Editor's note:
This article represents the first part of a two-part study on diffusion of electronic portfolios in teacher preparation programs. It is the beginning of an intensive investigation of this innovation, which has become the topic of considerable dialogue among teacher educators, their institutions, and other professional preparation programs. We have chosen to present the information in this manner (in the summer and fall issues) to encourage dialogue among our readers. Please feel free to send me your thoughts, questions, or personal experiences, and I will attempt to publish some of them with responses from Strudler and Wetzel. JRTE *strives to promote the type of dialogue that will further our efforts to articulate a "proactive research agenda for educational technology."*

The Diffusion of Electronic Portfolios in Teacher Education: Issues Of Initiation and Implementation

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Abstract

This descriptive study investigates the diffusion of electronic portfolios in preservice teacher education by documenting the context and emergent practices in six programs identified as mature in their implementation. Context variables examined include prior use of paper portfolios, pressures for standards-based assessment, and leadership and governance issues. Variations in program implementation are also explored including the portfolio tools employed, artifact selection, evaluation of student work, and the role of reflection. Findings of the study suggest that amidst the common themes across programs, there are numerous variations in approaches to e-portfolio use. The authors conclude that further research is needed to examine the future directions for e-portfolios envisioned as well as specific advice for those in earlier stages of adoption or implementation.

INTRODUCTION

This study investigates the diffusion of electronic portfolios in preservice teacher education by documenting emergent practices in their use and the process by which those practices are adopted and implemented. The focus of this study is to examine mature, well-articulated efforts in programs in which faculty and students have used electronic portfolios program-wide for two or more years. Specifically, it seeks to answer the following two research questions:

1. What was the situational and historical context in which electronic portfolios were adopted and implemented?
2. What do the various facets of the electronic portfolio process look like as implemented?

Portfolios in Teacher Education

The use of portfolios has a rich history in teacher education. In a survey of schools, colleges, and departments of education (hereafter referred to as colleges of education), Salzman, Denner, & Harris (2002) found that 89% reported using portfolios for some type of assessment. As technology has advanced, some institutions are moving from or are considering moving from hard copy to electronic portfolios (Bartlett, 2002; Gathercoal, Love, Bryde, & McKean, 2002; Smith, Harris & Sammons, 2001; Williams, Wetzel, & Wilhelm, 2004; Yancey, 2001). Colleges of education have marshaled resources to help them prepare for and develop electronic portfolio programs, as demonstrated by the fact that 50% of the 400 U.S. Dept. of Education's Preparing Tomorrows Teachers to Use Technology (PT^3) grant programs focused at least in part on implementing digital portfolios in teacher education (Britten, Mullen, & Stuve, 2003). An examination of the annual proceedings of the Society for Information Technology and Teacher Education (SITE) revealed 52 papers presented in 2003 and 56 in 2004 that focused on electronic portfolios in preservice education.

What Are Portfolios and Why Are They Used?

Shulman, an early proponent of educational portfolios, defines the teacher's working portfolio as a "structured documentary history of a set of coached or mentored acts of teaching, substantiated by samples of student portfolios, and fully realized only through reflective writing, deliberation, and conversation" (1998, p. 37). Preservice student portfolios document their journey in becoming a teacher. Preservice students select, share, and reflect on artifacts such as educational philosophies, classroom management plans, unit and lesson plans, plans to meet the needs of diverse and special needs pupils, and video clips of practice teaching. Portfolios make learning visible, and thus faculty members and students focus on learning in new ways (Yancey, 2001). In general, such learning portfolios are based on a constructivist philosophy. Students may be expected to take responsibility for selecting artifacts, making connections to standards, and interpreting their own learning.

Portfolios can also be used to promote or market students for employment opportunities. The hiring or employment portfolio includes work samples that showcase students' preparation to be teachers. It is designed to help students secure teaching positions. The audience is school district principals or others involved in selecting teachers.

Other approaches to portfolios are primarily designed to meet the needs of the programs or institutions (Barrett, 2004; Fagin, Hand, & Boyd, 2004). Teacher education programs are increasingly being asked to align curriculum and student outcomes with state and national teacher education standards. For programs, faculty, and preservice students, standards provide direction for artifact selection and organization of the electronic portfolio. Students thus create these portfolios to satisfy outside readers. Often rubrics are used to evaluate the included items. The evaluation data are aggregated and disaggregated to demonstrate that a program is meeting the necessary standards. Colleges of education also use the data to show where improvements are required.

In addition, portfolios can be used to determine whether individual students meet the requirements for certification and graduation. Portfolios assessed for these purposes can be considered high-stakes assessments. Several states mandate portfolios for this purpose.

What Tools Are Used To Create Electronic Portfolios?

Colleges of education are selecting one of two routes to portfolio creation. Some use off-the-shelf tools such as Microsoft Office and various Web authoring applications. Others use commercial Web-based systems (e.g., Chalk & Wire, Johns Hopkins' Portfolio System, Live Text, Professor Portfolio, and TaskStream). Off-the-shelf programs are productivity tools that students use to design their electronic portfolios. Commercial systems are Web-based and assist students with the construction of their electronic portfolios as well as provide for the storage and managing of the information in the portfolios.

THEORETICAL FRAMEWORK

The theoretical framework of this study is grounded within the change theory of Fullan (2001) and Hall and Hord (2001). Together these bodies of work serve as a lens for analyzing specifics of the change process. A discussion follows of selected themes of that work that are especially relevant to this study.

