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Educate at Penn State: preparing beginning teachers with powerful digital tools

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Abstract University based teacher education programs are slowly beginning to catch up to other professional programs that use modern digital tools to prepare students to enter professional fields. This discussion looks at how one teacher education program reached the conclusion that students and faculty would use notebook computers. Frequently referred to as one-to-one initiatives, there is ample evidence that Penn State College of Education's program is not another false summit in the pursuit to have technology transform teaching and learning.

Keywords Teacher education · Notebook computers · One-to-one computing · Educational technology

Introduction

The preparation of individuals for teaching elementary and secondary students, like many other professions (e.g., accounting, agriculture, architecture, dentistry, law, nursing, and social work) has over the last century occurred at the college or university level. As the use of computer and telecommunication based technologies has increased among professions, professional preparation programs at universities have sought to keep pace by preparing beginning practitioners with these tools. For example, architectural students who 10 years ago studied drafting with pen and ink now use computer programs to learn and do drafting. Even as we have seen the prevalence of computer and telecommunication based technologies significantly rise

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in K-12 education settings, teacher preparation programs have been slow to embrace these tools. Recently, however, the pace has begun to pick up.

Although Penn State's College of Education is not the first teacher preparation program to require notebook computers of its students, it is among a small number of early pioneers who are using mobile computer technologies to prepare beginning educators. This discussion considers this requirement in the context of educational technology broadly, and in teacher education specifically. Following a brief historic perspective on educational technology, we will explicate the thinking behind our decision to require all incoming teacher education students to bring notebook computers to class.

What does the preparation of beginning teachers look like when decisions about the inclusion or use of technology are principally driven by a desire to support and extend our core practice? This question will be address through an analysis of a pilot program conducted in our teacher education program. After presenting a description of the teacher preparation program and the pilot program, several examples underscoring how technology supports our core efforts will be presented. Findings from our pilot program will be followed by a discussion centering on a proposal to expand our conception of technology use in education.

Categorizing educational technology, a brief history

The history of technology use in educational settings, whether K-12 or higher education, is littered with instances of technology integration that can be categorized as either replacement or add-on. Central to the replacement ethos is the notion that newer is better. For example, 16 mm film was replaced by VHS tape, and chalk boards are being replaced by white and or "smart" boards. The add-on ethos is similar to the replacement ethos, in that it focuses on newness, but extant structures are pointedly ignored. Personal computers in educational settings have mostly fit in the add-on category (viz., Becker 1983, 1985). Moreover, the numerous calls that have been made by various individuals and organizations for the inclusion of technology in K-12 settings, from A Nation at Risk (National Commission on Educational Excellence 1983) to ISTE's standards (www.iste.org/NETS/), frequently look like add-ons.

Categorizing technology as either replacement or add-on might appear at odds with widely held notions about the relatively conservative nature of K-12 education (cf. Cuban 1986; Tyack and Cuban 1995). Reform efforts seeking to alter both the content and method of K-12 education have paralleled the introduction of personal computers in schools, and this parallel goes a long way to explain both the apparent inconsistency and the history of K-12 technology integration over the last several decades. As Means (1994) notes while education reform and the introduction of personal computers paralleled one another, "… the movements are fundamentally disconnected" (p. 3). In suggesting that technology can be used in either innovative or traditional ways, Means was neither the first, nor the last to comment on the agnostic nature of technology. Her comments did, however, come at a time when

much of the ink generated about technology in education focused on how it was going to transform teaching and learning.

The characterization of technology as agnostic, or unbiased, from a pedagogical or content perspective is perhaps the most important reason personal computer technology has not, to date, had the transformative effect on teaching and learning its boosters boast. Moreover, structural constraints, whether they originate at organizational (Murray 2006) or at individual levels (e.g., Jackson 1990; Rosenholtz 1989) effectively dampen the potential of innovations to transform teaching and learning. In light of this, it is no wonder that colleges of education have been slow to explicitly embrace educational technologies in the preparation of beginning educators. This approach, or mode of interacting with technology is, however, not unique to education. Even in industry or other professions where there are very compelling motives to make use of computers, change has been slow. For example, Brown and Duguid (2000) note that even technology oriented organizations have faltered in their attempts to move to what was hailed as a high watermark in the march of high technology: the paperless office. The idea that information conveyed on paper provides certain authority, which does not translate well to electronic mediums, can be interpreted as a critique of the replacement ethos of technology. Organizational researchers have also noted some caution with regard to how we think about technology use in organizations. In a study that considered the effects of a new technology on an existing practice, Barley (1986), provides a convincing case that while technologies may be agnostic or content free, how they get taken up in social situations, or organizations is both complex and interactive.

