical placement, the clinical placement seminar, and core courses (n = 7), including a desire to raise expectations for student use of laptops in the practicum and clinical placement (n = 2). One instructor suggested training students to use their laptops as tools for conducting observations in K–12 classrooms.

Particularly for the technology core course, an absence of connection with the clinical placement and clinical placement seminar limited instructor ability to provide actual experiences using technology to address common misconceptions (discussed above) and foster student learning in K–12 environments. As Instructor B explained, the disconnect between clinical placement and core courses provided no incentives for students to use computers in their clinical placement. This same instructor believed that students might consider learning to use technology an additional "burden" required exclusively for the completion of technology core courses.

Research question three states, "What barriers, including those identified by Ertmer (1999), still remain? We found three barriers: professional development, pedagogical concerns, and loss of instructional control.

Professional Development. Instructors articulated specific professional development needed before further implementation of technology could occur in their courses. Three instructors expressed the desire for more training to use Web-based tools, two wanted release time to explore and learn emerging technologies, and one believed that support was needed to develop online chat rooms for students to access outside of class to extend classroom dialogue

Pedagogical Concerns. There was some concern among instructors of a risk of reduced interactivity (particularly for students with attention problems) between student and material, student and student, and student and instructor. In the words of Instructor D, "if I want students to talk to each other, then I say 'talk to each other.' I don't say 'go online and do it' when there they are sitting next to each other. That would just seem to be getting kind of crazy with the technology. Like, OK now we have these laptops and now we have to use them. Enough of our daily lives are spent on these laptops and them mediating our communications with others. When we do have [the students] together in a live classroom let's have them talking to each other."

Both Instructors A and D felt that having the computer in class might distract students from the lecture or course material and reduce face-to-face discussion between and among students and between student and instructor. Instructor A shared a fear that reliance on technology such as PowerPoint presentations might align the course more closely with the boring lecture style of instruction that students have come to dread. In her words, "We have to be cautious in the use of PowerPoint and Web sites because back in the old days when we had notes, people just lec-

tured from their notes, classes were brutally boring. Now, if people just use PowerPoint, it could be as boring a way of teaching as back in the days where people read from lecture notes. Now you're just reading from PowerPoint. PowerPoint and Web sites should be treated as tools."

How technology affects pedagogy was also a concern as evident by comments from Instructor D, "I'm not sure how I would even use [technology]" and "nobody's come up to me and said here's our vision for how you might use the laptops with [the students]. Nobody's told me or made any suggestions with respect to how I might use these laptops fruitfully in that venue. I'd love to hear it, if there is a compelling case…not even a terribly compelling case, just a good one that really suggests to me that I can enhance their learning and understanding of the content. I don't need anybody to hold my hand, but I would like some concrete suggestions as to how I might use [technology] in this context."

Loss of Instructional Control. Several instructors (A, D, I) felt that the use of computers in class supported students' ability to be off-task, either by instant messaging, completing other assignments or playing solitaire. In the words of Instructor D, "quite frankly I'd be a little bit afraid of having [the students] online doing something else. I think it requires a little more monitoring. That's a big concern with me. Maybe if you've got some sort of activity and you can really use [technology] but when that activity is not going on, [the students] still might be online and that is an issue for me."

Research question four states, "How do these barriers impact technology integration in preservice teacher courses?" Analysis of the interview data reveals that despite the removal of first-order barriers during the ATI implementation, at least some first-order barriers (related to access) and several second-order barriers (Ertmer, 1999) impacted the design of the core courses and clinical placement seminars. Of the three core courses and six clinical placement seminars, only one was developed in such a way that students needed to bring their laptops to class. Not surprisingly, this was a technology course. Several instructors explained that despite improved wireless access in the SOE and campus-wide, their courses were held in classrooms without wireless access, and that this factor affected their decision not to utilize student laptops during class.

Second-order barriers (Ertmer, 1999) (related to pedagogy, strategy, and skill) also impacted technology integration. Instructor A explained that her decision not to require the use of the laptops during class resulted from an awareness of students' individual learning styles, and that using computers may not support all learners. Six of the 10 interviewees (instructors D, E, F, G, H, and I) expressed a lack of knowledge of *how* to integrate technology and/or the student laptops to promote student learning.

Even when the conditions were present for technology use, (i.e. there was functional wireless access and students possessed working laptops), technical barriers continued to affect integration, even for instructors who were technologically savvy. As one technologically skilled instructor, Instructor C, articulated, technology usage grows and invariably exceeds the technological capacity. While initially the barrier may preclude use, preliminary barriers are overcome, technology usage develops, and the barrier reappears at a new level.

Significance and Future Implications

These data provide valuable insight into how instructors of preservice courses are using technology and what barriers remain even when an Academic Technology Initiative is put into effect. In this study, new barriers and limitations, both technical and pedagogical, were identified, including a fear of reduced interactivity—particularly for students with attention problems, structure issues centering on a lack of coordination between the core courses and clinical placement, and a lack of knowledge and understanding regarding the wise pedagogical integration of technology. Consistent with Ertmer (2005), Becker (1998), and The National Center for Academic Transformation (2005), we found that the influence of contextual factors, particularly pedagogical considerations, profoundly affected instructional change. First- and second-order barriers, including remaining infrastructure challenges and deficiencies in pedagogical understanding emerged and need to be addressed before innovation becomes practice (Ertmer, 1999; Sandholtz et al., 1997).