Phases of the Change Process

Fullan (2001) outlined three broad phases of the change process:

1. Initiation or Adoption—consisting of the process that leads up to and includes a decision to adopt or proceed with a change.
2. Implementation—usually the first two or three years of use, involving the first experiences of attempting to put an idea or reform into practice.
3. Continuation or Institutionalization—referring to whether the change gets built in as an ongoing part of the system.

Fullan notes, however, that these phases offer a simplified version of a "detailed and snarled process" (p. 50). He adds that the process is not necessarily linear, "but rather one in which events at one phase can feedback and alter decisions made at previous stages…." (p. 50). For example, a decision made at the adoption phase to use a particular program may be later modified during implementation.

Change Is a Complex, Socio-Cultural Process that Takes Time

Hall and Hord (2001) view change in education as a complex process that takes a minimum of three to five years, with large-scale innovations taking longer. Fullan concurs that the "total time frame from initiation to institutionalization is lengthy; even moderately complex change takes 3 to 5 years, while larger scale efforts can take 5 to 10 years with sustaining improvements still being problematic" (p. 52). One explanation for this difficulty is that an organization

will not change until individuals within it change (Hall & Hord, 2001). Furthermore, the culture of the organization can present a major obstacle to implementing new ideas and practices. Fullan (2001) quantifies this challenge in what he calls the *25/75 Rule for Educational Change* in which "twenty-five percent of the solution is having good directional ideas; 75% is figuring out how to get there in one local context after another" (p. 269). Fullan (2001) supports this view in citing the work of Senge, a prominent theorist on organizational change. Senge wrote, "The fundamental flaw in most innovators' strategies is that they focus on their innovations, on what they are trying to do—rather on understanding how the larger culture, structures, and norms will react to their efforts" (p. 99). Hall and Hord (2001) agree that most change efforts overly emphasize development at the expense of implementation.

Governance Issues

In view of the challenges of implementing large-scale educational change, one might ask what governance structures best address these challenges? Primarily referring to K–12 schools, Hall and Hord (2001) assert, "Although top-down and bottom-up change can work, a horizontal perspective is best" (p. 10). Interestingly, both Hall and Hord and Fullan (2001) acknowledge that top-down change—that is, change mandated from administration—can be effective. Hall and Hord qualify that mandates can lead to successful change if accompanied by support, training, and an understanding of the change process. While noting that top-down change often leads to resistance during implementation, Fullan writes that administrative mandates can have positive results if the proposed change is indeed a good idea and is "combined with empowerment and choices as the process unfolds" (p. 67). In summary, the literature supports a horizontal or balanced approach to governing change that depends on administrators' support and assistance in securing resources as well as the eventual "buy-in" from those who will be most involved in implementing the change.

METHOD

This study employs case methodology (Yin, 1989) to investigate the adoption and implementation of electronic portfolios within teacher education programs. During the first phase of the study (Wetzel & Strudler, 2005), the researchers sought to identify teacher education programs in which the use of e-portfolios is well-articulated and mature and optimally in place for a minimum of two or three years. A call for nominees was posted on several listervs pertaining to teacher education and technology, including AERA, SIGTE, and AACE. The call stated:

> "We are conducting a study of on the use of electronic portfolios for teaching, learning, and assessing in preservice teacher education. We will survey, interview, and then visit selected teacher education sites to investigate current and emergent practices in the use of e-portfolios. For this study we are seeking nominations of institutions that are accomplished users of electronic portfolios. Programs that you recommend should

be well articulated and mature with faculty and students who have optimally used portfolios program-wide for a few years. You may self-nominate your program."

In addition, we reviewed related literature and polled experts in the field. Twenty-six programs were nominated by one or more of their peers or were self-nominated. The nominees represented 25 universities in 15 U.S. states and one Australian university. As programs were identified through the various methods described, a letter of nomination accompanied by a brief survey was sent out to deans to gather information about the 26 programs nominated, including purposes for electronic portfolio use and the dates of program-wide adoption. A follow-up reminder was sent to deans or the deans' designees of the programs nominated who did not complete the survey within two weeks. Twenty-three of the 26 deans or their designees completed the survey.

The 15-item questionnaire was administered using Survey Monkey's online survey tool (The survey is available at http://coe.nevada.edu/nstrudler/survey3.pdf). Upon analysis of the surveys, phone interviews were then employed to gather more data to inform the final selection of six programs for the case studies. The primary criteria for selection were the length of time that the electronic portfolio program had been in place and the extent that it is a program-wide venture that involves a large percentage of faculty and other personnel. Beyond seeking programs that are advanced in their use of electronic portfolios, cases were selected based on variations in their emphases and approaches. Variables considered were differing purposes for the portfolios (e.g., accreditation or accountability versus learning and reflection); low versus high stakes in terms of exit requirements; prior history with print-based portfolios; the size of the program; public versus private universities; and the employment of off-the-shelf applications versus commercial systems for creating portfolios.