It is from this perspective that we are building a program to make use of digital tools (hardware in the form of notebook computers and software in the form of an operating system and accompanying multimedia consumption and authoring applications) to support teacher education. Exploring directions in ubiquitous computing and teacher education, or EDUCATE is the umbrella under which these efforts fit. The idea underscoring ubiquity is one of two features that makes EDUCATE very different from other educational technology efforts. Notebook computers with wireless access to networks have finally delivered on the promise of anytime, anywhere computing. The second significant feature of EDUCATE is software that lets students and faculty collect, consume, edit, or author and share rich representations of their work.

A central principle of EDUCATE is that the core of what we do—preparing beginning elementary educators teacher—remain central to our efforts. An important implication of this principle is that technology is limited to a support role. We do not offer courses that focus on learning to teach with technology. Technology use is driven principally from a space where its function is to extend, amplify, or support our core effort of preparing beginning elementary educators. This notion of where and how technology fits, parallels ideas that have begun to emerge in education where the emphasis in K-12 classrooms has begun to shift away from a focus on what teachers do toward what pupils learn (Putnam and Borko 2000). For the noneducation researcher, these shifts might seem small or unimportant. They are, however, quite consequential.

Context of our work

The Elementary Professional Development School (PDS) Partnership is a collaborative teacher education initiative undertaken by State College Area School District and Penn State University (www.ed.psu.edu/pds). At the time of the pilot study reported in this manuscript, we were in our 12th year of the relationship, and the 8th year of a formal partnership. All ten elementary schools in the district are part of the PDS; thus we see ourselves as one PDS with common goals and vision distributed across the school district. The central goals of the PDS are to (a) enhance the educational experiences of all children, (b) ensure high-quality induction into the profession for beginning teacher, and (c) engage veteran teachers and teacher educators in ongoing professional development.

Veteran teachers in the PDS are known as mentors, and they participate substantially in leadership roles. Most notably, mentor teachers collaboratively plan, and in some cases co-teach, methods courses for university students in the program with university faculty. University students in the PDS are undergraduate elementary education majors who apply to participate. We refer to them as interns in part because they abandon the Penn State calendar during their senior year and adopt that of the school district, completing a yearlong internship in schools. More specifically, PDS interns begin the academic year one to 2 weeks before their peers return to campus, and they graduate and return to their classrooms to complete the school year. Of the 300 students admitted to the elementary education major at Penn State each year, approximately 60 are admitted to the PDS. During the fall semester of the program, interns spend four full days each week in their placement classrooms. They take 15 credits of coursework in the evenings and on the fifth day, which include science methods, mathematics methods, social studies methods, and classroom learning environments. In the spring semester, interns spend fives days each week in classrooms, take a professional seminar, and focus on conducting teacher research in their classrooms. Prior to participating in the PDS, interns complete a series of courses in language arts, art, and music education.

Since the initial development of the PDS program, technology has played a major role. Prior to the EDUCATE pilot, the use of technology was organized around three major strands. In concert with the goals of the PDS internship, the first strand was to enhance K-12 students' meaningful learning. This included the use of powerful learning tools, such as real-time data collection devices in science, and exploring the world beyond the classroom (e.g., Web-quests). The second strand was aimed at supporting teacher learning and development. Some examples of our approaches included the use of electronic teaching portfolios, video analysis of teaching, and other tools for supporting teacher research. The final strand was aimed at using technology in support of building and maintaining communities of practice (e.g., synchronous and asynchronous communication tools).

In this sense, the use of technology in the PDS has a history of being embedded and supporting core elements of the preparation of beginning elementary teachers. Moreover, these uses are more sophisticated than modal uses of technology in

educational settings, i.e., PowerPoint driven lectures, word-processed documents, and e-mail.

