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Non-Technology-Savvy Preservice Teachers' Perceptions of Electronic Teaching Portfolios

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Abstract

Twenty-three preservice elementary teachers with limited technology backgrounds created complex electronic portfolios during a 2-year teacher education program. At the end of the 2-year project, they responded to a 72-item survey based on previous qualitative research with the same students and Kirkpatrick's (1996) four dimensions for evaluation.

On this survey, students reported that they learned a great deal from creating electronic portfolios and that much of what they learned is directly applicable to their teaching careers and will impact the schools in which they teach. Even with their limited technology backgrounds, students were able to achieve what they (and the faculty) judged to be high quality portfolios. Although it was time consuming, most students believed the project was worth the time spent.

The study showed it is possible for nontechnology savvy students to complete a complex technology project, given adequate support. If this support is not available, faculty members may need to engage in proactive grant seeking. Since technology is playing an increasingly important part in K-12 schools, these efforts are necessary to prepare preservice teachers to meet that challenge.

The use of portfolios to document teaching development and expertise has surged in recent years. Portfolios are now used for many purposes, including admission into teacher education programs, documenting student teaching, showing in-service development, interviewing, accreditation and, in the United States, certification by the National Board for Professional Teaching Standards (McLaughlin & Vogt, 1996).

One reason for this growth in popularity is the broader, more contextualized view of teaching that portfolios provide as compared to traditional assessments such as standardized tests (Shulman, 1998). Teaching portfolios also encourage self-reflection (McLaughlin & Vogt, 1996) and the construction of knowledge from teaching (Norton-Meier, 2003).

Increasingly, educators are using electronic means to create and share their teaching portfolios. Constantino and De Lorenzo (2002) explained:

> The electronic portfolio, just like the paper-based portfolio, is a carefully selected collection of exemplary documents that highlights a teacher's best work and accomplishments. However, unlike the paper-based portfolio, the electronic portfolio is a multimedia approach that allows the teacher to present teaching, learning and reflective artifacts in a variety of formats (audio, video, graphics, and text). (p. 48)

In other words, electronic portfolios differ from traditional portfolios only in the media used—technology instead of being restricted to paper only. This technology may include CD-ROMs and the World Wide Web (Kovalchick, Milman & Elizabeth,1998).

Electronic portfolios have many advantages over traditional portfolios. Digital and web-based formats make them easier to update, transport and store. Electronic portfolios may also include a wide variety of artifacts that are easily cross-referenced (Yost, Brzycki & Onyett, 2002). As students use technology to create graphics and link artifacts, they are better able to see interconnections and understand their teaching development in terms of program standards (Norton-Meier, 2003).

Electronic Portfolios in Teacher Education

Many teacher educators have found electronic portfolios to provide an effective vehicle for integrating technology into their courses (Richards, 1998). By using electronic portfolios, teacher educators serve as models of technology use, while they provide opportunities for students to apply their technology knowledge (Kariuki, Franklin, & Duran, 2001). Teacher education students who experience technology become more comfortable with it and are more likely to use technology in their teaching (Goldsby & Fazal, 2000; McKinney, 1998). As teachers, they will be better prepared to meet the National Educational Technology Standards for Teachers (NETS-T; International Society for Technology in Education [ISTE], 2002) and to help their students meet the NETS for Students (ISTE, 2000).

The research on electronic portfolios in teacher education is largely positive. Creation of electronic portfolios has been found to be "positive and useful" (McKinney, 1998, p. 85), "constructivist, demanding, and multifaceted" (Milman, 1999, p. 1), and to have a positive impact on preservice teachers' self concepts (Ryan, Cole, & Mathies, 1997). Preservice teachers who create electronic portfolios learn an alternative way to think about and display their accomplishments (Richards, 1998; Wright, Stallworth, & Ray, 2002).

A recent study by Wilson, Wright, and Stallworth (2003) focused on secondary preservice teachers who developed electronic portfolios. Constant comparative analysis of multiple data sources showed that the preservice teachers viewed their portfolios mainly as employment tools, but some believed the portfolios encouraged them to reflect on their teaching development. The researchers concluded, "These preservice teachers felt a sense of accomplishment, believed that they were assessed in a more authentic way, and viewed

technology as essential" (p. 524). Although the results were positive, researchers were disappointed that few students planned to use electronic portfolios in their own teaching. The researchers recommended modelling by school-based teachers and portfolio conferences with university faculty to encourage this desire to implement electronic portfolios.