Data Sources & Analysis

Based on surveys, phone interviews, and review of Web sites and relevant documents, six programs were selected: California Lutheran University (CLU), Eastern Kentucky University (EKU), Indiana University of Pennsylvania (IUP), Johns Hopkins University (JHU), University of Rhode Island (URI), and University of Iowa (Iowa). Site visits were scheduled for the research team during November and December 2004 for approximately three days each. During that time, semi-structured interviews were conducted with teacher education faculty, university administrators, teacher candidates, recent graduates, and technology support providers. We opted for a non-random, purposeful sample of informants arranged with the help of one or more people serving in a liaison role at each of the universities. In some cases additional interviews were scheduled during the site visits based on information gathered during those visits. It was our intent to interview a cross section of informants that reflects a range of perspectives and participation in the process. Overall, we conducted 80 interviews of individuals and small groups with 124 informants in all. The interviews ranged from 15 to more than 90 minutes in length. The average interview took approximately 45 minutes.

In addition, we reviewed supporting artifacts and observed various facets of the implementation process, taking field notes throughout the visit. As with the interviews, in addition to classroom observations scheduled by our hosts, impromptu observations were arranged during our interactions with various informants.

During unscheduled intervals during the visits and subsequent to the daily schedule, the researchers discussed reactions to the interviews and observations. Notes were recorded and any unanswered questions were noted for follow-up in subsequently scheduled interviews. It was our goal in each of the site visits to probe into any unclear areas so that by the end of the visits, we arrived at a clear picture of each program and how it was perceived by the various stakeholders.

All interviews were audiotaped and transcribed, and then analyzed using HyperRESEARCH Qualitative Analysis Tool. Using the constant comparative method (Strauss, 1987), data analysis began as data were first collected and continued throughout the study. Data were triangulated as our review of documents and field notes from observations served to confirm the trustworthiness (Lincoln & Guba, 1985) of the interview data.

We began by reading and rereading our field notes and transcriptions of the interviews. Guided by the research questions, we coded the data, beginning with a common set of codes established by the researchers. As the study progressed, we revised our codes as needed to reflect the data gathered. Eventually we arrived at 50 unique codes, a subset of which was employed for this article.

Drafts of individual case summaries were written for three of the sites visited. Due to time constraints, the remaining cases were summarized through discussion among the researchers. Then, based on the cross-case analysis, drafts of the paper were written and sent to key informants at each site to check for accuracy of the data and feedback on our analysis. Corrections and modifications were then made to the paper as needed.

RESULTS

1. What was the situational and historical context in which electronic portfolios were adopted and implemented?

As previously described, sites for the case studies were selected for the degree of program-wide implementation of electronic portfolios and for variations in terms of the mission and size of the universities, and their approaches to and goals for electronic portfolio use. Table 1 provides a summary of program characteristics of the six sites visited. Further elaboration on selected data from Table 1 follows, organized by the following themes: prior experience with paper portfolios, impetus for adoption of electronic portfolios, leadership and governance, and grants.

Background: Prior Experience with Paper Portfolios

In analyzing data across cases, we looked for factors that led the various programs toward their early adoption of electronic portfolios. We found that five of the six sites selected had substantial program-wide experience with paper portfolios prior to working with electronic portfolios. Furthermore, we found

Table 1. Summary of Program Characteristics

	CLU	EKU	IUP	JHU	Iowa	U of RI
Approx. # Teachers Certified Annually	80	800	500	200	385	250
Public or Private	Private	Public	Public	Private	Public	Public
Carnegie Classification (2000)	Masters I	Masters I	Doctoral/ Research Intensive	Doctoral/ Research Extensive	Doctoral/ Research Extensive	Doctoral/ Research Extensive
Primary Certification Program	5th Year Initial Licensure	Undergrad	Undergrad	Master's	Undergrad	Undergrad
National Accreditation Body	NCATE	NCATE	NCATE	NCATE	TEAC	NCATE
Program-wide Paper Portfolio/ Initial Purpose	Yes/State Standards (CSTP)	Yes/State Standards (KERA)	Yes/Job Seeking	Yes/INTASC	No/Used in some courses	Yes/State Standards (RI-BTS)
Grants to Support Planning	PT³ (1999)	PT³ (2000)	PT³ (1999)	PT³ (1999); Title II	No PT³; Funding sources not specified	PT³ (1999); 3 State Grants
Primary Tools	ProfPort, commercially distributed	Templates, Front Page	Template, HTML editors	JHU system, commercially distributed	Templates, HTML editors	In-house system

that several of the programs were strongly influenced by their state standards for beginning teachers. Cal Lutheran had a history of use of paper portfolios throughout the teacher education program starting around 1995–96. The portfolio artifacts supported the California Standards for the Teaching Profession (CSTP), which evolved from six standards to the current number of 13. Similarly, Eastern Kentucky initiated paper portfolios to address new teacher standards that were enacted by the Kentucky Reform Act (KERA) in 1990. The first paper portfolio required of students included a resume, sample lesson plans, a teaching philosophy, and introductory material. University of Rhode Island enacted requirements for paper portfolios in the late 80s, based on work that led to the Rhode Island Beginning Teacher Standards (RI-BTS), which were derived largely from the INTASC principles. At Johns Hopkins, in 1995 faculty started looking at INTASC principles and developed a process for paper portfolios.

An administrator from Rhode Island described their initial efforts with paper portfolios:

> … It began in student-teaching and methods block, when we had much of the same discussion that we had today, to tell you the truth—what are some of the types of tasks that someone would accomplish to show that they are a competent planner, that they can manage a classroom, that they can assess students…There was a state group that was meeting at the same time and we sort of had some synergy here on campus with that state group. And we began to utilize those in student teaching and in methods...and it was, you know, a unit plan, and an assessment of student work, and what we called a context statement, where, you know: "Describe a district and its key variables or factors which influence student learning, SES, etc., etc., state testing." So we had these series of tasks, and students then completed these paper portfolios.