Clearly the SOE suffered from a lack of common vision and shared goals for technology integration. Instructors indicated they felt little pressure to integrate and model technology in their courses with the implementation of the ATI, and in turn there appeared to have been uneven integration and modeling of technology in the courses taken by juniors in the IBM Program during the first semester of ATI implementation. To be clear, technology was being used to support student learning, but not across the full range of courses taken by juniors in the IBM program. The three instructors who were using technology for student learning prior to the initiative (instructors A, B, and C) continued to integrate technology when the student laptops were introduced. In the words of Instructor A, "The initiative heightened my awareness of the use of technology. Before, I was aware of it and tried to incorporate it in increasing levels over the years. After it, I tried harder. I have consistently tried to use technology to engage and enrich student learning."

Professional development for faculty is an important consideration for the future. How to promote preservice teachers' ability to wisely integrate technology remains a challenge. Clearly articulated connections between clinical placement, clinical placement seminars, the technology core course, and the learning theories core courses are essential for supporting students' ability to integrate technology in their own classrooms.

In this case, simple surveying of instructors identified barriers potentially impeding the ATI's success. Relative to the amount of work invested in the development and implementation of the ATI, scheduling courses in wireless classrooms and forming connections between clinical placements, clinical placement seminars and core courses seem to be fairly straightforward solutions. Four instructors were asked during the course of the interviews whether they had informed the administration of their ATI-related concerns and without exception, they replied that they had not. As one instructor quipped, "I don't lie awake at night worrying about how I'm going to integrate technology. I have enough [other issues] to worry about." This is likely the case in many educational institutions; instructors are overwhelmed by the day-to-day responsibilities and if they are not questioned directly, important ideas, opinions, issues, and solutions are lost in the shuffle.

The success of the ATI, and of educational technology initiatives in general relates only partially to the actual technology employed. The ultimate goal of the ATI and related programs is to enhance the quality of teaching and learning. While the removal of access and infrastructure barriers fostered only minimal progress with regard to technology integration and instructor technology modeling, a significant limitation of this study is a lack of baseline data regarding technology usage prior to the implementation of the ATI. Without this information, it is impossible to discern the precise changes that resulted from the ATI.

The results of this study will inform new technology strategies at both this and other universities contemplating such programs. These findings will inform the future direction of the initiative and have implications for the teacher preparation programs in general. In the next phase of the evaluation, we will examine how students are using the computers beyond their teacher preparation classes, whether implementation of the ATI has fostered student learning, and what influence the initiative has had on student attitudes, knowledge and behaviors. This phase should provide important information regarding the effect of such an initiative on student progress, performance and enrollment. After addressing bar-

riers and limitations identified by instructors, future investigations may reveal whether and how improved access and faculty modeling increase the likelihood that students integrate technology into their own instructional methods, planning and instruction.

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APPENDIX

A. Interview Questions

1. What are the objectives for your course(s)?

2. What, if any, changes to your instruction have you made that relates to the IB/M Juniors all having laptops this past fall 2005?

3. How much of your class time, if any, did all students need to have their laptops in class in order to participate?

4. What barriers, limitations, or obstacles do you see to expanding your use of laptops with your IB/M students?

5. What, if any, resources/training/support would be required for you to integrate laptops even more into your instruction with IB/M students?

Have you used the following resources in your instruction this fall with the IB/M Juniors (respond "yes" or "no"):

6. WebCT: a) online syllabus ____ b) online grading ____ c) course materials ____ d) threaded discussions ____ e) synchronous chat ____ f) online quiz/ surveys ____ Taskstream: ____ a) Competencies-based electronic assignments (DRFs) with associated scoring rubric ____ b) Web page development tools ____ c) threaded discussion ____ d) electronic portfolio ____

7. E-mail: What is your preferred e-mail client? IM: What is your preferred IM?

8. Presentation Tools: a) Personal Response System (PRS) ____ b) PowerPoint slides ____ c) Cable/Live TV ____ d) Videotape, Movies, DVDs ____ e) Podcast or other audio broadcast ____ f) Web-pages you made with assignments for IB/M students (e.g., Webquests) ____

9. Web-page construction tools for student use (Dreamweaver, Frontpage, Go-Live) ____

10. Digital Video cameras/ webcams in use on student laptops ____

11. Grading Tools: a) PeopleSoft course listings and online grade submission ____ b) Excel spreadsheet grade book ____

12. Did you accept electronic submission of coursework (such a papers sent as .doc e-mail attachments or .ppt presentations)? ____ If so, was it submitted via e-mail, disc, memory card, shared file storage (drop box)?

Editor's Remarks continued from p. 78

Vermillion, Michael Young and Robert Hannafin provides a thoughtful and detailed analysis of teacher education faculty members' attitudes and behaviors with respect to a laptop initiative. The authors describe several barriers to faculty use of the laptops in instruction and thus share information useful to educators designing such programs.

Most of our readers are familiar with the idea of using technology to address problem areas in the curriculum, but I suspect that few of us have applied this approach in our teacher education programs. In "Filling the Gap with Technology Innovations: Standards, Curriculum, Collaboration, Success," Mia Kim Williams, Teresa S. Foulger, and Jody O'Connell describe a process designed to infuse a teacher education program with technology innovations selected to address identified gaps in the program's curriculum. The authors then present data collected from the experience and describe the variables in the adoption of the innovation by faculty members.

I believe that our readers will find that the results reported in the timely articles in this issue useful as we work together to create and improve innovative and high-quality teacher education programs in which technological pedagogical content knowledge is consciously built.

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