Some U.S. Department of Education Preparing Tomorrow's Teachers to Use Technology (PT3) grants have focused on electronic portfolios, and their results are beginning to be published. For example, Olsen, Wentworth, and Dimond (2002) described a 3-year process that began with a single class and moved toward college-wide implementation of electronic portfolios for elementary education majors. All 30 students in the original class elected to use an electronic format, and "naivete on the part of the instructors allowed them to start the horrendous process of developing electronic portfolios with a cohort of students" (p. 2). Faculty collaboration and guidance from an outside expert helped the college move toward acceptance of electronic portfolios. In a second PT3 grant, project director Mary Lundeberg (2002) also reported that additional resources provided by the grant, in this case technology support, were critical to their success in implementing electronic portfolios.

Bartlett (2002; in press) conducted a qualitative study with the same students as in the present study. Twenty-six undergraduate students responded to open-ended questions at the end of the first, second, and fourth semesters of their 2-year teacher education program. When asked what they learned from creating electronic portfolios, students were most likely to respond that they had learned to use hardware and/or software, and they had learned how to use technology to organize and present ideas. Students reported the major advantages: (a) electronic portfolios are more powerful and convenient than traditional portfolios, and (b) they learned about technology. Students planned to use their portfolios for job searches and to reflect on their teaching development. As for disadvantages, some students reported difficulties related to equipment and time constraints. Approximately one third of the students stated that the assignment could have been improved by providing more or differently timed technology instruction and by stating the guidelines more clearly. The researcher concluded that she would increase time for portfolio creation and sharing in the second year of the project. She also planned to provide more specific guidelines, without being overly prescriptive.

Although some research has been done on electronic portfolios, the research on portfolios is still in its infancy as asserted by Lyons (1998, p. 248) and should be conducted in the programs where portfolios are used. This paper describes a 2-year study of implementing complex electronic portfolios with undergraduate students who were preparing to be certified in elementary and special education. Students and faculty members began the project with little expertise in the technology that would be needed to create electronic portfolios.

Background of the Study

At the University of Hawaii-Manoa undergraduate students preparing to be elementary teachers are assigned to cohorts of approximately 25 students who attend most classes in their assigned groups. The program has a strong field experience component: Students spend up to 2 days a week in elementary classrooms during the three semesters prior to full-time student teaching. University faculty and classroom mentor teachers collaborate in planning and supervising all field experiences.

A PT3 grant provides numerous workshops, weekly one-on-one tutoring sessions, and graduate student assistants to College of Education faculty members who want to

integrate technology into their courses. Due to this high level of support, the first author of this study decided to implement electronic portfolios with her preservice teachers.

Electronic portfolios caught her interest because they provide a way for students to show clear evidence of their teaching development in a form that is easy to share, update, and store. Even though this faculty member lacked a strong background in technology, she determined to implement electronic portfolios with her students and to study the effectiveness of this innovative assessment approach in collaboration with an educational technology colleague.

Methods

The 23 undergraduate students participating in this study were in a 2-year elementary education program designed to prepare them for certification in both general and special education. The majority of the students were of Asian American heritage and female (20 females and 3 males). Educational technology was not a requirement of their program, so students entered with limited knowledge of the technology needed to create electronic portfolios.

As cohort coordinator, the first author taught two literacy education courses and supervised field experiences for the preservice teachers in the study. This faculty member also learned much of the technology used to create the electronic portfolios during the 2 years of the program.

Technology Instruction

Since most of the preservice teachers were technology novices, educational technology graduate students designed and taught a series of workshops. These capable technology assistants offered 2 1/2 hour workshops on both camera skills and video editing during the first semester. These assistants also helped students put their first instructional units into multimedia format, which took an additional 7 hours of class time. Students used PowerPoint to outline their units. Then, they inserted video clips of their teaching—using Avid Cinema or I-Movie—and scanned photographs and documents. Sounds and special effects provided the electronic portfolios with additional verve and individuality.

The technology assistants provided another 5 hours of technology support during the second semester, while students added a second instructional unit to the portfolio. Assistants were also available during the 18 hours students spent adding their third instructional unit and other components in the fourth semester. Throughout the project, students received additional assistance from the well-equipped, well-staffed PT3 Technology Learning Center located in the college.

By the end of their 2-year teacher education program, students had created electronic portfolios with the following components: table of contents, resume, teaching philosophy, self-evaluation based on state teacher standards, and three instructional units. Portfolios included still images and 30- to 180-second video clips of their classroom instruction. Final products were burned on CDs with necessary software readers and links for navigating within the portfolio. Labels with the College of Education logo were added to enhance the professional appearance of the final products. (See http://www.hawaii.edu/etec/vr/vr.htm to view a related video, teaching materials, and a sample portfolio.)