At IUP, the initial impetus for electronic portfolios was to aid in students' seeking jobs. Explained an administrator, "The paper portfolio that they had was intended more to guide the students toward the creation of a job-hunting portfolio when they were to complete the program." At University of Iowa, paper portfolios were used in courses such as the student teaching seminar or as a culminating experience in art education, but were not implemented across an entire program.

Impetus for Initiation of Electronic Portfolios

Each case has its own unique interaction of factors that led to initiating their respective electronic portfolio programs. In this section we discuss themes identified in various programs as the main impetus for adopting electronic portfolios. Related factors such as governance, leadership, and grants are discussed in subsequent sections.

Transition from Paper Portfolios. As described above, a primary impetus for initiating paper portfolios at several sites was to meet state standards for beginning teachers. With that approach already established, it follows that the implementation of paper portfolios would pave the way for initiating electronic alternatives. Interview data suggest that paper portfolios posed several logistical problems that needed to be addressed. Faculty alluded to the onerous task of lugging around and sharing large paper portfolios. A professor at Cal Lutheran explained, "You had these rooms full of these four and five inch thick portfolios that we had to go through, so they were physically unwieldy." Another Cal Lutheran faculty member added, "We typically collected them at the end of the semester, so we had this truckload of binders that we needed to go through. It was a very laborious proposition." Another recalled, "We used to have portfolios lining the walls. Every student had one and we would pass them from faculty member to faculty member. Sometimes they even got lost. And that was sad but true."

An administrator from Rhode Island concurred,

> I'm sinking under the paper. Which ones do you keep? Which ones don't you keep? And you began to think about electronic portfolios. And we got some seed money to begin to develop that concept….

A professor from Eastern Kentucky reflected on the transition to electronic portfolios from paper to make it so that binder portfolio would become broadly viewable.

> The binder had not been around that long to say it was a permanent part of the education program. Then putting it into the e-portfolio form just seemed like a logical next step with the development of the World Wide Web and the ability to access things from remote locations. That's a large part of it.

To varying degrees, paper portfolios provided alternatives for faculty and students in terms of how student learning was evaluated. A director at Cal Lutheran noted that due to the prior paper portfolio use, the move to electronic portfolios "…was a technological leap but not necessarily a conceptual one in terms of assessment." He added, "If you're not into authentic assessment, then you're probably not going to appreciate what a Web folio system can do for you."

Standards and Accreditation. Whereas state standards were prominent in decisions to adopt paper portfolios, electronic portfolios were initiated in large part to address NCATE requirements for documenting teacher candidates' attainment of standards. A dean from one of the programs articulated what several others had noted:

> The impetus, to some extent, maybe more of an extent than I'd want to admit, is continuing NCATE accreditation, and the need to have very extensive, clearly archived records of how well students...are achieving the goals of the program.

A chair at Johns Hopkins explained their approach to implement electronic portfolios that would serve in lieu of a traditional thesis for their master's program. She stated that it's an exit requirement that becomes driven by needs of accountability and accreditation,

> When you are up against NCATE standards and specialty organization standards, how do you show evidence of this and this? You can point to some of it from observations in classrooms, but a fair amount of it can be hinged on their portfolios.

An administrator at Johns Hopkins stated that they developed an electronic version for their portfolio based on a structure already in place. Fortunately, Johns Hopkins had access to the necessary expertise in the Center for Technology in Education, an entrepreneurial unit housed within the college of education.

Although Iowa had initial plans for electronic portfolios to support the professional placement of their teacher candidates (i.e., marketing/hiring), it became a means for addressing state and national mandates for standards-based performance assessment. Stated a University of Iowa administrator, "Obviously, it's a tool for moving through accreditation." A Rhode Island administrator discussed the challenge of tracking student progress across programs and the potential of electronic portfolios to help:

> I think that the requirement that you will have data across programs, and you've got to keep that straight in some fashion. Every program has a different task and a different rubric and a different scaling system, you're really talking about some resources to be able to give any judgments about how well are students doing.

Leadership & Governance

Leadership for electronic portfolios can come from the top (i.e., administration) or from faculty and staff. While the literature supports the effectiveness of a combination of top-down and bottom-up leadership, it also suggests that administrative mandates can work when accompanied by the allocation of resources and meaningful faculty input over time. Clearly, data in this study suggest that the approaches to leadership and governance are key variables in how the initiation of electronic portfolios were received by faculty and ultimately implemented. While it is beyond the scope of this paper to explore leadership and governance issues in depth for each case, selected themes are described.

Respect and Vision. Interview data illustrate many examples in which informants recognized the influence and leadership of those who are respected by others. One University of Iowa professor noted:

> The discussion of the e-portfolio was spearheaded by [a staff member and administrator]; they're the ones who really got

> that going. They're both very well respected here, and if somebody else had come in with this idea, it might not have gone over so well, but they're both very well respected and they're good at building consensus and making adjustments.

A University of Iowa faculty member confirmed this regarding that particular administrator. She explained, "Everybody has such respect for ____ that they're going to do it [electronic portfolios]…. But I never got the impression that anyone's passionate about it like, for example, their research."