Tensions and solutions: the educate pilot

EDUCATE came about through the confluence of tensions surrounding the use of technology in the PDS partnership. First, because methods courses are taught on site in the elementary schools, we were in direct competition with classroom teachers for the computer labs. Given that we always defer to the importance of K-12 student's learning and classroom instruction, the methods course instructors used technology less and less frequently in their courses. Second, we shifted from using a simple, but discontinued, Web page creation tool (Claris Homepage) to using a sophisticated and complex tool (Macromedia's Dreamweaver) for the development of teaching e-portfolios. This move generated a need for intensive technology support for interns, and the faculty began to notice a significant shift away from a focus on thoughtful reflection to technology difficulties and anxiety. In contrast to the steady decline in technical support required by interns, moving from Homepage to Dreamweaver generated a spike in the number of calls to the school district's technology help desk; increasingly our interns were seen as a burden to the school district.

In Fall 2004, the PDS faculty approached our Associate Dean of Technology, Professor Kyle Peck, for assistance. We anticipated support in the form of a graduate student and possibly some technology resources for PDS methods instructors. What Professor Peck proposed was a bold vision for moving our teacher education programs forward—a proof of concept for a one-to-one notebook computer initiative in the PDS. The next few months were a whirl of activity as we prepared to provide all PDS interns and instructors with Apple iBooks for the 2005–2006 internship year. EDUCATE at Penn State was born.

One of the most important investments made initially was in the professional development of faculty. In addition to becoming familiar with the operating system and standard multimedia tools available on the iBooks (iPhoto, iMovie, GarageBand), we spent substantial time with faculty rethinking class time and course work—before students were given iBooks to use in class. Emphasis was placed on how in-class interactions could be transformed by everyone having access to powerful digital tools and the Internet. Each methods instructor identified several signature assignments to modify, or in some cases reconceptualize, to make the most of multimedia authoring. We also considered how to share intern-created content more broadly within the community. Sample assignments will be shared later in the manuscript. The organization and structure of the PDS provided important constraints that helped faculty focus on how the iBooks, accompanying software, and wireless network connections could amplify, extend, or deepen the content and pedagogy of the PDS.

Another key strategy for early success was to coordinate efforts closely between technology support at Penn State and the school district. Our goal was for interns and instructors to be able to move seamlessly from one context to the next. This

included coordinating a disk image, providing wireless Internet access for interns (i.e., Penn State students) on school district systems, and clarifying support roles. It was decided that issues of instructional technology would be directed to school district personnel, while technical issues associated with hardware and software would be directed to PSU personnel. This division of labor has been successful, and we still use it today. State College Area School District also redefined the role of interns as beginning teaching in the district, providing them with access to software used to support curriculum and district-wide professional development. By being proactive in attending to the technology needs of interns, the district has cultivated an important human resource, and interns are now viewed as instructional technology leaders in schools.

Interns in the pilot reported having little or no experience using the Macintosh operating system and related tools. In response, we organized a series of opportunities for students to make the switch from a Windows to the Macintosh operating system and familiarize themselves with the software needed for course assignments. The initial half-day session was aimed at getting the iBooks into the hands of interns and training them in "care and feeding." This was followed by a school district session in which interns learned to navigate attendance systems, servers, and online report cards.

Professional Development School instructors organized technology training opportunities on a rotating schedule based on the tools that were to be used with particular assignments. For example, the first use of iMovie was for Classroom Learning Environments and used still photographs and music to construct a slide show with captions and narration. Faculty teaching that course introduced the software in connection to the project. Later in the semester, interns worked with the children in their classrooms to develop Public Service Announcements (PSA) for social studies methods using video clips, music, captions, and narration. Instructors in that course built on interns' existing experiences with iMovie to develop the PSA project. Finally, at the end of the semester, interns used video of their own science teaching to create edited movies of the highlights. By then, they were comfortable using iMovie and did not need further instruction. Similarly, the science methods instructor was the first to introduce podcasting, so she taught the interns GarageBand. Using this model, instruction on using software was distributed across instructors, and interns received professional development on demand.