While creating their portfolios, students learned to use new hardware, including Macintosh computers, scanners, and digital video and still cameras. They also learned new software programs such as PowerPoint and I-movie.

Instrument

After submitting their final portfolios, students' perspectives about electronic portfolios were captured on a 72-item survey they were asked to complete (see appendix for a copy of the survey). The major source of items was an earlier qualitative study with the same students. At the end of the first and second semesters of their program, the students had responded to open-ended questions concerning what they had learned, potential uses of their portfolio, and the advantages and disadvantages of electronic portfolios (Bartlett, 2002). For example, students reported in the earlier study that they had learned to organize and present ideas while creating their portfolios. That statement became the following item in the present study: "I learned to organize and present ideas." Researchers wrote six additional items concerning impact on schools, since this area had not been sufficiently addressed by students in the qualitative study.

The first 68 items were rated on a 5-point scale that ranged from *strongly disagree* to *strongly agree*. Six of these items also asked students to list additional information related to that category. Three additional items asked students to rate the electronic portfolio assignment on a 10-point scale, and the final item asked whether students thought the electronic portfolio assignment had been worth the time spent.

Findings

For reporting purposes, the researchers collaboratively organized items into two major categories: (a) electronic portfolios, in general, and (b) this electronic portfolio assignment, in particular. Items pertaining to electronic portfolios, in general, were further categorized according to Kirkpatrick's (1996) four levels of evaluation: (a) reaction (attitudes), (b) learning, (c) transfer (application), and (d) results (impact on the organization). We selected this model because it goes beyond participants' satisfaction with a learning experience to examine projected application and change in the workplace. Items were categorized according to the present electronic portfolio assignment as "technology/resources," "process," "feedback/grading," and "completed portfolios."

More than half of the students agreed with each of the six statements related to attitudes (see Table 1). Twenty students agreed that electronic portfolios can be used to showcase teaching and learning. Slightly fewer students agreed that "electronic portfolios provide a means of self-evaluation" and "electronic portfolios can be used for job interviews." Students were less likely to agree that electronic portfolios are more powerful and convenient than traditional portfolios or that they would like to put their portfolios on the Web.

Table 1
Reaction (Attitudes) of Preservice Teachers to the Electronic Portfolio Process (N = 23)

Item	Agree No. (%)	Neutral No.(%)	Disagree No.(%)	Mean	*SD*
Showcase teaching	20 (86.96)	1 (4.35)	2 (8.70)	4.13	.99
Showcase learning	20 (90.91)	2 (9.09)	1 (4.55)	4.13[a]	.90
Self-evaluation	18 (78.26)	4 (17.39)	1 (4.35)	3.87	.85
Can be used during teaching interviews	17 (73.92)	3 (13.04)	3 (13.04)	3.84	1.05
Powerful/convenient	12 (52.17)	9 (39.13)	2 (8.70)	3.61	1.01
Like to put on Web	12 (52.17)	4 (17.39)	7 (30.43)	3.22	1.35

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*
[a]*N* = 22

In the learning category, all but one student agreed that they learned about technology from the electronic portfolio assignment (see Table 2). These same students reported learning most about new equipment, and they listed digital video cameras, digital still cameras, Macintosh computers, and scanners under this item. Twenty-one students agreed that they learned new software, specifically I-movie, Avid Cinema, PowerPoint, QuickTime, and Adobe Acrobat. The remaining seven learning items also had high levels of agreement, making this component notable for its high means and low standard deviations. In other words, responses were more positive and more tightly clustered than in other sections of the study.

Table 2
Preservice Teachers' Perceptions About Their Learning Related to the Electronic Portfolio Process (N = 23)

Item	Agree No. (%)	Neutral No. (%)	Disagree No. (%)	Mean	*SD*
Learned technology	22 (95.66)		1 (4.35)	4.57	.43
Learned new equipment	22 (95.66)		1 (4.35)	4.35	.50
Learned new software	21 (91.30)	1 (4.35)	1 (4.35)	4.13	.47
Can apply what I learned to my learning	19 (82.60)	3 (13.04)	1 (4.35)	4.09	.41
Improved use of familiar software	19 (82.60)	3 (13.04)	1 (4.35)	4.04	.91
Learned to organize and present ideas	19 (82.60)	3 (13.04)	1 (4.35)	4.04	.91
Improved use of familiar equipment	18 (78.26)	4 (17.39)	1 (4.35)	3.96	.64
Learned to apply technology in learning	19 (82.60)	3 (13.04)	1 (4.35)	3.96	.86
Learned to evaluate my teaching	19 (82.60)	3 (13.04)	1 (4.35)	3.91	.83
Learned to evaluate my learning	18 (78.26)	4 (17.39)	1 (4.35)	3.83	.82

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*

In the all-important area of transfer, all but one student agreed that they can a pply what they learned while creating electronic portfolios to their teaching (see Table 3). Twenty students anticipated using their portfolios to reflect on future teaching development. Slightly fewer students agreed that they had learned to apply technology in their teaching and that they plan to use their portfolios in job searches. More than half agreed that they are “more likely to use technology in their future employment” after creating portfolios. Twelve thought they would show their portfolios to t heir students, and 3 planned to have their students produce portfolios. On the other hand, only 4 responded that they did not plan to use their portfolios in the future.