When asked about influential leaders, a Rhode Island faculty member noted:

> He was one of those faculty members that everybody looked to and was respected and known across the university…He was always good at sort of cutting through the B.S., you know, "Folks, you can gripe all you like, but you're just wasting our time."

There were several comments about the vision of particular administrators and the respect that they command pertaining to electronic portfolios:

> We have a dean who saw the value of this, who was able to look in a crystal ball and see this is coming down the road. We have an associate dean who was nationally known in accreditation and standards movements, he's nationally known as a visionary in how this should be done. So we're very fortunate…

Selling the Vision. Part of leadership is communicating and "selling the vision" to others. One administrator commented on the effect of a faculty leader for electronic portfolios at Cal Lutheran:

> I think there's no doubt that [his] force of personality has made things happen around here because he doesn't take no for an answer. It's kind of funny and wonderful. The real impetus came from [him]. He knew about it. He was in love with it. He sold it.

A University of Iowa administrator elaborated on the importance of helping others establish a vision for electronic portfolios and spread their enthusiasm:

> Part of it was also a little-kid-like enthusiasm about look what we've got here! And see this again is where [two leaders] were so critical because they developed the frameworks that we could demonstrate to faculty even before we asked them to get started, so we could show them how user-friendly it was going to be, how relatively simple it was going to be, for them to upload their syllabi and to design their assignments that

were standards based, and how easy it was going to be for the students to follow up on that. So, there was a kind of gee whiz factor involved, and nobody wanted to say, "I don't get this. I don't want to do this."

One of the University of Iowa leaders described their leadership strategy for selling their vision by working with those who are most ready in large groups, small groups and one-to-one, with the hope that word will spread:

> We don't just bring it all together at one time. We try to start off with pioneers, like Art Education was one of our early pioneers…Elementary Ed faculty seem to be really in tune to ePortfolios, and so now we're putting in the pieces for our secondary education program. But you just can't do all of this at once. Incremental implementation and especially trying to find pioneer peers that the faculty respect and will follow is really key.

Finally, another electronic portfolio proponent at University of Iowa reflected on their commitment to develop and disseminate their electronic portfolio system:

> You couldn't pay someone to spend as much time as we did, but it was our baby—it was our passion. We knew it helped students, who thanked us endlessly for giving them these tools. And I don't know if an institution can really generate this kind of program without serious collaboration from the top to the very bottom.

Allocation of Resources. Resource allocation is a major prerogative of administration that clearly affects users' perceptions about particular initiatives. A large majority of the informants across cases noted the successful acquisition of technology resources as evidence of administrative support and leadership. At Eastern Kentucky, although faculty appeared to lead the effort to design the paper portfolio system, the primary leadership for the electronic portfolio efforts was reported to have come from the dean and other administrators. A chair assesses the effects of that leadership:

> It was an administrative decision. The leadership that we had at that time believed in technology, believed in the paperless format, and provided opportunities and resources for us to be able to move forward with that. But it took the right leadership at the top, all the way down. We had, during that time, a change of president; we had a change in the provost level, and a change in the dean of our college. All three very much aligned with the use of technology and moving forward. They moved the university forward very quickly in a short period of time. That was most helpful in that initial process to get it going.

In addition to obtaining technology resources, securing adequate human resources in the form of staff and faculty is critical. Several informants made note of efforts by administrators to fund the personnel necessary to support the respective electronic portfolio programs. For example, one chair alluded to their dean's effective leadership in securing resources to hire a technology coordinator for their college.

Involving Faculty. Inclusive and productive faculty governance can be a key component in contributing to faculty participation and satisfaction with the electronic portfolio program. Consistently, informants cited Cal Lutheran's collaborative culture and its positive effect on the adoption and implementation of electronic portfolios. A Cal Lutheran professor recalled the process in which electronic portfolios were discussed and adopted by the faculty:

> No, no. There was never a vote on that. ...These are our goals. If anyone has a problem with it, speak now or forever hold your peace. Because if we get this [grant], we will do it. And we got it, so we did it. But I think going and asking for buy-in, it then wasn't this top down thing because we had a committee that was working on this grant that included our partners in K–12 schools, and they all were in on this thing.

When asked if she was involved in conceptualizing and planning the electronic portfolio system, a Cal Lutheran administrator replied:

> We were all involved in those workshops where we talked about what it might be and what it could do, and here is how it works. And because we had the PT^3 grant, it gave us an opportunity to really delve in work and with it.

Although there were several comments about collaborative governance at the various sites, sometime committees were not involved in the initiative until after administrative decisions were made. As Fullan (2001) noted, however, administrative mandates can have positive results if the proposed change is a good idea and is "combined with empowerment and choices as the process unfolds" (p. 67). Interview data include many references to committees and other governance structures to get faculty input and potentially empower faculty in the process. For some faculty, that scenario worked, while others expressed dissatisfaction. For example, Eastern Kentucky faculty differed on their perception of the governance of the electronic portfolio process. Some faculty thought that the leadership did not sufficiently seek out their input, and others thought that input was adequately sought and it was time to move on and start implementing.

Along that vein, a University of Iowa professor acknowledged the mandate to implement electronic portfolios and reflected:

> We'll continue it [use of electronic portfolios] now because it's turned out to be a good way to show what we're doing in

> the program. But we also had this standards-based program dumped on us, and we had to figure out what to do with it.