Sample assignments

In this section, we will describe three signature assignments from the methods courses taken by PDS interns and how they have been approached differently in light of the EDUCATE pilot.

Analyzing learning environment

In the Classroom Learning Environments course, instructors begin the semester by asking interns to visit a variety of classrooms during the first week of school and

observe the ways in which teachers have set-up their classrooms to build community and support interaction and learning. Prior to EDUCATE, interns wrote about their observations in their journals and discussed them in class. The assignment has been transformed to a first-hand data collection and analysis activity. Interns now work in small group to take digital images of the classrooms they visit. They use ideas from seminal readings to examine the images or data for patterns. These patterns are articulated in the form of claims about the influence of the physical setting on supporting learning environments and supporting evidence in the form of images is provided.

Intern groups develop a slide show using iMovie and share and discuss their findings with peers in class. Instructors report that the quality of early conversations about classroom learning environments has improved using this approach, and interns identify this assignment as one of the most meaningful they engage in during the fall semester.

Greenwood furnace podcasts

In the science methods course, interns support the school district's fifth-grade curriculum by facilitating stations during an annual field trip to Greenwood Furnace (GWF) State Park, where students participate in a water quality study. To prepare for their part in the field trip, interns must develop an adult understanding of content and issues associated with water quality. In addition to taking them to GWF to engage in the stations as learners, we ask them to conduct subject matter research on a variety of topics related to water quality, including macroinverebrates, pH, temperature, turbidity, human-environment interactions, etc. In the past interns worked in groups to develop reports that were shared with peers online. This assignment shifted to a podcast series when EDUCATE began. Interns work in groups and develop podcast episodes on a water quality or testing topics. The criteria for the assignment requires that the content is accurate and, in addition, engaging and educational for fifth-grade children. Final products for the first group were shared in iTunes: Podcasts and teachers were able to access them for use with the children in their classes to supplement the curriculum. In this way, the project has a greater impact than merely within the methods class, reaching young learners in the PDS community.

Analyzing science teaching

We have used video artifacts to support the development of science teaching in the PDS for a number of years. Throughout the semester, interns work to develop a conceptual framework and associated approaches for teaching science as inquiry and argument (NRC 2000, 2007). They analyze model lessons and online video-based cases, which give them opportunities to critically examine fundamental aspects of science teaching and learning before they teach science in their placement classrooms. When they do plan and teach a sequence of three science lessons in the fall semester, they record their teaching. In past years, interns' reflections on teaching took the form of a 10–12 page paper in which questions provided by the

instructor guided their written analyses of teaching. In addition, interns were asked to select a 10-min video segment from their teaching to highlight a particular tension or accomplishment in their teaching and submit that with their paper.

In keeping with EDUCATE, the video analysis of science teaching project has been modified. Interns edit down their three science lessons to a collection of purposefully selected segments that best exemplify central elements of teaching science as inquiry (e.g., supporting children in constructing a scientific claim from evidence). Interns then narrate their justification for the selection of the particular practices portrayed in the clips. The final video submission is still 10–15 min long; however, instructors report learning much more about interns' abilities to translate knowledge into practice, as well as being able to provide more targeted feedback to individual interns. Additionally, the video artifacts can be used with groups of interns to share differences in practices associated with a variety of grade levels and content areas. Rather than being a mechanism for feedback for an individual's teaching, the video analysis project has become a vehicle for engaging interns in powerful conversations about practice that move the community forward.

Lessons learned from the pilot

Throughout the 3 years of the pilot project, we have collected data from interns about their use of technology via online surveys. Results from the first year of EDUCATE are reported here; however, findings have been remarkably consistent across groups and over time. During the fall semester, interns in the first cohort responded weekly to a brief online survey. In the spring semester, they participated in more lengthy surveys with diminished frequency (three times across the semester).

When asked about their stress levels related to technology use in general, interns initially reported high levels of stress that reduced dramatically by about the fourth week of the internship. During this time, multiple technology-rich assignments were introduced across coursework and field experiences. Even though all but one of the interns was switching from PC to Mac, interns reported becoming very comfortable with their iBooks within the first 4 weeks of the fall semester, which parallels reductions in their stress levels concerning technology in general. The level of comfortableness with iBooks among interns rose to more than 98% in the spring. By the 6th week in the semester, interns reported increases in their iBook use, from 6–10 h per week to 11–15 h per week. This increase continued through the final weeks of the fall semester.