Table 3
Preservice Teachers' Perceptions About Anticipated Applications (Transfer) of the Electronic Portfolio Process (N = 23)

Item	Agree No. (%)	Neutral No. (%)	Disagree No. (%)	Mean	*SD*
Can apply learning to teaching	22 (95.65)		1 (4.35)	4.04	.75
Plan to use for reflecting on teaching/professional development	20 (86.96)	2 (8.70)	1 (4.35)	4.00	.83
Learned to apply technology in teaching	17 (73.92)	3 (13.04)	3 (13.04)	3.87	1.02
Plan to use my portfolio in job searches	18 (78.26)	3 (13.04)	2 (8.70)	3.83	.92
More likely to use technology in future employment	14 (60.87)	8 (34.78)	1 (4.35)	3.70	.91
Learned ways to apply technology to education	12 (52.17)	9 (39.13)	2 (8.70)	3.61	.91
Plan to show portfolio to present/future students	12 (52.12)	9 (39.13)	2 (8.70)	3.52	.93
Plan to use portfolio to apply for graduate school	7 (30.43)	14 (60.87)	2 (8.70)	3.22	.78
Plan to have my students produce portfolios	3 (13.04)	16 (69.57)	4 (17.39)	2.96	.75
Plan to put portfolio on the Web	8 (34.78)	7 (30.43)	8 (34.78)	2.87	1.35
Do not plan to use portfolio in the future	4 (17.39)	3 (13.04)	16 (69.57)	2.30	1.20

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*

Impact on future school setting had the lowest level of agreement of the four categories related to electronic portfolios in general (see Table 4). Fourteen students agreed that they planned to show their portfolios to other teachers and that other teachers would want to create portfolios after seeing theirs. This group of students was much less likely to agree that they would advocate for electronic portfolios for accreditation, student assessment or teacher assessment.

Table 4
Preservice Teachers' Perceptions About Anticipated Impact (Results) of the Electronic Portfolio Process (N = 23)

Item	Agree No. (%)	Neutral No. (%)	Disagree No. (%)	Mean	*SD*
Plan to show my electronic portfolio to other teachers	14 (60.87)	7 (30.43)	2 (8.70)	3.65	.96
Predict professional peers will want to produce portfolios when they see mine	14 (60.87)	6 (26.09)	3 (13.04)	3.48	.88
Plan to advocate portfolios by educators/employees as part of accreditation/quality process at school/work site	5 (21.74)	12 (52.17)	6 (26.09)	3.13	.80
Plan to prepare others in the portfolio production process	6 (26.09)	12 (52.17)	5 (21.74)	3.04	.86
Plan to advocate for electronic portfolios as part of the assessment process for students	4 (18.18)	14 (63.64)	4 (18.18)	2.95[a]	.71
Plan to advocate for portfolios as part of assessment process for employees at school/work site	5 (21.74)	12 (52.17)	6 (26.09)	2.91	.76

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*
[a]*N* = 22

When evaluating the electronic portfolio assignment, students were most likely to agree they had adequate access to technical support, followed by adequate access to equipment, needed equipment, and needed software (see Table 5). Students' responses also show some difficulties related to both equipment and software. When asked to list areas of difficulty, 4 students specifically mentioned problems using Macintosh computers, 3 had problems with I-movie; and 2 students had difficulties with PowerPoint. More than half the students agreed that their lack of knowledge of technology was a problem. In fact, 1 student wrote an unsolicited comment: "I knew nothing about technology before this project." Only 2 students judged the assignment to be too expensive.