In this particular case, the professor saw the value of the electronic portfolio program and suspended resistance in favor of program implementation.

An administrator at IUP summed up the pros and cons of the collaborative process:

> It's sometimes slower and more painful than to just put up the sign on the wall that says, "By Monday, the following will happen." But that would be a very unrealistic thing for me to do here—probably would be anywhere with faculty. But because they're not going to do anything this significant [implement electronic portfolios] unless they genuinely believe that this is the right thing to do. And I think that the support for the idea is built.

Grants

As reflected in Table 1 and in the prior narrative, PT^3 and other grant awards had a huge effect on electronic portfolio implementation across cases. Clearly, initiatives of this scope cannot be successfully implemented without adequate resources. In most cases, programs used the awards to fund the development of electronic portfolio software or templates, and in all cases funds were secured to provide critical training and support.

In some cases, the grants specifically were focused on electronic portfolios. For example, a faculty leader at Cal Lutheran recalled:

> Our dean came back from a conference and she said there's money available and you're going to write the grant. I said thanks. And so I immediately started getting school people together and we met in groups and we decided on goals and things that we would like to do, and included in that, one of them was that we will establish an electronic portfolio system and throughout teacher preparation…Then we got the grant and it was sufficient that we would employ Doug and Jerry as consultants and they would come in and we would set this up. We had enough money to buy our own server.

At Eastern Kentucky, an administrator brought colleagues together from Arts & Sciences and Education to write the implementation PT^3 grant. The first major component was to integrate technology and good pedagogical skills into general education classes, and to do this with teams from across the colleges. The second major component was to develop and implement an electronic portfolio program.

At other programs, their PT³ grants did not explicitly focus on electronic portfolios at first, though they did later on as the project evolved. Overall, all of the other programs secured PT³ grants and/or other major funding to support the level of change embodied in the large-scale implementation of electronic portfolios.

2. What do the various facets of the e-portfolio process look like as implemented?

A number of decisions must be made as colleges of education bring the electronic portfolio from an idea to implementation. For example, what electronic tool will be used? What will be included in the electronic portfolio and who will make the decision? How will the electronic portfolio be introduced to students? How will it be assessed? To answer the research question, these issues are addressed.

The Tools Selected

There was significant variation in the types of tools that were employed to construct the electronic portfolio. At three colleges (Eastern Kentucky, IUP, and Iowa), students built electronic portfolios using templates and HTML tools (hereafter, "tools approaches"). Two others (Johns Hopkins and Rhode Island) designed their own systems. At Johns Hopkins, students used a Web-based integrated system designed by the university that is now being made available commercially to others. Rhode Island developed its own system, but is examining other systems to replace it. Cal Lutheran collaborated with a university-based software developer to tailor a commercially available system to their needs. Although the electronic portfolios varied across cases, the template designers reported that their tools approaches met their program goals. To provide an overview of the tools approach, we will explain an electronic portfolio using examples from Iowa and IUP. The Iowa electronic portfolio system has three components: (a) the Digital Backpack containing standards, performance assessments and artifacts, and links to course syllabi, (b) a collection of best work for employment, and (c) The Cyber ToolBox, which stores materials for use after graduation (Achrazoglou, Anthony, Jun, Marshall, & Roe, 2002).

An Iowa faculty member explained that for their electronic portfolios, students download templates for each course.

> For example, here's one of our programs, these are index pages for Early Childhood, and here's the template, linked to the standards page…and here are all the classes that have portfolio elements in Early Childhood, so you can see that it's quite lengthy. So students don't have to ask, "Well, for what classes in Early Childhood do I have to upload artifacts?" This is the index page…Likewise, if you're in secondary English, this is what your index page would look like…and again a link to a standards page.

An IUP student explained the technical aspects of building an electronic portfolio using templates and common tools:

> I created them in Word and I saved them as Web pages . . . and then I just linked them. I used Word as my editing tool for my Web pages. And I scanned some things in, like my clearances, or some documents that I didn't have saved electronically.

The Johns Hopkins University Center for Technology in Education (2002) provides an overview of their commercially available system and describes the student electronic portfolio as an organized collection of student work to show progress toward a set of standards. The system has three interfaces: working portfolio, reviewer, and presentation. Integrated features include an electronic filing cabinet, a journal tool, and a message center.

Although the commercially available Web-based systems are comprehensive in scope, the template-based electronic portfolios also have links to standards, course materials, artifacts, and rubrics. In fact, we found the distinction between the commercial systems and tool approaches to be somewhat blurred. Each approach allows students to upload/attach artifacts and align them to specific standards. While the tool approaches require that students learn to create hyperlinks, both approaches require students to use technology skills such as scanning, editing and sizing digital graphics, and converting documents to PDFs. Although the commercial integrated systems include data collection and analysis tools, designers of the tools approach could add a database and aggregate data from evaluation rubrics. Generally, the commercial systems tend to involve more integrated components such as communication systems and online grading in addition to the electronic portfolio construction and viewing sections. For both approaches, study participants had recently developed or were planning to develop their data collection and analysis tools.

Description of the Electronic Portfolio Process

Colleges of education made three major decisions about the electronic portfolio process: (a) who controls the content of the electronic portfolio, (b) the point at which faculty evaluate the artifacts that are placed in the electronic portfolio, and (c) the role of student reflection in the learning and evaluating process.