Not surprisingly, interns did not report teaching with technology until the final weeks of the fall semester. This is consistent with the shift from observing in classrooms in the fall to increasing levels of responsibility for teaching in the spring of the internship year.

At the beginning of the spring semester, interns were asked to identify the two to three technology-rich assignments from their methods coursework that influenced their development as a teacher. More than half identified the video analysis of science teaching assignment described previously. The quote below is typical of the

way in which interns described the video analysis project. "In SCIED I created an iMovie. It was useful for me to evaluate and reflect on my science teaching. I found that I learned a lot about what I am capable [of] as a science teacher and where I would like to improve…. I believe that the iMovie allowed me to look at the tape from a different eye. If I had just reflected on just my videotape, I might have gotten hung up on how I was standing or talking to the students. Instead, by having questions that I had to answer, it forced me to look at the tapes a number of times for specific more focused aspects of my teaching. I got past looking at superficial aspects of the tape and explored more my inquiry techniques as a teacher. I was able to find strengths and areas I need to improve." The GWF podcast and the PSA for social studies—which they apparently viewed as curriculum development—were other assignments that interns identified as shaping their development as teachers. The analysis of classroom learning environments assignment also received high marks from interns.

In the spring, interns also were asked to identify two to three methods course assignments that influenced their thinking about how to use technology to support children's learning. With an emphasis on learning to teach with technology, more than half of the interns identified the PSA and GWF podcasts as having an impact on their teaching. The intern quote below exemplifies how interns talked about using technology to support student learning.

"The podcasts were a great assignment that influenced my thinking about how to use technology to support children's learning. Podcasts allow students to present information learned in a whole new way that is interesting and exciting. The students can be as creative as they want while presenting newly learned information."

When asked about their iBook use in the spring semester, 20% of interns reported 6–10 h of use at school, with another 13% reporting 11 or more hours of use at school. When it came to using their iBooks outside of school, 44% reported more than 15 h of use each week. When asked how they were using their iBooks in the spring, 94% of interns indicated they designed lessons and activities with them. Personal reflections on instruction and online research for lesson or unit development also rated high in terms of activities for which the iBooks were used.

While pointing to several successes, there are two indices we think represent the success of EDUCATE. First, elementary education majors number approximately 360 students in the college. The PDS enrolls approximately 60 of these students. After three years in the PDS, the elementary education faculty voted to extend EDUCATE to the entire program. Secondly, in the pilot phase of EDUCATE, PDS interns were loaned iBooks. In the last 2 years, more than 90% of PDS interns have asked to keep the notebooks loaned to them. Moreover, in the majority of instances, these interns began their internships as owners and users of Windows computers.

Discussion

Based on the findings presented in this discussion, EDUCATE appears to represent a significant development in the quest to utilize technology to improve teaching and

learning. At institutions like Penn State (e.g., Michigan State University, Teacher's College, and the University of Wisconsin among others) where research and teacher preparation co-exist, researchers and teacher educators are continually looking for ways to transform teaching and, by extension, student learning.

By focusing on the fundamental aspects of teaching and learning in the PDS, the EDUCATE pilot succeeded in moving what educators and students can do with technology to a level long sought after. The success of EDUCATE is evident in the decision of the elementary education faculty to require all incoming elementary education students to bring notebook computers to class in the fall of 2008. In the pilot notebook computers were loaned to interns, and the decision to require students to bring their own notebook to class beginning with the fall 2008 terms was made only after a unanimous faculty carefully weighed the benefits accrued in the pilot. The confidence of the faculty also appears to be shared by students who participated in the pilot. Teaching is not a well-remunerated field and the fact that such a high percentage of interns choose to purchase their loaned notebooks speaks volumes about their confidence in the toolset. The ways in which technology was used in the EDUCATE pilot go far beyond replacement or add-on, and we think represents a category that can have profound effects on teaching and learning. When technology is used to extend a core practice, transformation of that practice is possible. To date technology as extension has been conspicuously absent in education. EDUCATE at Penn State is on the verge of changing this fact.

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