Table 5
Preservice Teachers' Perceptions About Technology/Resources During the Electronic Portfolio Process (N = 23)

Item	Agree No. (%)	Neutral No. (%)	Disagree No. (%)	Mean	*SD*
Adequate access to technology support	19 (82.61)	2 (8.70)	2 (8.70)	4.17	1.05
Adequate access to equipment	17 (73.91)	4 (17.39)	2 (8.70)	3.74	.90
Adequate access to needed equipment	17 (73.91)	3 (13.04)	3 (13.04)	3.74	.99
Difficulties related to equipment	14 (60.57)	6 (26.09)	3 (13.04)	3.57	.82
Difficulties related to software	14 (60.57)	5 (21.74)	4 (17.39)	3.57	.92
Adequate access to needed software	14 (60.57)	6 (26.09)	3 (13.04)	3.48	.88
My lack of knowledge of technology a problem	12 (52.17)	4 (17.39)	7 (30.43)	3.26	.94
Assignment was too expensive	2 (8.70)	4 (17.39)	17 (73.91)	2.17	.82

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*

When evaluating the process of creating their portfolios, 19 of the students agreed they felt time constraints (see Table 6). On the positive side, 20 students felt they had done adequate reflection on their development as both a teacher and a learner. More than half of the students agreed they were able to be creative, reflective, inquiring, dynamic, collaborative, and inclusive during this assignment. Fewer students believed sufficient class time had been allotted (10), the guidelines had been clearly stated (9), and that they

had adequate opportunity to view peers' portfolios (7), or sufficient time to work on their portfolios (7).

Table 6
Preservice Teachers' Perceptions About the Process of Creating Electronic Portfolios (N = 23)

Item	Agree No. (%)	Neutral No.(%)	Disagree No.(%)	Mean	*SD*
Felt time constraints	19 (82.60)	3 (13.04)	1(4.35)	4.30	1.00
Able to be creative	20 (86.96)	2 (8.70)	1 (4.35)	4.17	.92
Did adequate reflection on development as teacher	20 (86.96)	2 (8.70)	1 (4.35)	4.09	.72
Did adequate reflection on development as learner	20 (86.96)	1 (4.35)	2 (8.70)	4.00	.93
Was reflective	20 (86.96)	2 (8.70)	1 (4.35)	3.96	.81
Was inquiring	19 (82.60)	3 (13.04)	1 (4.35)	3.83	.76
Was dynamic	16 (69.57)	6 (26.09)	1 (4.35)	3.74	.85
Was collaborative	14 (60.87)	7 (30.43)	2 (8.70)	3.57	.88
Was Inclusive	13 (56.52)	7 (30.43)	3 (13.04)	3.39	.82
Guidelines clearly stated	9 (39.13)	8 (34.78)	6 (26.09)	3.22	.93
Challenging to select content	11 (47.83)	7 (30.43)	7 (30.43)	3.22	1.06
Sufficient class time allotted	10 (43.48)	4 (17.39)	9 (39.13)	3.17	1.20
Sufficient opportunity to view peers' portfolios	7 (30.43)	7 (30.43)	9 (39.13)	2.91	.97
Sufficient time to work on	7 (30.43)	3 (13.04)	13 (56.52)	2.61	1.05

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*

More than half the students agreed that they had needed more direct guidance while creating their portfolios (see Table 7). Fewer students agreed that they received sufficient feedback from peers (10) or faculty (9). Eight students agreed that the electronic portfolios should be optional, and the same number believed it should be graded instead of credit/no credit.

Table 7
Preservice Teachers' Perceptions About Feedback/Grading Related to the Electronic Portfolio Process (N = 23)

Item	Agree No. (%)	Neutral No. (%)	Disagree No. (%)	Mean	*SD*
I needed more direct guidance	12 (54.55)	3 (13.64)	7 (31.82)	3.41[a]	1.11
It should be optional	8 (36.36)	8 (36.36)	6 (27.27)	3.18[a]	1.07
I received sufficient feedback from peers	10 (43.48)	5 (21.74)	8 (34.78)	3.13	1.08
I received sufficient feedback from faculty	9 (39.13)	6 (26.09)	8 (34.78)	3.00	.93
It should be graded	8 (34.78)	3 (13.04)	12 (52.17)	2.70	1.30

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*
[a]*N* = 22

When it came to their completed portfolios, students were generally positive (see Table 8). Twenty-two students agreed that their electronic portfolios looked professional, and 19 believed that the portfolios reflected them as professionals. Students were also in agreement that they had protected the privacy of individuals, shown adequate reflection, and shown that they understood the needs of a wide range of learners. Similarly, most students were satisfied with the number of topics they were able to include in their portfolios. Students disagreed that the amount of memory in the CD-ROM format limited their final products.