Artifact Inclusion Decision. Cal Lutheran, Eastern Kentucky, and Johns Hopkins asked students to make decisions about and select their best work demonstrating progress toward the standard. These programs provided explicit guidelines for the self-selection of artifacts for the electronic portfolio. Typically, the guideline included the standard and performance objectives that must be met and the minimal number of artifacts to be used to demonstrate the competence as well as the student's statement as to the reasons that these artifacts were selected and how they meet the standards. Other guidelines included whether the artifacts (e.g., a lesson plan) had to be implemented in a practicum setting and whether one artifact could be used as evidence for more than one standard. A Johns Hopkins faculty member explained the support they provide for students in selecting artifacts and providing the rationale for selection:

> We begin talking about the INTASC principles in every course … in each one of those seminars they address an INTASC principle, they talk about the strategies … for how they will go about writing their rationale for selecting that assignment … [they also] need to reflect on the breadth of what they have done.

On the other hand faculty at Iowa, IUP, and Rhode Island specified the artifacts that students were to include in the electronic portfolio. An IUP faculty member stated:

> We have just really gone through, within the whole College of Ed., and identified for every class at least one artifact that would fit and meet one of the standards—whether they're professional ones or under INTASC, that would actually fit. And so, when the students get a copy of the syllabus, they will see the breakdown and what objectives meet what standard. And then there will be at least one key artifact, and possibly up to three that they know goes with what standard.

This decision about who chooses the artifacts reflects philosophical beliefs as well as assessment considerations. On the one hand, assessment may become more difficult when students choose the artifacts that they think best meet the standards rather than when the assignments that meet the standards are prescribed for them. On the other hand, student selection of artifacts may lead to a deeper learning experience as they wrestle with understanding the connections between what they do and the standards. In addition, they may have a deeper belief that the electronic portfolios belong to them rather than just the college. Each of the study programs made decisions that matched their beliefs and purposes.

Electronic Portfolio Evaluation: Course or Checkpoint. Faculty may evaluate electronic portfolio artifacts as part of a course or at checkpoints to determine student progress toward the standards. If students self-selected the artifacts for their electronic portfolios, faculty (and others, e.g., student teaching supervisors) examined them at each of several checkpoints or at the end of the program. With the exception of Johns Hopkins, at a minimum the checkpoints occurred before and after student teaching. If the education faculty specified the artifacts to be included, the evaluation of the artifact occurred as part of the regular course grading procedure. This means that faculty members did not conduct a formal evaluation of the electronic portfolio outside of the typical grading procedures.

All programs that followed the checkpoint procedures discussed the time involved in conducting the reviews. Although the extensiveness of the evaluation of each student's portfolio varied across the sites, all checkpoint systems require faculty time to set them up, develop standard procedures for evaluating the portfolios, provide rater feedback for students, provide opportunities for students to address concerns raised, and provide for the raters to re-evaluate the portfolio.

For Johns Hopkins, a student's electronic portfolio is completed in lieu of his/her master's thesis. The electronic portfolio is a culminating event and is assessed during the final semester of the student's program. Although there is one checkpoint, faculty commented on the commitment of time required for this extensive review.

Role of Reflection. In both instances—evaluation within courses and at checkpoints—programs required that students reflect on their work. The nature of the reflection differed across the sites. At a minimum, students were asked to discuss what they learned as a result of doing the work, what they learned from implementation in the practicum, and what they would do differently. At a minimum, faculty reported that they checked to see if the reflection was present, but with less attention to the substance of the reflection. At other sites, faculty reported that the role of reflection was substantive. For example, at Johns Hopkins, several faculty and students explained a theoretical model for reflection that required analysis beyond the basic questions discussed above.

In a similar vein, a Rhode Island faculty member described the reflection process in elementary education:

> Our final reflection is structured for them to go back … through their entire portfolio, look at what they had completed for tasks over the student-teaching semester and, if appropriate, prior to, and reflect on what it has meant in terms of their development as teachers. The idea is to get them to really state where they are right now. How far have you come? How did you get there? And then to take the next step and say "What is this going to mean for your first couple years of teaching? What are you going to have to focus on? What do you think your professional development's going to need to look like? What are your strengths and weaknesses?"

The Rhode Island electronic portfolio system kept track of all student reflections and responses. In addition, the written student reflection and faculty responses cycles were analyzed as part of the process of gathering data for program and accreditation review.

Similarly, at Cal Lutheran, informants reported that reflection was an important part of each assignment but also a special feature of the checkpoint review. As part of the professional development plan that accompanied the artifacts, students specified the areas they needed to address during the following semester and before the next checkpoint review. At the next review they would report on their progress toward the professional goals and add their goals to address before the next review.

Introduction of the Electronic Portfolio and Support

As is the case with technology skills in general, programs had different approaches to teaching their students how to construct the portfolios. Iowa and IUP had a required educational technology course that students completed at the beginning of their programs. The educational technology course taught students

the technology and pedagogical skills needed to design the electronic portfolio and add the artifacts required from each course taken during that semester. At the completion of this course, typically students reported that they were comfortable with their electronic portfolios and their ability to design their initial portfolio. On the other hand, Johns Hopkins, Cal Lutheran, Eastern Kentucky, and Rhode Island did not have a required educational technology course. Their approaches to helping students learn to use the electronic portfolio system varied. Often they reported a combination of two methods: introduction during regular teacher education courses and labs with specific hours for electronic portfolio construction.