Table 8
Perceptions of Preservice Teachers About Their Completed Electronic Portfolios (N = 23)

Item	Agree No. (%)	Neutral No.(%)	Disagree No. (%)	Mean	*SD*
Looks professional	22 (95.65)	1 (4.35)		4.30	.55
Reflects me as a professional	19 (82.61)	3 (13.04)	1 (4.35)	3.96	.86
I adequately protected the privacy of individuals	18 (78.26)	3 (13.04)	2 (8.70)	3.96	1.00
Shows adequate reflection on the samples included	18 (78.26)	2 (8.70)	3 (13.04)	3.83	1.01
Reflects my understanding of a wide range of learners	17 (73.91)	3 (13.04)	3 (13.04)	3.78	1.02
Able to include sufficient topics	17 (73.91)	2 (8.70)	4 (17.39)	3.57	.92
Topics limited	9 (39.13)	6 (26.09)	8 (34.78)	3.09	.93
Limited by memory on CD-ROM	0 (0)	9 (39.13)	14 (60.87)	2.35	.56

Note. Scale ranged from 1- *strongly disagree* to 5 - *strongly agree.*
[a]*N* = 22

On the final three items, students rated the assignment above 7 on a 10-point scale when compared to other assignments (*M* = 7.30), in overall satisfaction with the assignment (*M* = 7.57), and in overall satisfaction with their own electronic portfolios (*M* = 7.87). Seventeen students responded the assignment was worth the time spent, 5 gave mixed answers, and 1 student said it had not been worth the time. One positive student wrote, “Yes, it enriched me! I learned a lot.” A student in the mixed category said, “Yes, because I learned a lot. No, because some of the people when I interview may not have the necessary equipment to look at it. Others may not want to take the time to look at it.” A negative comment was, “Not sure how principals will receive it.”

Summary and Conclusions

Twenty-three preservice teachers responded to a 72-item questionnaire after completing electronic portfolios of their teaching development. The undergraduate students' responses indicated that they believed the experience of creating electronic portfolios increased the likelihood they would use technology in their future employment, a finding supported by previous research (Goldsby & Fazal, 2000; McKinney, 1998). These students also believed that they had learned many technical skills they could use to improve their teaching and learning.

This study also indicates preservice teachers have positive attitudes toward electronic portfolios once they have created one. As in earlier studies (Bartlett, 2002, in press; Wilson, Wright, & Stallworth, 2003), these preservice teachers anticipated using their portfolios to reflect upon their teaching development, a worthwhile result that will undoubtedly make them better teachers, and to search for jobs.

Regarding instructional uses, preservice teachers in the present study were positive about showing their portfolios to the children in their classes. As in the studies cited previously, few believed they would have their own students create electronic portfolios. This finding warrants further research as to why preservice teachers' enthusiasm for electronic portfolios did not carry into their own projected classroom use. Since they did not observe their mentor teachers using this type of assessment, the preservice teachers may have thought it was not feasible or practical as a school project.

The present study went beyond previous research to measure anticipated impact, or results, on the schools in which the preservice teachers would teach. While the preservice teachers in this study planned to show their portfolios to other teachers, few believed they would advocate for electronic portfolios in their future teaching positions. Although this finding was disappointing, these preservice teachers may decide to advocate for other aspects of technology not addressed in the study. Teachers who are familiar and comfortable with technology will be important catalysts for technology use, so this leadership role deserves further investigation.

There are several implications for teacher education faculty's use of electronic portfolios. The 2-year cohort program facilitated the long-term project, and it would have been difficult, if not impossible, to complete portfolios in one course (as is often done), since students were unfamiliar with the equipment and multimedia software. Even though 35 hours of class/seminar time were provided over the 2 years of the project, students still reported time constraints to be an issue. Other research has found time to be an important factor in creating electronic portfolios (Bartlett & Sherry, in press). Given the many benefits identified by students, faculty members plan to increase the amount of time provided, especially for peer sharing and faculty feedback, as students recommended.

Time was an issue for the faculty as well. However, the benefits these students reported, in addition to possible applications for future courses, led investigators to conclude that this project was well worthwhile. Therefore, we encourage other teacher educators to integrate technology into their courses given that technology will, almost certainly, play an increasingly important role in tomorrow's classrooms (Willis & Raines, 2001).

Regarding structure of electronic portfolios, some students thought there should have been more explicit guidelines, even a template. While students may feel more comfortable with a structured assignment, portfolios are process oriented and evolving, so

assignments should remain flexible (Lamson, Thomas, Aldrich, & King, 2001). With this group's portfolios all on one CD-ROM, it will be convenient to show new students what has been done in the past, with the understanding that theirs will be different, and even better, as we gain experience creating portfolios.

The preservice teachers in this study used state teacher standards in some aspects of their portfolios. In the future, however, the teaching standards could provide overall structure to the portfolio, allowing students to add assignments from any of their teacher education courses. In a recent study, Sherry (2001) found that most of her graduate students who created electronic portfolios planned to retain the standards-based framework when adding to and revising their portfolios after graduation, even though many were initially hesitant about overtly addressing standards for their field. Given the growing interest in standards-based education, teaching standards provide an ideal structure for electronic teaching portfolios, while allowing a great deal of flexibility.

Technology has the potential to reshape teacher education: "It has become a catalyst for challenging our attitudes, long-held beliefs about the way things have always been done, classroom practices and the way students learn" (Willis & Raines, 2001, p. 3). Simpson and Payne (1999) reiterated the value of using technology in teacher education:

> We will be showing them [teacher education students] that teachers learn as they teach, that they are no longer the prime possessors, controllers and transmitters of knowledge, but that if they have a sound grasp of the principles of pedagogy and the processes of learning they can plan educational contexts within which young people can engage innovatively with ICT to achieve valued educational goals. (p. 7)

Preservice teachers should be prepared to take advantage of the potential of technology to develop higher level thinking skills (Wenglinsky, 1998) and to create learning environments that are active, constructive, collaborative, intentional, conversational, contextualized and reflective; all learning modes supported by current research (Collins, 1991; Jonassen, 1995; Norton & Sprague, 2001). The present study showed that electronic portfolios provide an effective way to encourage the use of technology in schools.

In conclusion, preservice teachers perceived that they learned a great deal from creating electronic portfolios and that much of what they learned is directly applicable to their teaching careers. Even with their limited technology backgrounds, students were able to achieve what they (and the faculty) judged to be high quality portfolios. Although time consuming, most students believed the project was worth the time spent.

The study also showed that it is possible for non-technology-savvy students to complete a complex technology project, given adequate support. As other PT3 grant participants have found, these resources are critical to the successful implementation of electronic portfolios (Lundeberg, 2002; Olsen et al., 2002). If this support is not available, faculty members may need to engage in proactive grant seeking to secure necessary funding. Since technology will play an increasingly important part in the schools of tomorrow, these efforts are necessary to prepare preservice teachers to meet that challenge.

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Appendix
Electronic Portfolio Survey

1. While creating my electronic portfolio, I learned about technology.	SA	A	N	D	SD
2. While creating my electronic portfolio, I learned to use new equipment. Please list:	SA	A	N	D	SD
3. While creating my electronic portfolio I improved my use of familiar equipment. Please list:	SA	A	N	D	SD
4. While creating my electronic portfolio I learned to use new software programs. Please list:	SA	A	N	D	SD
5. While creating my electronic portfolio I improved my use of familiar software programs. Please list:	SA	A	N	D	SD
6. While creating my electronic portfolio I learned to organize and present ideas. Please list:	SA	A	N	D	SD
7. While creating my electronic portfolio I learned to apply technology in my teaching.	SA	A	N	D	SD
8. While creating my electronic portfolio I learned to apply technology in my learning.	SA	A	N	D	SD
9. While creating my electronic portfolio I learned to evaluate my teaching.	SA	A	N	D	SD
10. While creating my electronic portfolio I learned to evaluate my learning.	SA	A	N	D	SD
11. While creating my electronic portfolio I learned ways to apply technology to education.	SA	A	N	D	SD
12. Electronic portfolios are more powerful and convenient than traditional portfolios.	SA	A	N	D	SD
13. Electronic portfolios can showcase teaching.	SA	A	N	D	SD
14. Electronic portfolios can showcase learning.	SA	A	N	D	SD

15. Electronic portfolios provide a means of self-evaluation.	SA	A	N	D	SD
16. Electronic portfolios can be used during interviews for teaching positions.	SA	A	N	D	SD
17. I can apply what I learned from creating an electronic portfolio to my teaching.	SA	A	N	D	SD
18. I can apply what I learned from creating an electronic portfolio to my learning.	SA	A	N	D	SD
19. I had difficulties related to equipment when creating my electronic portfolio.	SA	A	N	D	SD
20. I had difficulties related to software when creating my electronic portfolio.	SA	A	N	D	SD
21. I felt time constraints when creating my electronic portfolio.	SA	A	N	D	SD
22. My electronic portfolio was too limited in the topics that were covered.	SA	A	N	D	SD
23. My electronic portfolio was too limited because of the amount of memory available when saving on a CD-ROM.	SA	A	N	D	SD
24. My lack of knowledge with certain aspects of technology was a problem when creating my portfolio. Please list:	SA	A	N	D	SD
25. This assignment was too expensive.	SA	A	N	D	SD
26. This assignment needs to have more direct guidance throughout the process.	SA	A	N	D	SD
27. It was challenging to select the content of my electronic portfolio.	SA	A	N	D	SD
28. I had sufficient time to work on my electronic portfolio assignment.	SA	A	N	D	SD
29. Sufficient class time was allotted for working on my portfolio.	SA	A	N	D	SD
30. I had adequate access to equipment when creating my electronic portfolio.	SA	A	N	D	SD