With respect to the specific skills required for the portfolio, most had developed a step-by-step tutorial or guide that students could print or access online. Cal Lutheran offered tutorials online with short videos illustrating each electronic portfolio step and phone support along with optional weekend sessions. Throughout their programs, students reported that they were most satisfied when general education faculty took a few minutes of class time to discuss the artifacts that they might include from their classes, the standards that they met, and the placement in the electronic portfolio, and modeling of the procedure for uploading and commenting on artifacts. For those programs requiring specific artifacts from each class, students voiced their appreciation if all instructors would check to make sure the correct artifacts were in the right place. Students also reported helping each other construct their electronic portfolios. Most preferred learning from another student rather than attending an out-of-class session.

Generally, students reported that technical support and access to technology were adequate. However, there were exceptions. Across most cases, informants reported that students often saved their electronic portfolio work until the end of the semester or program. This was particularly problematic at the conclusion of student teaching when many artifacts were due or a checkpoint was pending. Often students reported that the electronic portfolio labs were full and they had to wait in line to complete their work.

Assessment of Electronic Portfolios

The nature of the evaluation process differed across the sites. Johns Hopkins' electronic portfolio was the comprehensive examination for their MAT program. The checkpoint occurred at the conclusion of the program and included an evaluation of the electronic portfolio and an oral defense.

Eastern Kentucky, Cal Lutheran, and Rhode Island reported that they used three benchmark checkpoints to assess student progress towards the standards at each of three checkpoints. For each checkpoint, there was a standard rubric used for evaluation. The rubrics were aligned with the standards and the performance objectives. A mastery learning approach was employed; that is, if students did not meet an acceptable level, they were allowed to address the rater's concerns and re-submit.

For those without benchmark checkpoints, artifacts were assignments that were assessed as part of the course. For multiple sections of the same course, none of the programs reported training instructors to rate assignments across courses with consistency. Further, they reported that they had not established inter-rater reliability among all instructors.

In both cases (for individual assignments and benchmark checks), programs rarely reported providing rater training. Most programs with checkpoints reported that they had more than one scorer for the checkpoint and the scorers came to an agreement about the final score. However, they had not established procedures for consistency of scoring of an electronic portfolio across all raters and had not established inter-rater reliability among all scorers. Leaders representing each program participating in the study indicated that this was an area that they hoped to address in the future.

DISCUSSION

In analyzing data across cases, it was interesting to note common themes that led to program-wide adoption of electronic portfolios. Consistent with the literature (Gathercoal et al., 2002), prior experience with paper portfolios in this study was an important factor in the successful implementation of e-portfolios, especially for those programs with a greater emphasis on performance assessment and student reflection.

In exploring the impetus for the adoption of e-portfolios across cases, we also found quite a bit of common ground. Although each case has its own unique flavor, much of the momentum for the initiation of e-portfolios was influenced by new requirements from accrediting bodies to document teacher candidates on a range of performance standards. Clearly, top-level support for portfolios was affected by these requirements. Also in line with the literature, there was ample evidence of strong dean-level leadership that included substantial allocation of resources to support faculty and students in their use of portfolios. This involved securing grants and obtaining internal funding within the university.

Overall, the cases selected for this study nicely illustrate Fullan's (2001) assertion that effective change requires a combination of both pressure and support. Pressure, in this case, refers to expectations that faculty will participate in the electronic portfolio program and support students in their use. Support encompasses both the human and technological infrastructure that facilitates the implementation of e-portfolios. Fullan explains that pressure without support leads to resistance and alienation, while support without pressure can lead to drift or waste. Data from the present study suggest that effective, large-scale implementation of e-portfolios benefits from a good balance of both pressure and support.

It is interesting to note that the pressure for change with technology in the current study was greater than what is typically cited in the technology and teacher education literature. For example, in a prior study by the authors on exemplary integration of technology in teacher education, when reflecting on the notion of pressure and support, we wrote:

> Pressure for technology implementation, however, does not appear to be effective when it comes in the form of a mandate. Rather, as a faculty leader at the University of Virginia stated, the pressure for change should be like the wind at your back (Strudler & Wetzel, 1999, p. 79).

The mandate in this case was not for electronic portfolios per se, but for some type of standards-based performance assessment. This requirement, however, was a major factor that led to initiation and implementation of e-portfolios in all of the programs. Although the level of support was clearly acknowledged and appreciated, some faculty and students expressed negative views toward the pressure for implementation. As opposed to the supportive image of a gentle breeze at your back, the pressure for using e-portfolios was seen by some as an unwelcome gust. This, however, can be expected when moving to mandatory participation in a large-scale change effort. Although most prior efforts to integrate technology in teacher education have been on a voluntary basis, the implementation of e-portfolios represents a new level of technology-based initiatives that have required program-wide participation.

Finally, it should be noted that each of the programs in the current study has plans to fine-tune their approaches to better meet the needs of the various stakeholders. To help us understand these new directions, we asked informants about the "next steps" that they envisioned for their electronic portfolio programs. Their responses provide a nice window from which to view how the stakeholders perceive the program and where they would like to see it go. Furthermore, we asked for their recommendations for other programs in earlier stages of adoption or implementation of electronic portfolios. Again, informants' advice provides valuable insights into what the stakeholders value and what might prove useful for others just getting started with e-portfolios. Answers to both of these questions will be addressed in a forthcoming article based on an extension of the data set explored in this study.

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