31. I was able to include a sufficient number of topics in my electronic portfolio.	SA	A	N	D	SD
32. I was able to be creative in my portfolio.	SA	A	N	D	SD
33. I did an adequate amount of reflection on my development as a teacher.	SA	A	N	D	SD
34. I did an adequate amount of reflection on my development as a learner.	SA	A	N	D	SD
35. My electronic portfolio shows an adequate level of reflection on the samples I chose to include.	SA	A	N	D	SD
36. My electronic portfolio reflects me as a professional.	SA	A	N	D	SD
37. My electronic portfolio looks professional.	SA	A	N	D	SD
38. Guidelines for the electronic portfolio assignment were clearly stated.	SA	A	N	D	SD
39. There were sufficient opportunities to receive feedback on my portfolio from my peers.	SA	A	N	D	SD
40. There were sufficient opportunities to receive feedback on my portfolio from faculty.	SA	A	N	D	SD
41. There were sufficient opportunities to view my peers' portfolios during the process.	SA	A	N	D	SD
42. The electronic portfolio assignment should be optional.	SA	A	N	D	SD
43. The electronic portfolio assignment should be graded instead of credit/no credit (acceptable/unacceptable).	SA	A	N	D	SD
44. I had adequate access to needed software when creating my electronic portfolio.	SA	A	N	D	SD
45. I had adequate access to technical support when creating my electronic portfolio.	SA	A	N	D	SD

46. I had adequate access to needed equipment when creating my electronic portfolio.	SA	A	N	D	SD
47. I felt I adequately protected the privacy of individuals appearing in my electronic portfolio.	SA	A	N	D	SD
48. My portfolio reflects my understanding of the needs of a wide range of learners.	SA	A	N	D	SD
49. I would like to put my electronic portfolio on the Web.	SA	A	N	D	SD
50. I am more likely to use technology in my future employment because of my experiences making an electronic portfolio.	SA	A	N	D	SD
51. I found the electronic portfolio assignment to be collaborative.	SA	A	N	D	SD
52. I found the electronic portfolio assignment to be inclusive.	SA	A	N	D	SD
53. I found the electronic portfolio assignment to be dynamic.	SA	A	N	D	SD
54. I found the electronic portfolio assignment to be inquiring.	SA	A	N	D	SD
55. I found the electronic portfolio assignment to be reflective.	SA	A	N	D	SD
56. I plan to use my electronic portfolio in job searches.	SA	A	N	D	SD
57. I plan to use my electronic portfolio for reflecting on my teaching and professional development.	SA	A	N	D	SD
58. I plan to show my electronic portfolio to my present or future students.	SA	A	N	D	SD
59. I plan to show my electronic portfolio to other teachers.	SA	A	N	D	SD
60. I plan to use my electronic portfolio to apply for graduate school.	SA	A	N	D	SD

61. I do not plan to use my electronic portfolio in the future.	SA	A	N	D	SD
62. I plan to put my electronic portfolio on the Web.	SA	A	N	D	SD
63. I plan to have my students produce electronic portfolios of their own.	SA	A	N	D	SD
64. I predict that other educators and professionals I work with will want to produce electronic portfolios when they see what I have accomplished.	SA	A	N	D	SD
65. I plan to prepare others in the electronic portfolio production process.	SA	A	N	D	SD
66. I plan to advocate for electronic portfolios as part of the assessment process for students.	SA	A	N	D	SD
67. I plan to advocate for electronic portfolios as part of the assessment process for employees at my school/work site.	SA	A	N	D	SD
68. I plan to advocate electronic portfolios by educators/employees as part of the accreditation/quality process at my school/work site.	SA	A	N	D	SD
69. On a scale of 1 -10, with 10 being the highest score, I would give the electronic portfolio this score as compared to other assignments I have had in my teacher education program.	1	2	3	4	5
70. On a scale of 1 -10, with 10 being the highest score, my overall satisfaction with this assignment was:	1	2	3	4	5
71. On a scale of 1 -10, with 10 being the highest score, my overall satisfaction with my electronic portfolio was:	1	2	3	4	5

72. Do you believe it was worth your time to create an electronic portfolio?

Comments:

Note. SA = *Strongly agree*, A = *Agree*, N = *Neutral*, D = *Disagree*, SD = *Strongly disagree*